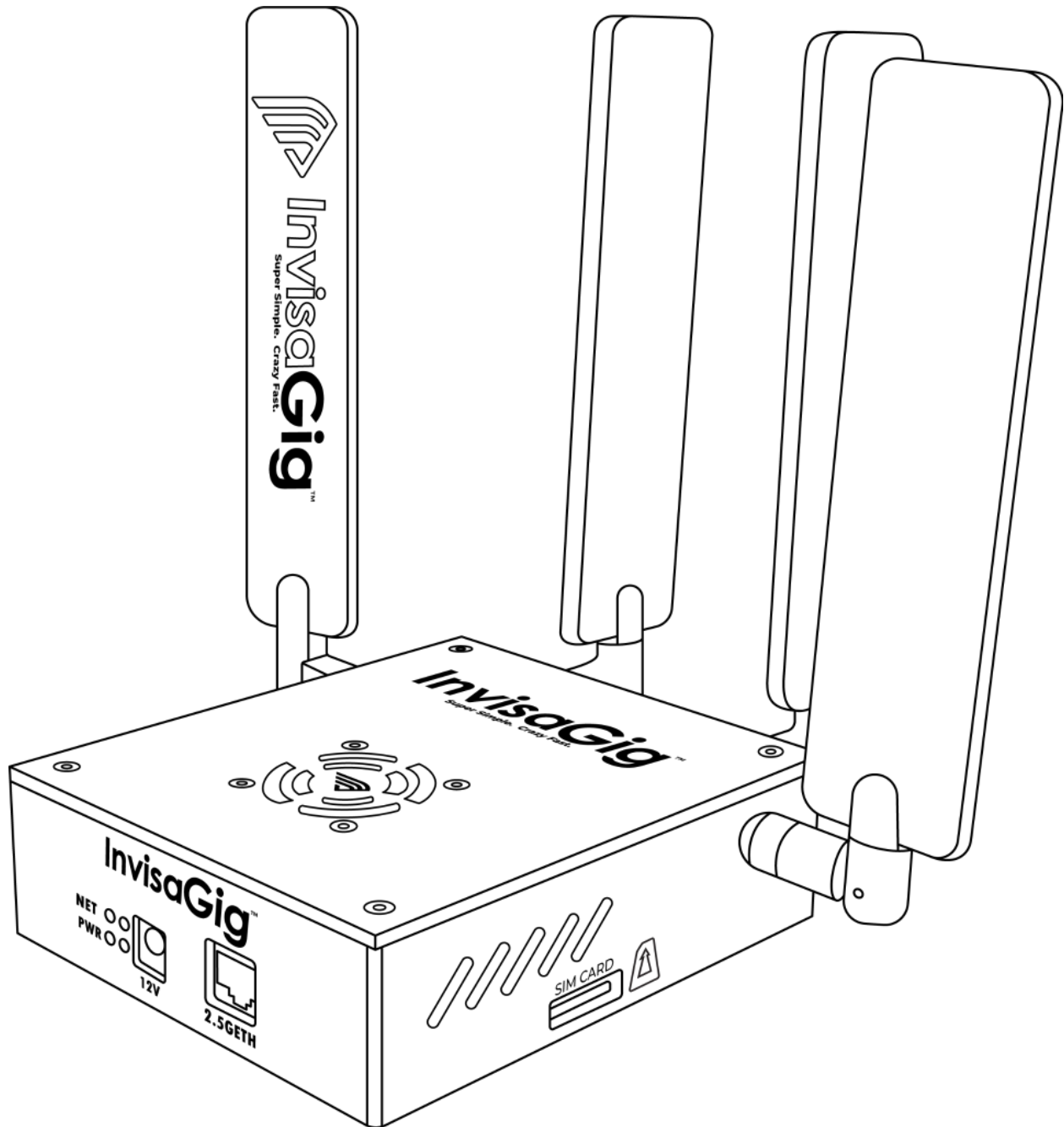


InvisaGig™

Super Simple. Crazy Fast.

User Manual



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Hardware Overview

Package Contents

- InvisaGig Unit
- Ethernet Cable
- SIM Card Adapter Set
- Power Supply
- 4x Detachable Antennas

Specifications

Operating Temperature: Min. -30c, Typ. 25c, Max. 75c

Operating Environment: Main Unit is designed for indoor operation. Proper clearance should be given all around the unit for proper airflow

Supported Ethernet Transfer Rates: 10/100/1000/2500Mbps

Supported LTE Bands:

B1/B2/B3/B4/B5/B7/B8/B12/B13/B14/B17/B18/B19/B20/B25/B26/B28/B29/B30/B32/B34/B38/B39/B40/B41/B42/B43/B46/B48/B66/B71

Supported 5G NR Bands:

n1/n2/n3/n5/n7/n8/n12/n13/n14/n18/n20/n25/n26/n28/n29/n30/n38/n40/n41/n48/n66/n70/n71/n75/n76/n77/n78/n79

Assembly

Once all package contents have been checked, the unit can be assembled. In the case of external antennas, begin by attaching all 4 antennas to the unit by screwing them onto the 4 threaded, SMA connectors of the InvisaGig main unit, clockwise until tight. Take care not to cross thread or overtighten the antennas; they should be hand-tightened only, do NOT use any tools as this may damage the unit and/or antennas.

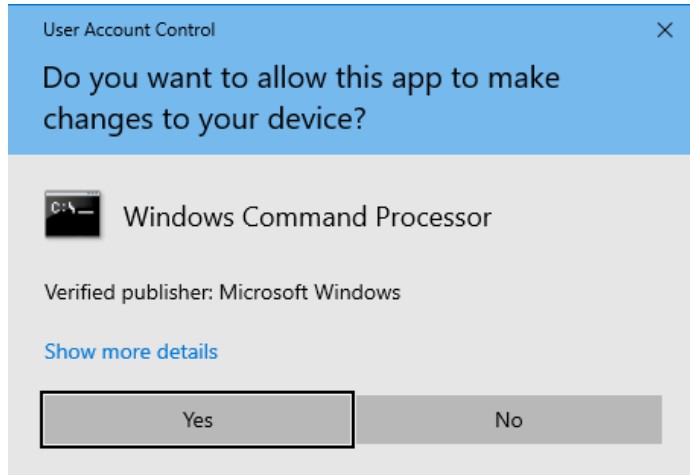
Once the antennas are connected, insert your SIM card into the unit. Be sure that the SIM card is oriented correctly when inserted with the metal contacts in the downward position. At this point you can connect the Ethernet cable between the Ethernet port of the InvisaGig unit and your PC or router's WAN/Internet port. Finally, once the antennas are connected, SIM is inserted, and Ethernet is connected, you can plug in the DC barrel connector from the power supply into the power port of the unit to power it on. The unit will take a minute or two to power up.

Software Overview

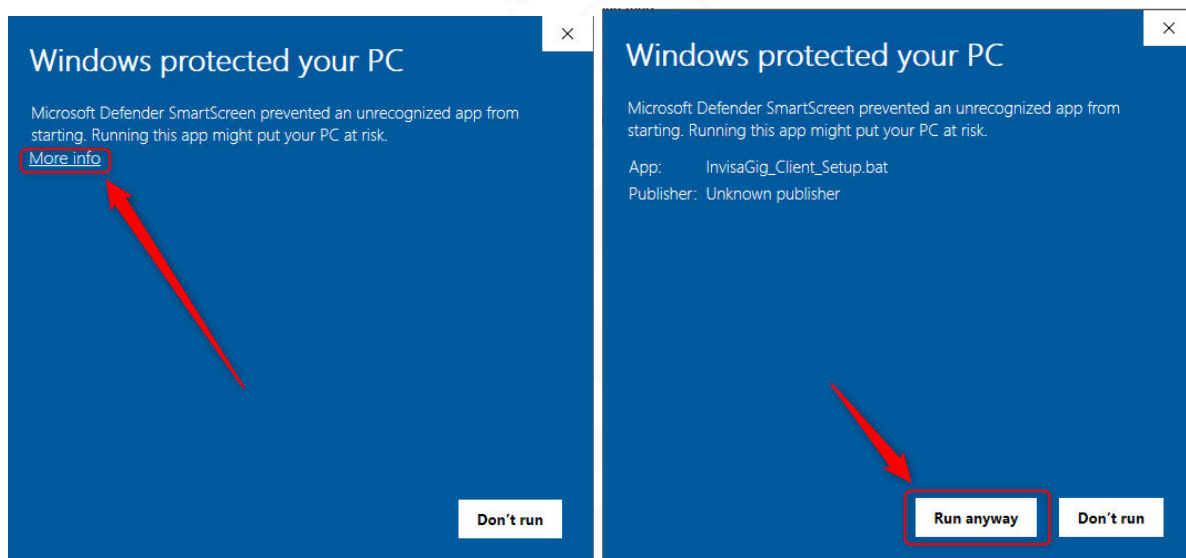
First Time Setup and/or Access from a New PC

The first time the device is accessed from a new PC navigate to <http://192.168.225.1> (*not* HTTPS!) to download the 'InvisaGig_Client_Setup.zip' setup package. Extract the .zip contents then refer to the 'README.txt' for operating system specific instructions.

For Windows, simply double-click the 'InvisaGig_Client_Setup.bat' to execute the setup and select 'Yes' at the UAC prompt to continue:



When executed under the default local Administrator account, Windows has been known to intercept the script with SmartScreen. If you receive the SmartScreen prompt, simply select "More info" followed by "Run anyway, as shown below:



This script installs the required SSL certificate for secure access to the configuration interface, sets local hosts file entries for the IP address(es) and hostname(s) used to access this interface, then opens

<https://config.invisagig.com> to finish the unit configuration. The setup instructions for other operating systems are covered in the 'README.txt'.

Currently, setup and configuration from a phone or tablet is not officially supported. If you wish to attempt unsupported setup and configuration via a phone/tablet, you may download the certificate from the .zip package directly to your device using <http://config.invisagig.com/cert> (*not* HTTPS) and set a DNS record for 'config.invisagig.com' on your local network. Be advised that due to various device display resolution variations and mobile browser rendering variability, the menu system of the device may be difficult to view and/or navigate. Thus, we strongly recommend using a laptop or desktop device for setup and configuration of the device.

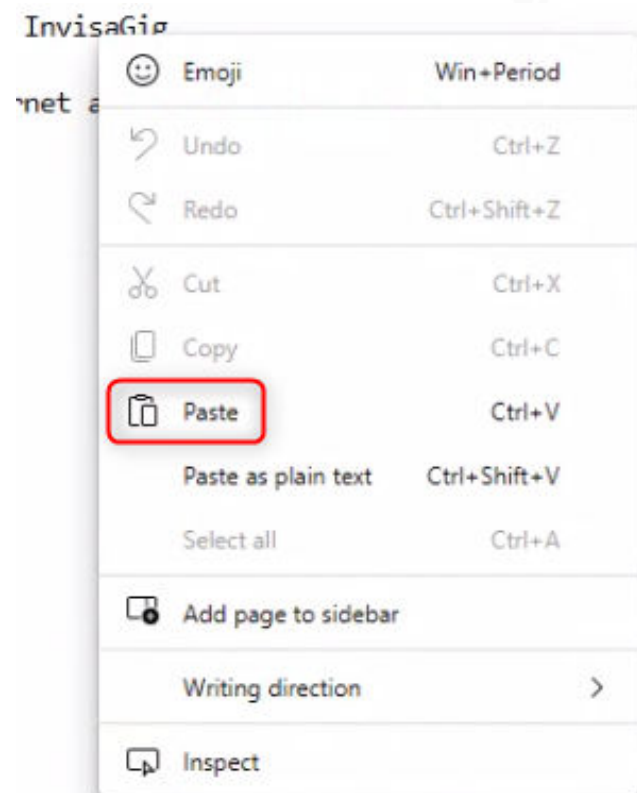
Configuration Interface

Accessing the Configuration Interface

Once the initial client setup is completed, the configuration interface can be accessed at <https://config.invisagig.com>.

Option Selection and Input

The menu is driven by text input provided by the user. To select an option, input its corresponding menu number and press [Enter]. For options which require extended input, you can simply copy and paste text as you can in most other computer applications. Paste is accomplished by right-clicking in the browser window displaying the menu interface, right-clicking the mouse, and selecting 'Paste':



Access Interruptions During Network Changes

Be aware that when executing certain configuration menu options, the browser may temporarily lose connection to the Configuration Interface as it commits network changes internal to the device. For less impactful changes, the interface page may show a “Reconnecting...” message like the one below:



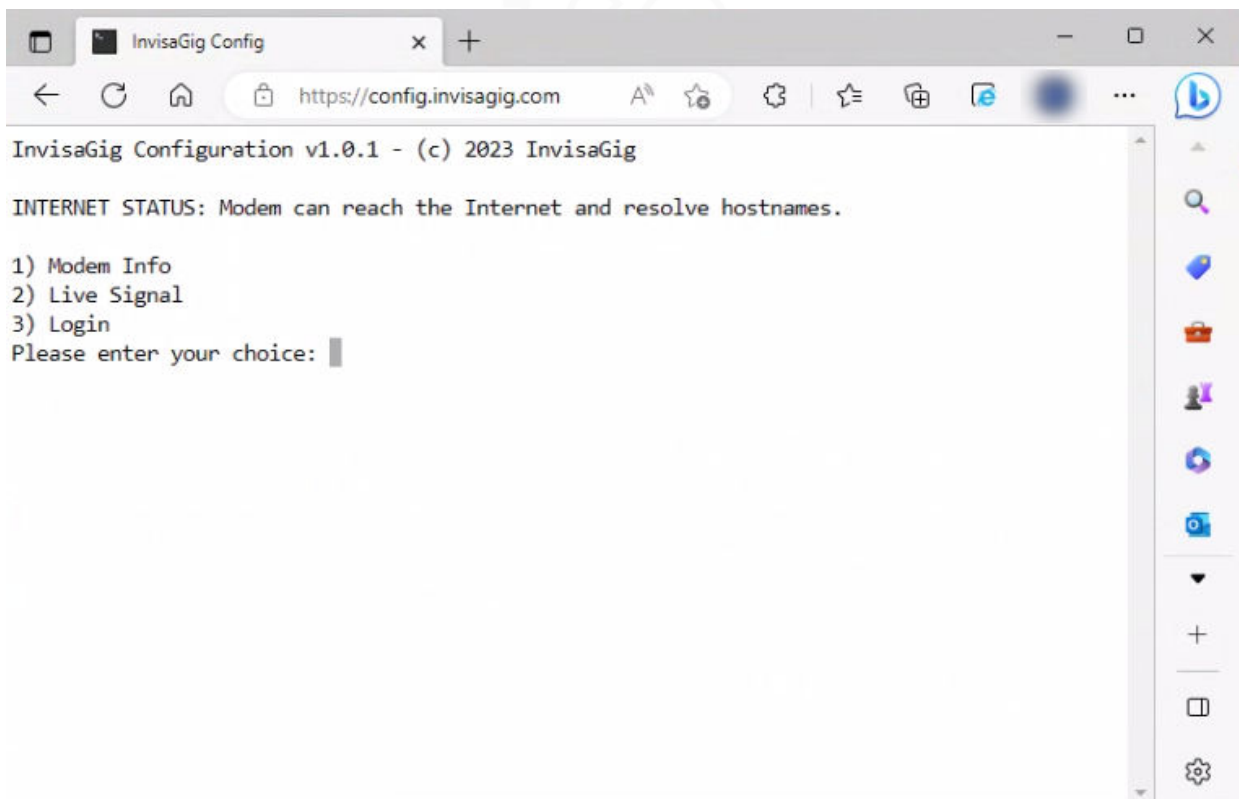
In many cases the connection will then restore itself and you will be returned to the Landing Menu. During more impactful changes (i.e., Cell Locks, reboots, etc.) the automatic reconnection attempts may time out and drop you to a “Press [Enter] to Reconnect” message like the one below:



In such case, press [Enter] to reconnect as instructed. If the device is still processing networking changes you may have to wait 30-60 seconds before retrying access. If no reconnection status messages are displayed simply use the refresh function on your browser to manually reload the page. Upon reconnection you will be returned to the Landing Menu.

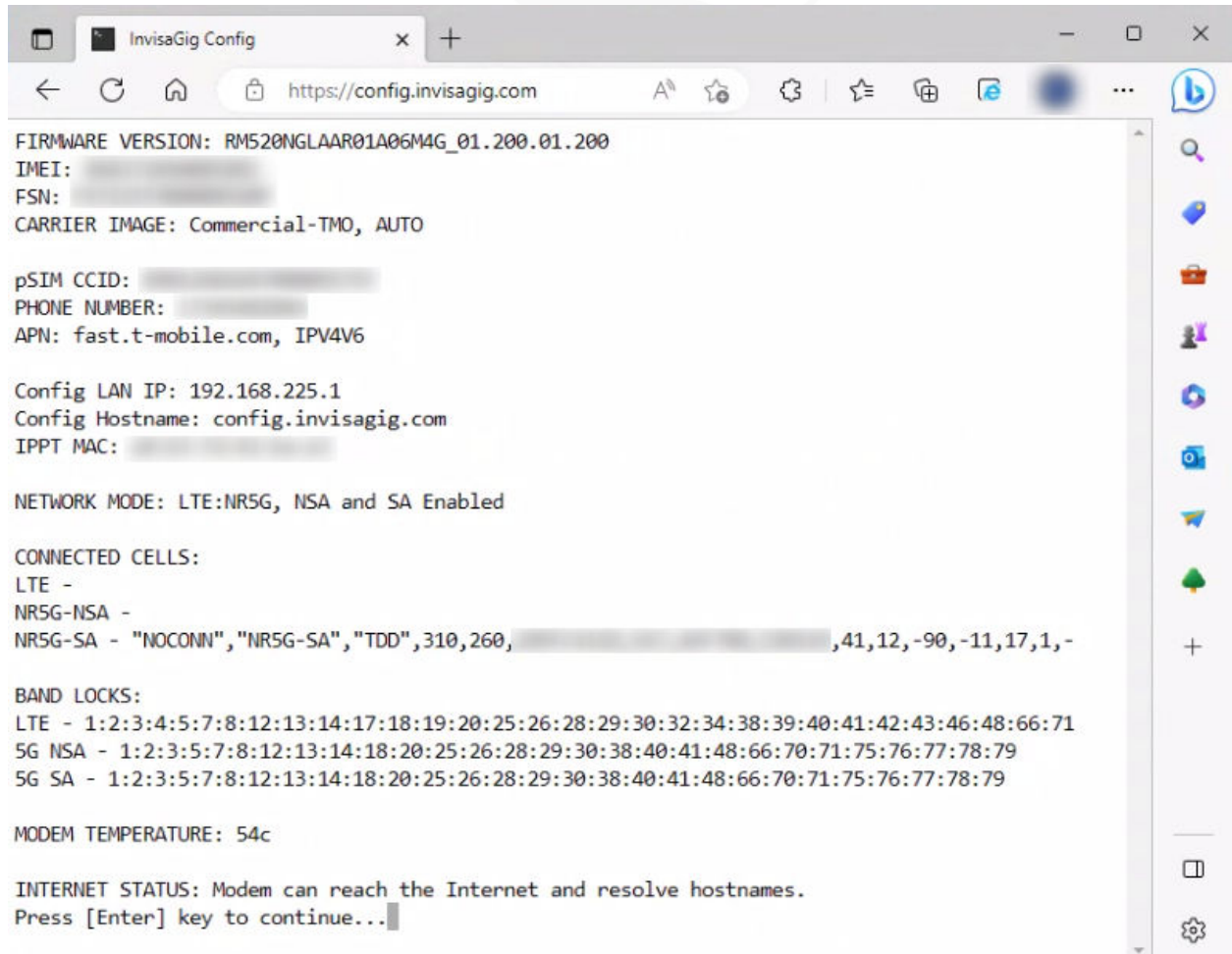
Landing Menu

This is the initial menu observed when accessing <https://config.invisagig.com>:



Modem Info

Modem info displays all relevant information about the current state of the modem, cellular carrier, and current configuration:



The screenshot shows a web browser window titled "InvisaGig Config" with the URL "https://config.invisagig.com". The page content displays the following modem information:

```
FIRMWARE VERSION: RM520NGLAAR01A06M4G_01.200.01.200
IMEI: ██████████
FSN: ██████████
CARRIER IMAGE: Commercial-TMO, AUTO

pSIM CCID: ██████████
PHONE NUMBER: ██████████
APN: fast.t-mobile.com, IPV4V6

Config LAN IP: 192.168.225.1
Config Hostname: config.invisagig.com
IPPT MAC: ██████████

NETWORK MODE: LTE:NR5G, NSA and SA Enabled

CONNECTED CELLS:
LTE -
NR5G-NSA -
NR5G-SA - "NOCONN", "NR5G-SA", "TDD", 310, 260, ██████████, 41, 12, -90, -11, 17, 1, -

BAND LOCKS:
LTE - 1:2:3:4:5:7:8:12:13:14:17:18:19:20:25:26:28:29:30:32:34:38:39:40:41:42:43:46:48:66:71
5G NSA - 1:2:3:5:7:8:12:13:14:18:20:25:26:28:29:30:38:40:41:48:66:70:71:75:76:77:78:79
5G SA - 1:2:3:5:7:8:12:13:14:18:20:25:26:28:29:30:38:40:41:48:66:70:71:75:76:77:78:79

MODEM TEMPERATURE: 54c

INTERNET STATUS: Modem can reach the Internet and resolve hostnames.
Press [Enter] key to continue...
```

Firmware Version

Current base revision of the modem firmware release.

IMEI

IMEI of the modem.

FSN

Factory serial number of the modem.

Carrier Image

Currently selected carrier image and how the image was selected (AUTO/MANUAL).

pSIM CCID

CCID of the currently inserted physical SIM card.

Phone Number

Provisioned phone number of the currently inserted physical SIM card.

Config LAN IP

LAN IP address of the InvisaGig unit.

Config Hostname

Hostname of the InvisaGig unit.

IPPT MAC

If IP Passthrough (IPPT) is enabled, this reflects the MAC address of the interface which should have IPPT enabled.

APN

Currently selected carrier APN and PDP context

Network Mode

Currently selected network RF technology of the modem, along with the 5G technology enabled if relevant (NSA = Non-Standalone, SA = Standalone).

Connected Cells

Currently connected primary carrier cell(s). When connected to 5G NSA, two cells will be displayed: the anchor LTE cell and its supporting NR5G-NSA cell. For LTE-only or 5G SA connections only one cell will be displayed.

Band Locks

Displays the currently selected list of bands enabled for modem attach. If 5G NSA or SA are disabled, the band list for these will show "DISABLED", respectively.

Modem Temperature

Current temperature in degrees centigrade of the modem as measured internally.

Internet Status

Displays if the modem can reach the Internet and whether it can resolve hostnames or only IP addresses (the latter indicating a potential carrier DNS issue).

Live Signal

Selecting the optimal installation location for your InvisaGig unit is the key to achieving the best performance. The unit should be placed in a location and orientation where it will receive the best signal exposure from the carrier's nearest cell site. The Live Signal function allows for near instant feedback of signal information while reorienting the unit and selecting its permanent installation location.

Under Live Signal view, the connected cell, associated signal information, and modem temperature is displayed in near real-time, refreshing all information once per second. For signal information values are shown which represent each internal antenna of the InvisaGig unit. Pressing [x] will end the live view and display the last measured value until you press [Enter] to return to the Main Menu.

```
InvisaGig Config x +
https://config.invisagig.com
Press [x] to exit live view.
PRIMARY CARRIER CELL
"FDD LTE", "310260", "LTE BAND 2", 
"TDD NR5G", "310260", "NR5G BAND 41", 

SIGNAL POWER
-95, -92, -96, -96, LTE
-91, -85, -87, -99, NR5G

SIGNAL QUALITY
-10, -10, -3, -3, NR5G

SIGNAL/NOISE RATIO
0, 2, 2, 1, LTE
10, 12, 12, 9, NR5G

CARRIER AGGREGATION CELLS
"PCC", , "LTE BAND 2", 
"SCC", , "NR5G BAND 41", 
(PCC=PRIMARY, SCC=SECONDARY)

MODEM TEMPERATURE
49c
xPress [Enter] key to continue...
```

Primary Carrier Cell

This is the primary carrier channel that the modem is connected to.

Signal Power

This shows the Reference Signal Received Power (RSRP) for all four connected antennas in dBm.

Reference ranges:

Excellent = > -80, **Good = -80 to -90**, **Marginal = -90 to -100**, **Weak = < -100**

Signal Quality

This shows the Reference Signal Received Quality (RSRQ) for all four connected antennas in dB.

Reference ranges:

Excellent = > -10, **Good = -10 to -15**, **Okay = -15 to -20**, **Bad = < -20**

Signal/Noise Ratio

This shows the Signal to Noise Ratio (SINR) for all four connected antennas in dB. Reference ranges:

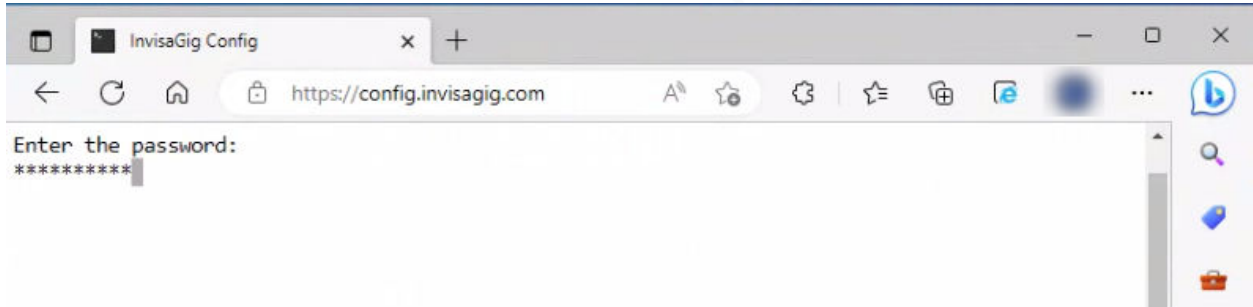
Excellent = > -20, **Good = 13 to 20**, **Okay = 0 to 13**, **Bad = < 0**

Carrier Aggregation Cells

This shows the Primary (PCC) and Secondary (SCC) cells being used for Carrier Aggregation (CA).

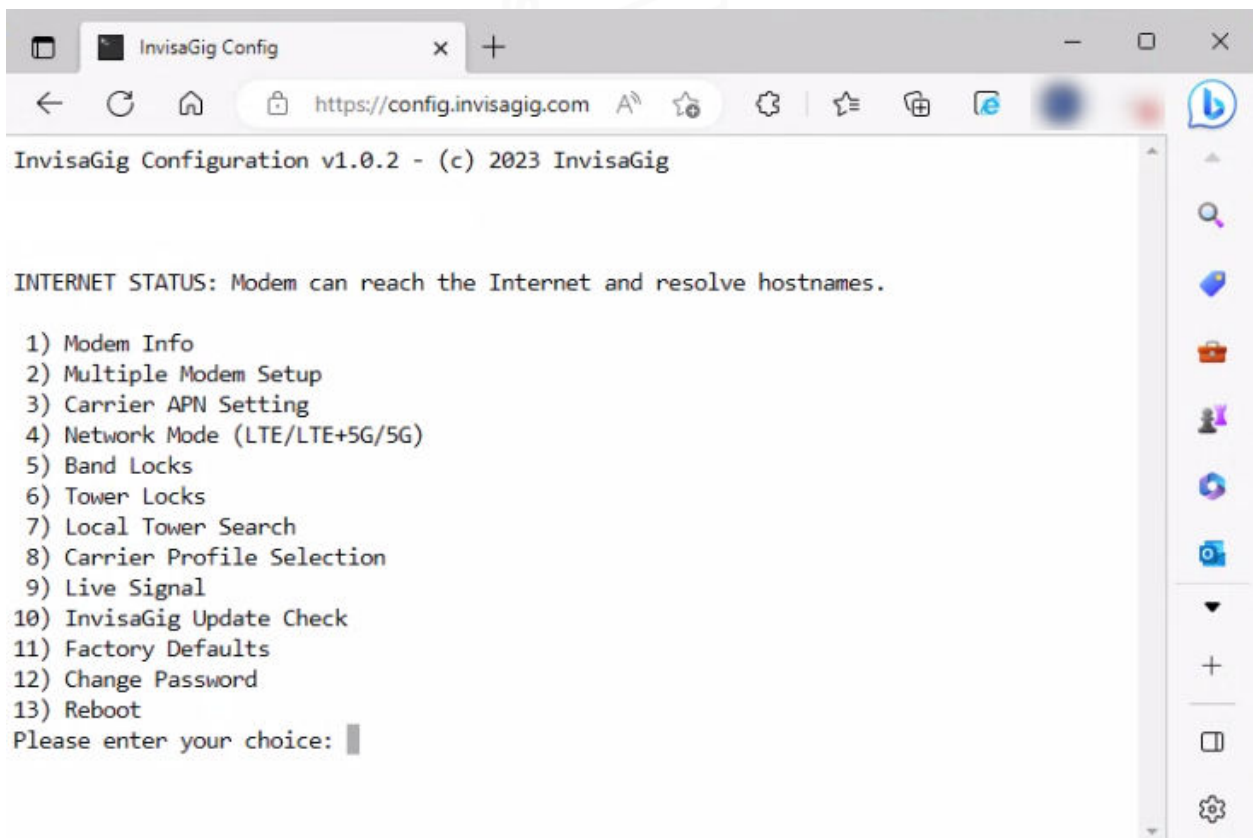
Login

Selecting this option will prompt for a password and log you into the Main Menu. The default password delivered by default is “**ChangeME2\$**”. This should be changed with the “Change Password” option in the Main Menu.



Main Menu

This is the main menu which is accessed after Login on the Landing Menu.

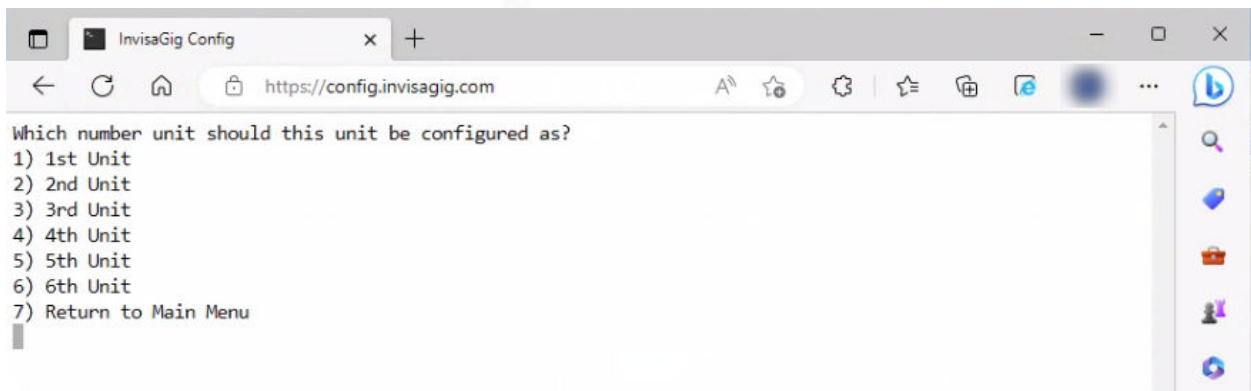
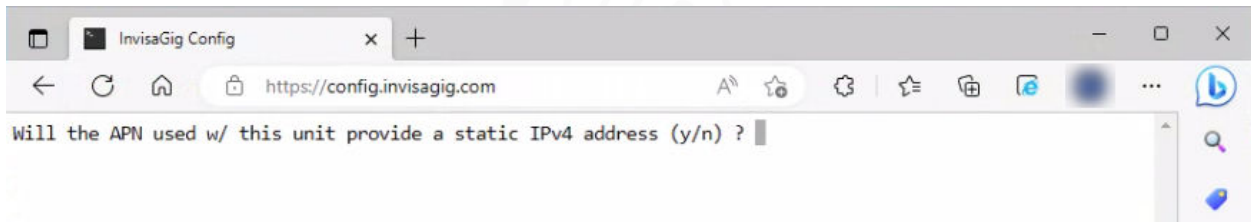
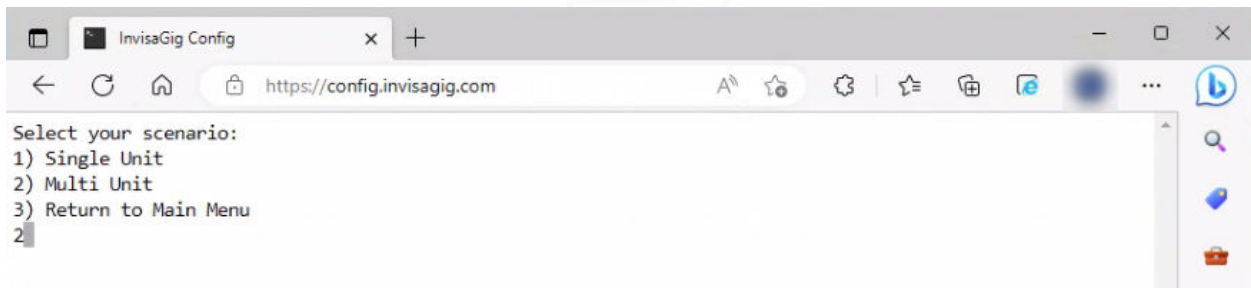
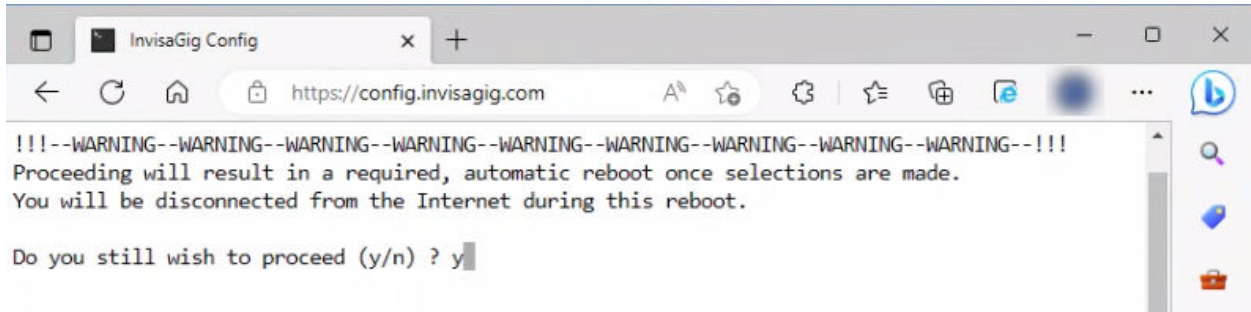


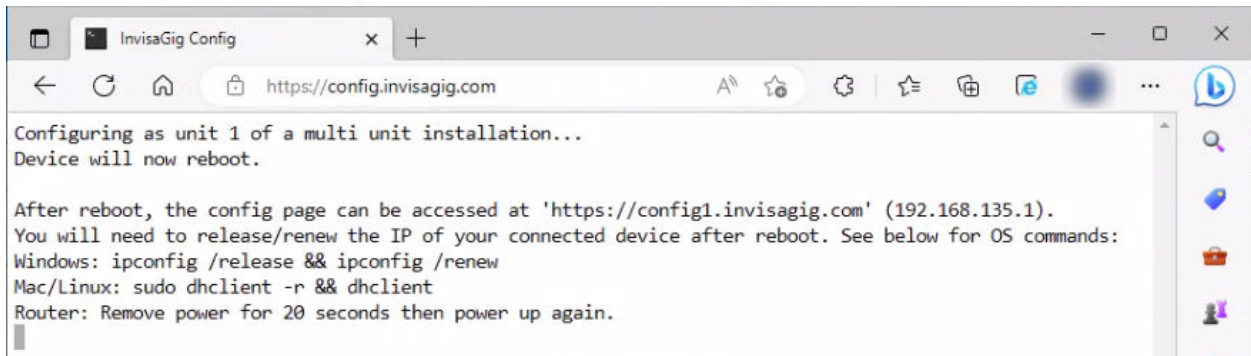
Modem Info

This is the same ‘Modem Info’ accessed via the Landing Menu. See ‘Modem Info’ description from the previous ‘Landing Menu’ section for details.

Multiple Modem Setup

Allows selection of the installation scenario. The unit may operate as single unit or as a member of a larger set of units (up to 6) configured together in a failover or load-balanced scenario using appropriate third-party equipment. Changing the Usage Mode will result in an automatic reboot of the unit upon selection confirmation due to the required IP changes.



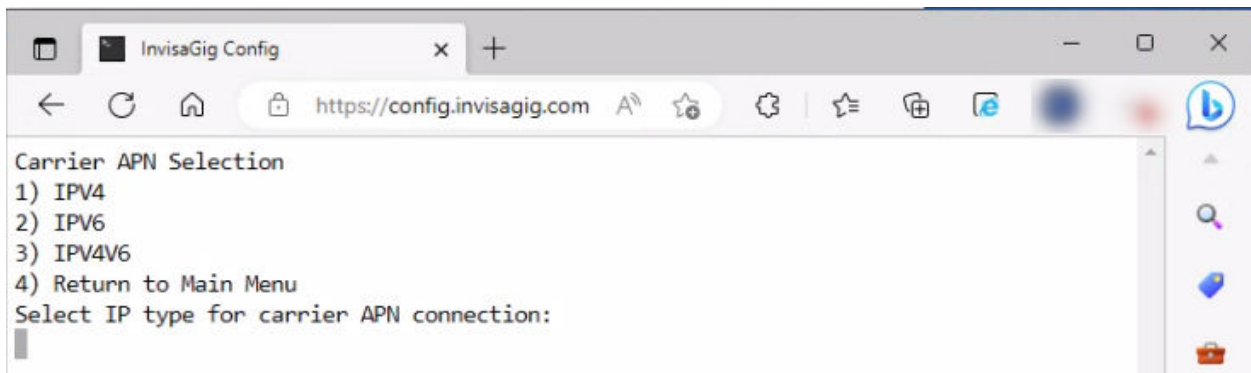


```
Configuring as unit 1 of a multi unit installation...
Device will now reboot.

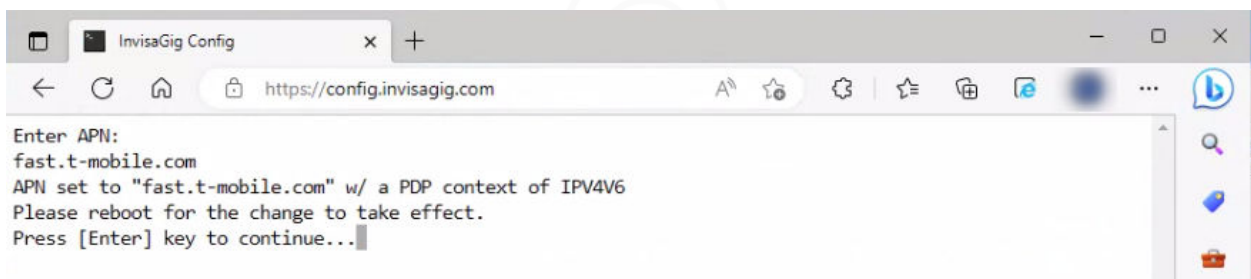
After reboot, the config page can be accessed at 'https://config1.invisagig.com' (192.168.135.1).
You will need to release/renew the IP of your connected device after reboot. See below for OS commands:
Windows: ipconfig /release && ipconfig /renew
Mac/Linux: sudo dhclient -r && dhclient
Router: Remove power for 20 seconds then power up again.
```

Carrier APN Setting

This option is used to set the carrier APN and PDP (IP) context required by the provisioned cellular subscription. A reboot should be performed after changing this value to ensure the new values take effect. Be aware that blank/empty input is considered valid so, if you select the APN option by mistake, simply select the “Return to Main Menu” if you wish to go back without setting a new value:



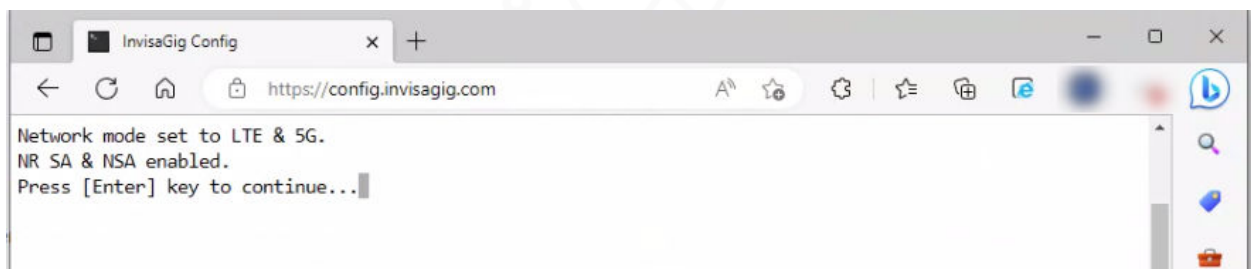
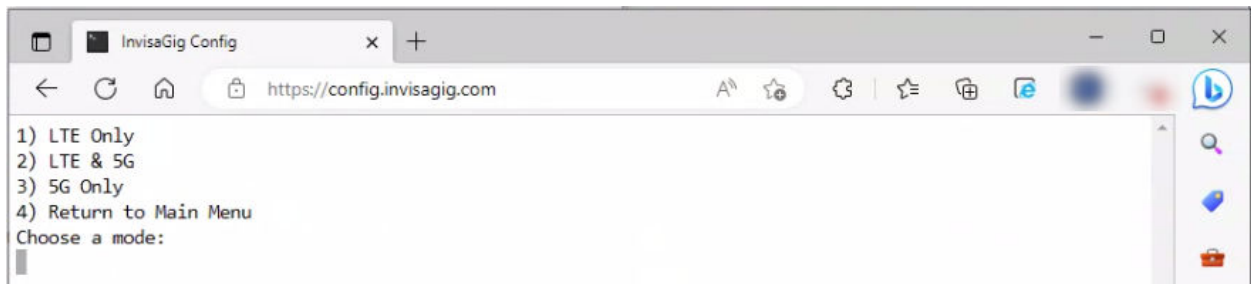
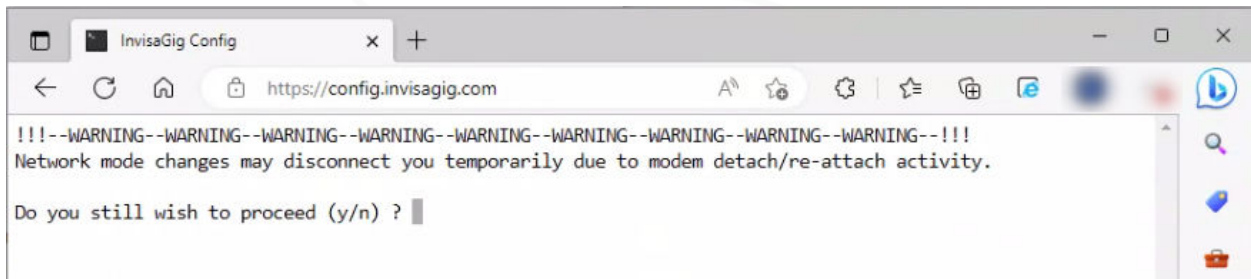
```
Carrier APN Selection
1) IPV4
2) IPV6
3) IPV4V6
4) Return to Main Menu
Select IP type for carrier APN connection:
```



```
Enter APN:
fast.t-mobile.com
APN set to "fast.t-mobile.com" w/ a PDP context of IPV4V6
Please reboot for the change to take effect.
Press [Enter] key to continue...
```

Network Mode (LTE/LTE+5G/5G)

The RF technology type used by the modem can be changed using this option. Selection options are comprised of LTE Only, LTE & 5G, or 5G Only. When selecting LTE & 5G, an additional prompt is shown asking which 5G technology should be enabled (NSA = Non-Standalone, SA = Standalone).

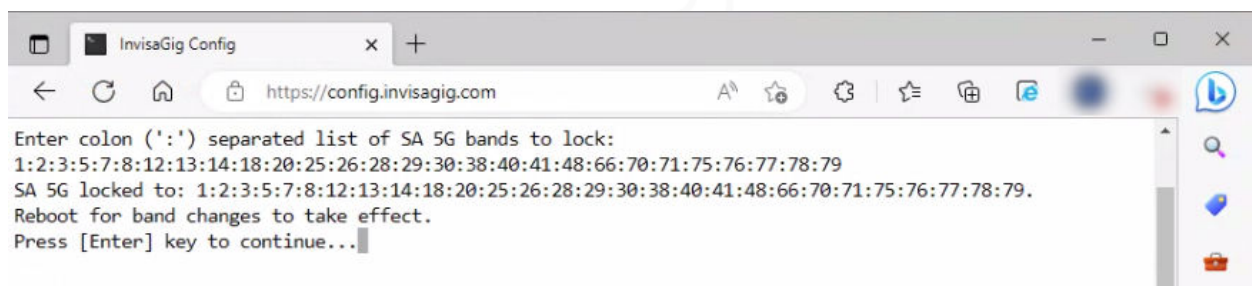
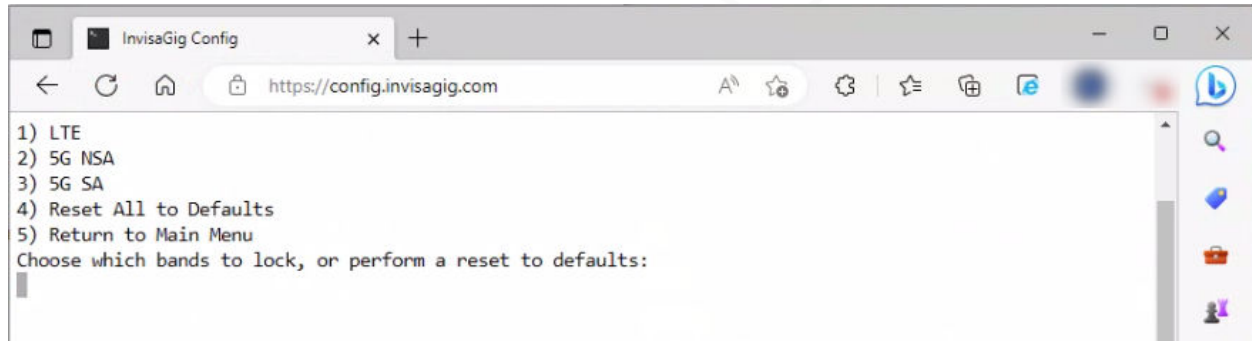


Band Locks

Band locking can be used to limit the bands used by the modem when connecting to carrier cells. This can be useful to limit cell attach on specific bands in situations where these bands are known to have issues such as instability or congestion. By default, all listed bands supported by the modem are enabled. To “lock” bands, one can shorten the list of available bands by removing undesirable ones from the list, leaving only the ones which are still desired. User input should be formatted as a colon (‘:’) separated list of band values (ex. ‘2:4:12:71...’). The modem will then connect to the band(s) in the remaining list based on signal strength. If no input or invalid input is provided for the list of bands to lock, no changes will be made.

Be aware that if bands are removed from the list of available bands, they can no longer be used for either primary carrier channels (PCC) or secondary carrier channels (SCC) which means that they will not

be included in any available carrier aggregation band combinations. Also, be aware that 5G NSA is still using LTE for its PCC so any bands removed from the LTE list will have a direct effect on 5G NSA connectivity. Finally, Band Locking should not be confused with Tower Locking which is the process of forcing the modem to only attach to a specific cell (tower). Tower Locks are covered in the next section.



Tower Locks

Tower locking, a.k.a. Cell locking, allows the modem to be locked to a specific LTE or 5G NR cell (or list of cells under LTE Only network mode). **Tower locking is not recommended in most cases due to the connectivity issues it may introduce if the locked cell goes offline due to malfunction, maintenance, etc.** This is because, when the modem is instructed to lock to a specific cell, it will, by default, not “fall back” to other cells if the locked one loses connectivity. However, InvisaGig has added some failsafe functionality to ensure cell locks are removed if the modem loses connectivity for more than one minute.

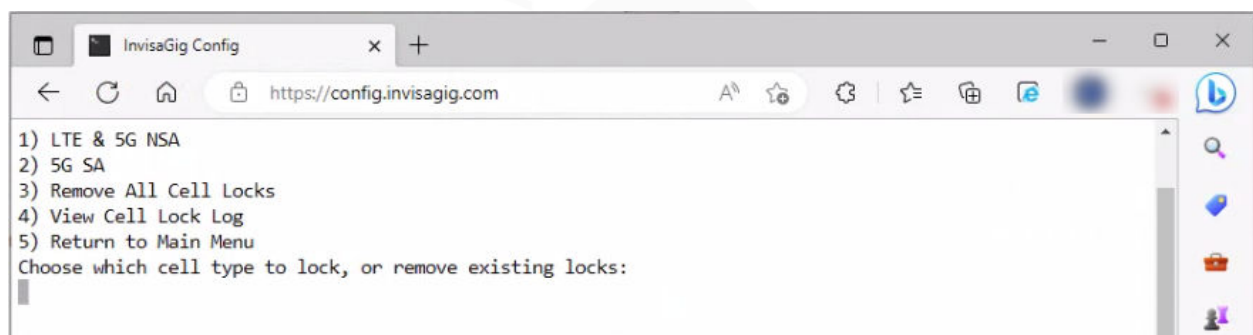
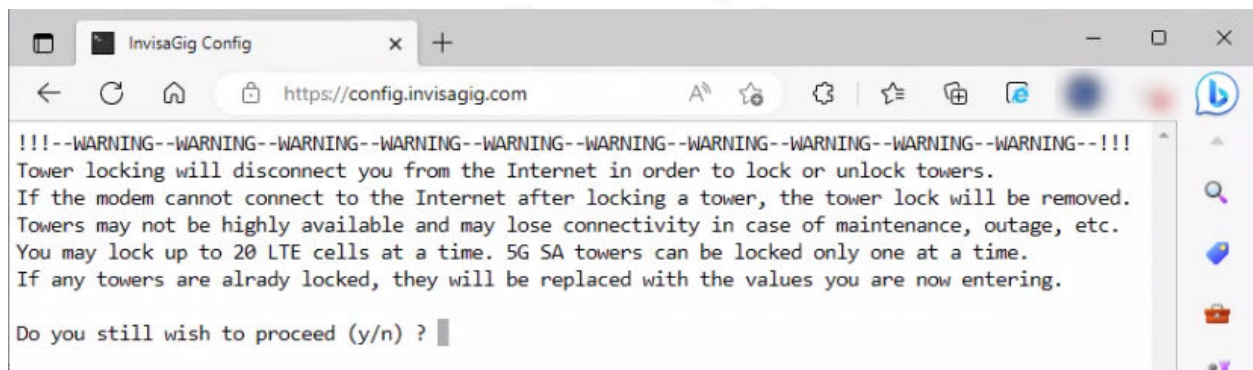
Cell locking is really only beneficial when the unit is located an equal distance between two carrier cell sites which broadcast the same bands with roughly the same signal strength but have different amounts of congestion. If the user wishes to ensure the modem does not connect to the congested site, then a cell lock can be put in place to keep it from roaming between the two sites. Outside of this scenario, it is recommended to either allow default modem logic to select the cell, or if the undesired cell site is broadcasting on different bands, use Band Locking to mitigate the issue instead.

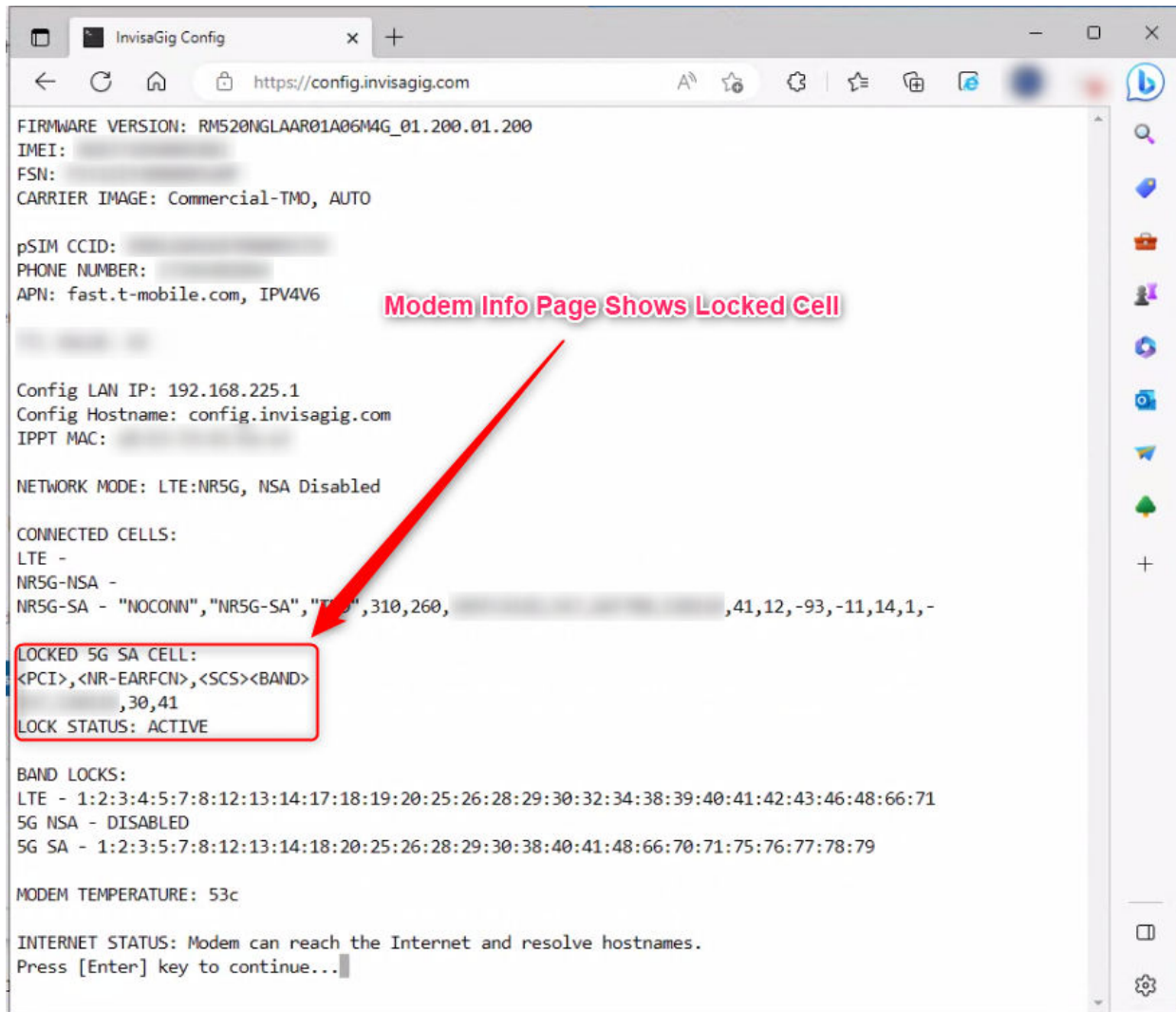
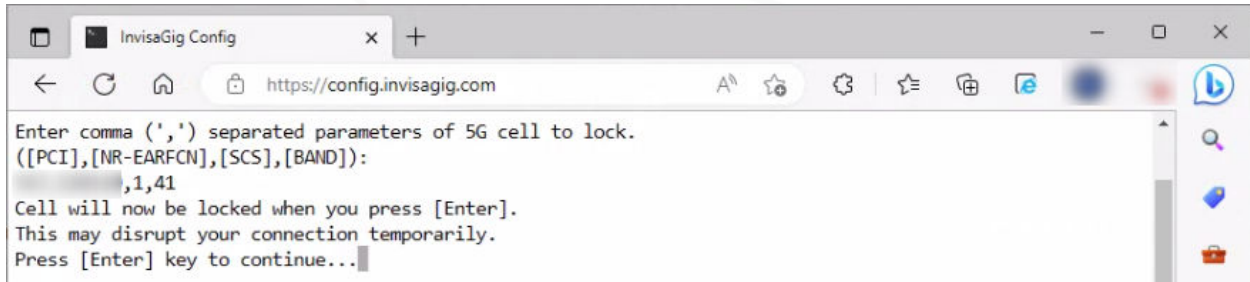
To lock an LTE tower (or for 5G NSA since the primary carrier is still LTE), you will require its EARFCN (‘E-UTRA Absolute Radio Frequency Channel Number’) and PCI (‘Physical Cell ID’) identifiers. To lock a 5G SA tower, you will need its PCI, NR-EARFCN (‘New Radio – EAERFCN’), SCS (‘Subcarrier Spacing’)*, and BAND (New Radio Band #). These required values can be obtained in a number of different ways:

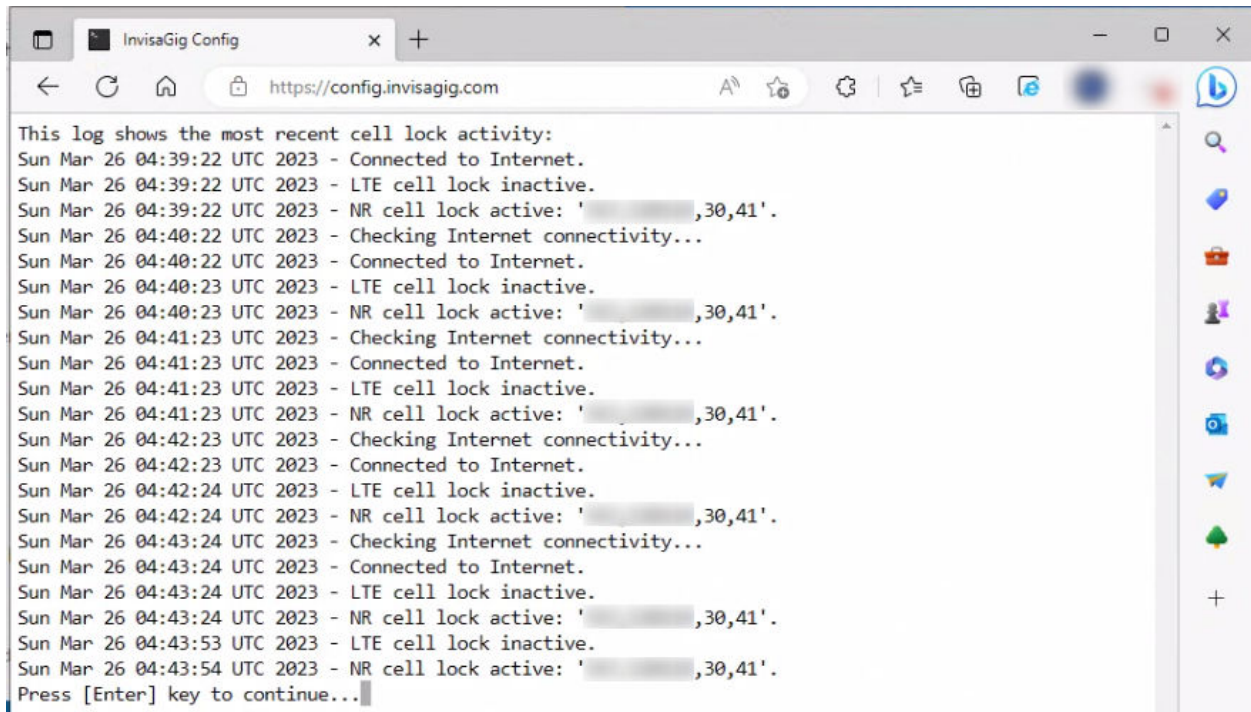
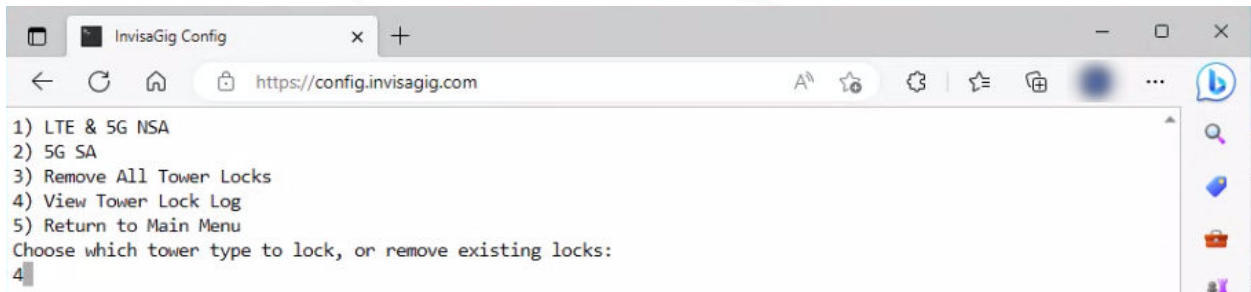
through the unit using Cell Scan option in the main menu of the InvisaGig device, a community repository source (i.e. CellMapper, etc.) or additional third party spectrum scanning tools (such as a iPhone in Field Test Mode, an Android app like LTE Discovery, or other dedicated spectrum analyzer hardware). The only method used in the context of this document is the Cell Scan option of the InvisaGig device.

IMPORTANT: The Tower Lock function has strict requirements that are mutually exclusive depending on the Network Mode of the modem. If you wish you lock a cell under LTE or 5G NSA, you must select a Network Mode which includes LTE, and 5G SA mode must be disabled. Conversely, if you wish to lock a cell under 5G SA, you must select a network mode which includes NR5G, and 5G NSA must be disabled. If you attempt to lock a cell without setting the appropriate Network Mode options first, you will receive a message indicating the conflict and be prompted to return to the Main Menu to select the proper Network Mode setting before retrying.

***NOTE:** SCS, or ‘Subcarrier Spacing’, is a new parameter used for 5G NR; it is measured in bandwidth values of 15, 30, 60, 120, 240, or 480 KHz. When referring to Cell Scan output to obtain a cell’s SCS, be aware that it is reported as a single digit value ranging between ‘1’ (30KHz) and ‘5’ (480KHz) which corresponds to the bandwidth. The Tower Lock function will accept either the actual KHz value or its equivalent, single-digit, representative value (that Cell Scan output provides). If the single digit format is used, the Cell Lock function will automatically convert it to the corresponding KHz value in the background. The converted, actual KHz value will then be reported in the Tower Lock logs and Modem Info outputs.



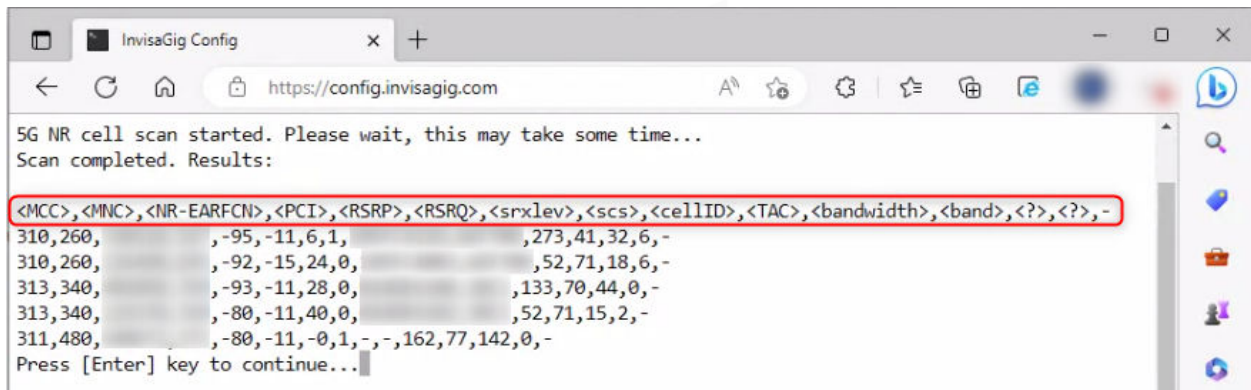
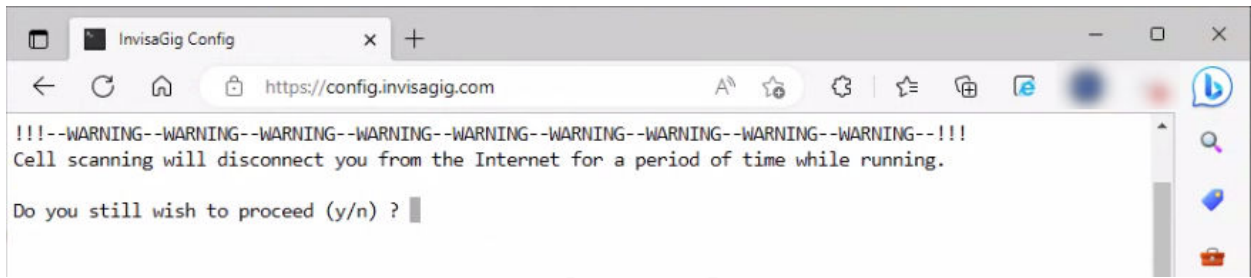
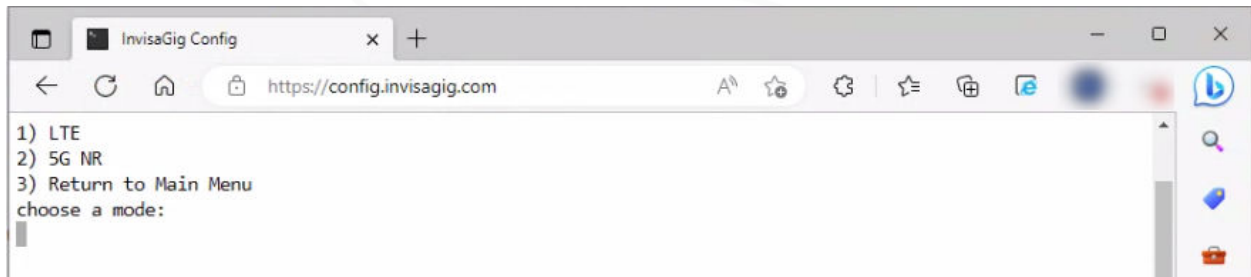




Local Tower Search

To use the Tower Locking function, you must obtain local cell tower parameters such as EARFCN, PCI, etc. Local Tower Search (a.k.a. Cell Scanning) allows us to search for available cells and provides parameter output for the discovered cells which can be used to lock desired cells which belong to your carrier. Cell scanning with a carrier SIM already installed will yield results reflecting mostly the carrier's own cells and/or roaming partner cells. Cell scanning without a SIM inserted may yield additional cells for other available carriers, but you would need to insert the appropriate carrier provisioned SIM to be able to attach to them. The top line of output in a cell scan is a key that indicates which parameters each comma separated value corresponds to.

Note: 5G NR cell scanning is still under active improvement by modem vendors. InvisaGig recommends performing at least two to three consecutive scans to ensure all available cells are listed. It has been observed that sometimes, in at least the first 5G NR scan performed, the actively connected cell details are not included in the result; thus, the recommendation to scan multiple times to ensure completeness of cell information.

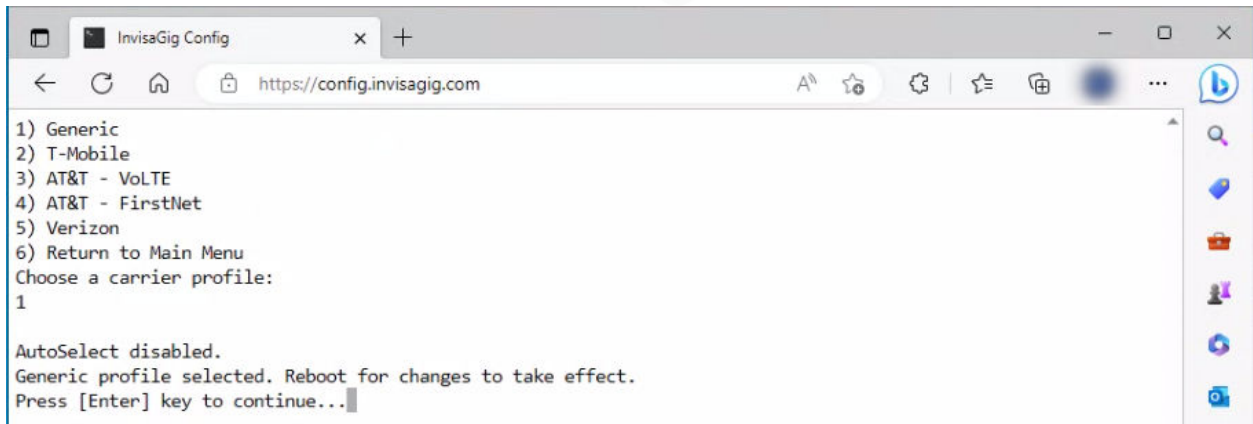
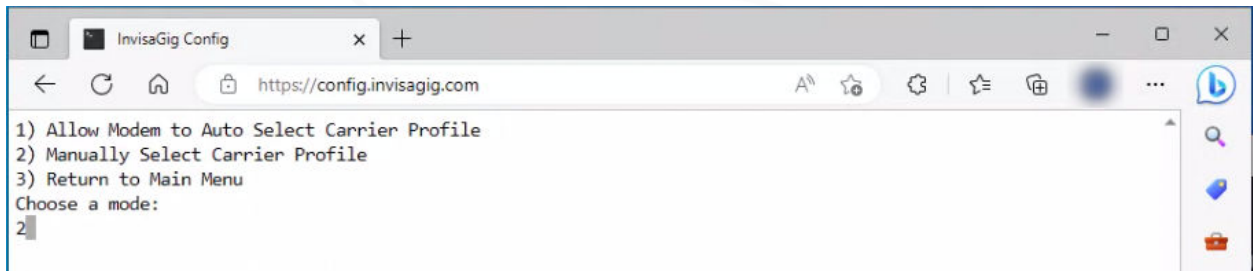


Refer to the 'Modem Info' info description under the 'Landing Menu' section of this document to reference signal strength/quality values shown in the Tower Search output.

Carrier Profile Selection

Modern cellular modems employ carrier optimized profiles which are used for connection to a specific carrier. In the case of InvisaGig, these profiles are referred to as 'Modem Configuration Binaries' (MBN), Carrier Images, or Carrier Profiles. By default, the modem will automatically choose the preferred profile using Auto selection based on the physical SIM card's identifier (ICCID). In some cases, a carrier profile may contain restrictions on which towers or bands it will allow the modem to connect to.

In cases such as troubleshooting specific connection issues (WiFi Calling dropouts, etc.) or using a SIM whose ICCID is not recognized by Auto selection, it may be desirable to select a specific profile manually. The Carrier Profile Selection function of the menu allows you do this. As the InvisaGig platform has only been tested with cellular carriers in the United States, currently the only manual selections reflect US carrier profiles and one generic profile. If Carrier Profile changes are made, a reboot is required for the change to take effect.

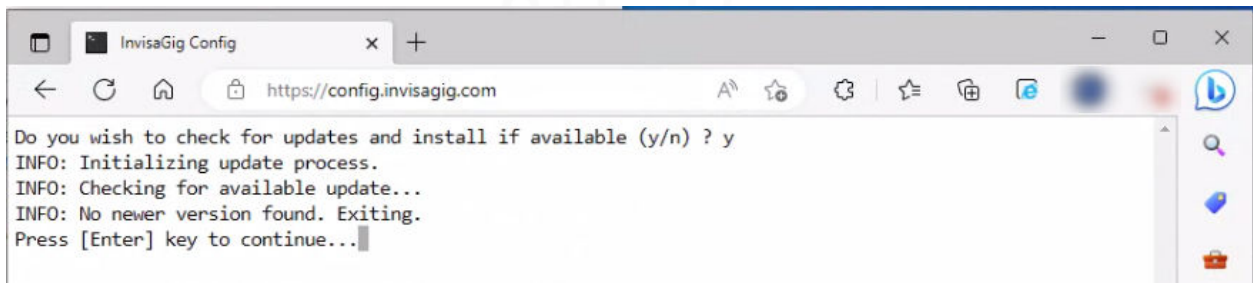


Live Signal

This is the same Live Signal information which can be found in the Landing Menu. Refer to the 'Live Signal' description under the Landing Menu section of this document for more info.

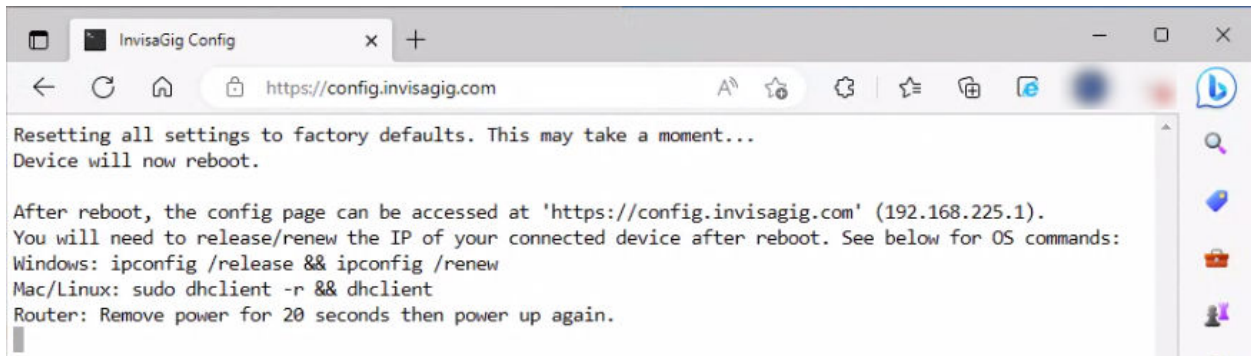
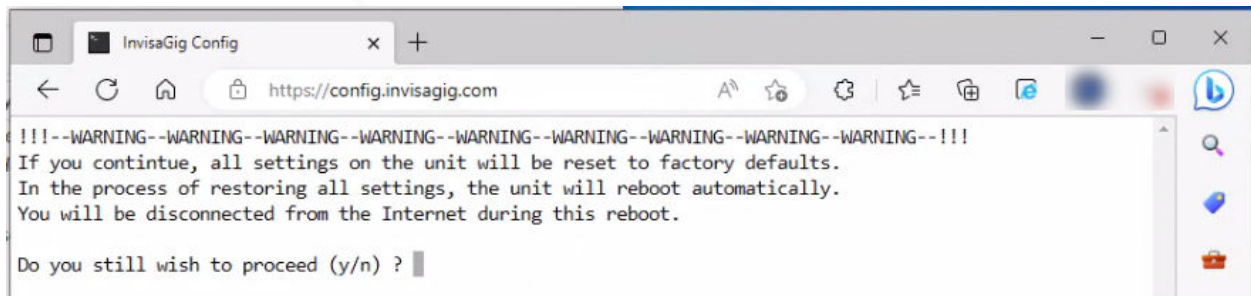
Updates

Periodically, feature enhancements and bug fixes will be published as updates to the InvisaGig configuration interface. To check for and install updates, use this option.



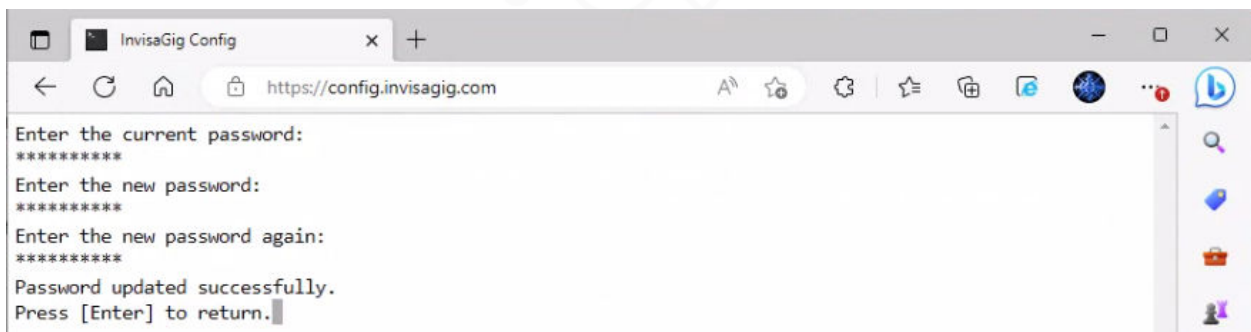
Factory Defaults

In case you would like to start fresh, you can reset all configuration values back to factory defaults by selecting this option.



Change Password

Selecting this option will allow you to change the password used to access the Main Menu. You will be prompted to first enter the existing password and, if correct, then for the new password twice to confirm it. Upon update of the password you will be dropped back to the Landing Menu where you would then need to enter the updated password to access the Main Menu again.



Reboot

When making configuration changes it is sometimes necessary to perform a reboot for the changes to take effect. Selecting this option will allow you to perform a restart.

