Antenna Node Manual

Wiser Systems Antenna Node Specifications and Functionality

Specifications

Antenna Nodes

Antenna Nodes are positioned to establish the tracking arena. These antennas provide location data by triangulating signals from tags within the arena. They can also be tracked as high-update rate Antenna Tags. The models of Antenna Nodes are USBV1.0 (Channel 4), USB3V2.0 (Channel 3 extended range), USB5V1.0 (Channel 5), and USB5V2.0 (Channel 5 extended range).

- Antenna dimensions: 6” x 2” x 1”
- Antenna weight: 40-45 grams
- Antennas can be powered via USB port, battery, wall outlet, PoE, or solar
- Current usage: USBV1.0: 110 milliamp, USB3V2.0: 120 milliamp, USB5V2.0: 80 miliamp
- Power draw: USBV1.0: 0.5 Watts, USB3V2.0: 0.6 Watts, USB5V2.0: 0.4 Watts
- Temperature Range: -30 degrees Celsius to 55 degrees Celsius
- Operates indoors and out
- Easy installation and adjustment

- Features multiple tracking modes
- Antennas can also be set to tracker-mode, enabling high update-rate tags

Functionality

1. Small Scale Demo Hardware Setup

This setup assumes you have at least five antennas. Four or more of these antennas will establish the area. One will be plugged into the base station or laptop; this antenna also contributes to the area. One antenna may serve as a roaming device (Antenna Tag).

First, identify an area within which you wish to track, such as a small shop floor or office space. It is helpful to have a to-scale image of the floorplan (BMP, PNG, JPG, SVG) of the area pre-loaded onto your computer for use in the software program. In the absence of your own to-scale image, the software provides an infinite grid and scale so you can determine distances quickly and accurately.

Next, position the antennas in a rough square to form your tracking perimeter. When selecting antenna positions, keep in mind the availability of power, height, distances between antennas, and the shape of the perimeter being formed by antenna placement. One of these antennas should be plugged into a USB port on the computer that will run the WiSER software.

Note that operating distance varies indoors depending on the density of large objects and walls. The spacing of the antennas can typically be much farther apart in large, open spaces with a direct line-of-sight between antennas. Typically, spacing of no more than 50 feet indoors yields the best performance. Outdoors, spacing can usually be much larger, with an upper bound of more than 150 feet.

For optimal performance, place antennas 10 to 15 feet above the floor with a clear line-of-sight between each other and the tracked items. Note: antennas and tags do not require line-of-sight for tracking, though it typically enhances system performance. The UWB pulses will be able to penetrate most interior walls, but not

metal sheeting. FCC requires the antennas to be at least 20 centimeters from any person.

After positioning them, power four or more of the antennas. Antennas can be plugged into USB power banks or AC power adapters; one antenna will be powered by being plugged directly into a computer. They can also draw power over Ethernet (PoE), which typically works best for more complicated installations.

Note: Some USB power banks intelligently sense power draw and turn off automatically if there is not enough power drawn. WiSER devices use very little power, so some power banks may shut off prematurely. If using your own batteries, choose one that remains on at least a minute after a device is plugged in.

The images below show the antenna plugged into a USB power bank and into a standard AC power adapter.

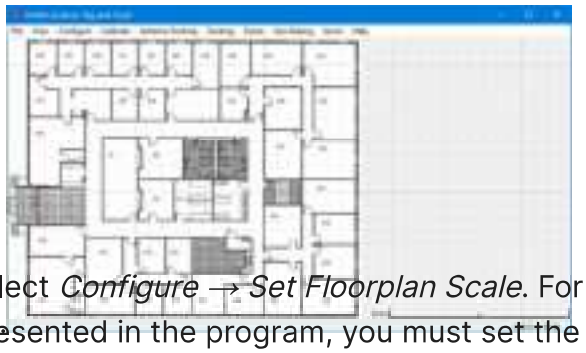
Antennas can be temporarily attached to walls as well. For best performance, the devices need to be oriented with the flat surface of the antenna head facing the floor. To achieve this, rotate the stem of the device 180 degrees relative to the base. Then, the device can be attached to a wall somewhat like is shown:

2. Small Scale Demo Software Setup

2.1 Discovering Antennas

The Wiser System will track tagged assets within the polygon established by the antennas. Note the specific location and height of each device and its associated short-ID number, located near the base of the USB cable.

1. Download and open the package folder. Then, open *wiserex.exe*. The following window will open: 
2. Click on the menu item *Configure → Load Floorplan*. Select a layout image and load. Note: This example uses the map from an office suite, but your own image



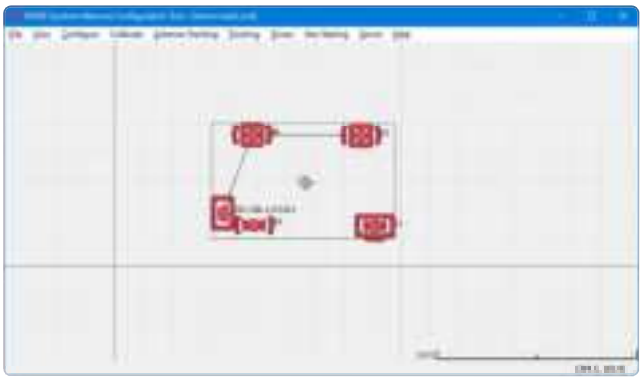
3. In the menu, select *Configure → Set Floorplan Scale*. For a scaled image to be accurately represented in the program, you must set the number of inches per pixel within the image. Measure an actual object in the tracking area like a doorframe in inches and then find the number of pixels for the object in the image. In the example shown above, the scale is “2.”

will be different.

4. Verifiy one antenna is plugged into the computer and run the WISER application. In the menu, select *Configure → Enable USB Antenna Node.* As with other antennas, placing this device high, with no visible obstructions around or near it, will improve overall system performance. Note: To run Antenna Tracking you will also need to have at least one antenna that is not yet plugged in or powered. This unit will serve as the Antenna Tag.
5. In the menu, select *Configure → Discover Network*. You will receive a message that says, “Found X Antenna Nodes.” Verify that the system has detected each USB or wireless device and that the short IDs match those detected.

6. If not all of your antennas appear, make sure all devices are powered and that each antenna is in communication range with at least one other antenna.
7. Antenna icons should now appear on your map in the application. These Icons may appear differently depending on the situation. Under normal circumstances, the icons will appear red while not in tracking mode. If the device is offline, the icon will appear white. If the device's position is locked, for instance during tracking, the icon will appear grey. Using the mouse, left click and hold on the dots at the center of each icon and move them to the location that roughly reflects their position in the physical environment to be tracked. The currently selected icon will be highlighted with a black outline. Do this for each individual icon. 

8. For large arenas, multiple antennas can be moved as a group. To select a group of antennas, first either click and hold the middle mouse button or hold the shift key and click and hold the left mouse button. Drag the mouse so that the box that appears contains all desired antennas then release the mouse button. All devices can be selected using the keyboard shortcut Ctrl+A. Individual devices can be added or removed from the selection by holding Ctrl and left clicking on them. A dotted box will now appear around the selected antennas. To translate these antennas, click the left mouse button on the central handle and drag the group to the desired location. To rotate the group of antennas, click any of the four handles in the corners of the selection box. To mirror the antenna positions about the vertical axis, click the handle positioned on the right-hand interior of the selection box. This axis is relative to the selection box, not the coordinate grid. When finished, press the escape key.



9. Finally, set the height of each antenna to prepare for system calibration. To set antenna heights, right click each individual Antenna Node or hover the cursor over an antenna and type “H” on the keyboard. Then supply a measurement in inches and click “OK” or hit “Enter” to complete this step.

2.2 System Calibration

To achieve maximum accuracy, it is important to calibrate antenna positions by utilizing communication between the antennas. There are two methods to do so.

1. Auto Calibration: Select the menu item *Calibrate → Auto Calibrate Arena*. After collecting necessary environmental data, the system will automatically position antennas relative to one another. Afterward, users can select all the antennas using the selection box or the keyboard short cut and then drag, rotate, and mirror them to correspond with their known locations in the floorplan. Please note that auto calibrate only positions the x and y coordinates of the antennas. The z coordinate must still be set manually.
2. Manual Calibration
    1. Select the menu item *Calibrate → Calibrate Arena*. By default, circles showing the measured range and measurement stability between antennas are shown. These can be disabled in the menu (*Calibrate → Toggle Circles*).

2. The circles represent measured distances from antenna to antenna. Where the circles intersect, an orange target will appear, indicating a calculated position for drag-and-drop antenna placement. Black or gray circles indicate proper relative placement of antennas. Red circles indicate that measurements between antennas do not match the current calibration. In very harsh environments, some red circles are permissible, but system users should strive to calibrate such that all the circles are black. Note: It is typically the case that antennas with red circles should be physically moved to a more optimal position. However, it is also possible that the calibration on the floorplan is simply not yet correct.
3. If your circles are not intersecting, are too far apart, or are not displaying correctly, check the map scaling step to assure your scale value is accurate.
4. The orange target on the screen will indicate an estimation of where the antenna is positioned according to each of the other antennas. Press the spacebar to move the red antenna icon to the location of the orange target and to advance to the next antenna. You can also move an antenna manually by clicking and dragging the red antenna icons with the mouse. To manually select the next antenna, position the mouse over another antenna and press “R.” To automatically choose the next antenna without moving the current one, press “N.” If the automatically chosen antenna is not currently visible in the viewport, the display will automatically center on the chosen antenna.
5. Repeat this in an iterative fashion for all fixed antennas until they are all aligned.
6. It is often useful to ignore the circles of antennas that are behind too many walls or too far away to properly register distance. If this is the case, use the reliable antenna circle intersections to calibrate the system. A circle flashing, for instance, could mean the system is not constantly recognizing the targeted device or that the signal is too weak.

2.3 Tracking / Tag Tracking

1. Select the menu item *Calibrate → Set Expected Tag Height*. Enter an approximate value in inches of how high the tags are from the floor.
2. Select the menu item *Tracking → Auto-Configure Tracking*. When this is complete, you should receive the following message: "Successfully configured using 1 clock."
3. Select the menu item *View → Toggle Tag Filtering.*
4. Select the menu item *Tracking → Run Tracking*. All powered tags should appear in the tracking area soon after this. Note: Tags maintain both "moving" and "resting" update rates to conserve power when motionless. Because of this, motionless tags will take longer to appear when the system begins running tracking.
5. Tracking will then continue indefinitely. To halt tracking, select the menu item *Tracking→ Stop Tracking.*
6. While tracking is not running, you may adjust tag tracking settings via the menu item *Configure → Tracking Settings*.

7. Note: If you have trouble keeping antenna positions in the correct places on the floorplan despite accurate scaling from pixels to inches, or if you have antennas that are already configured in the correct location, you can lock an antenna with a known location in place by positioning the mouse over the antenna and typing "L" on the keyboard. This antenna will then appear in gray. Antenna placement can also be unlocked by typing "L" while the mouse hovers over an antenna.
8. Select the menu item *Calibrate → Stop Antenna Node Calibration* to conclude this step.

2.4 Antenna Tracking

1. After the arena has been discovered and calibrated, plug one or more additional WISER antennas into batteries. These will be the roaming devices you use to perform antenna tracking. Note that these devices needed to be unpowered when you first discovered the network (*Configure → Discover Network*). Otherwise, the system will mistakenly count them among the system's fixed antennas.
2. Select the menu item *Antenna Tracking → Find Antenna Tags*. If successful, the system will show the following message "*Found X Mobile Antenna Node(s).*"

3. Select the menu item *Antenna Tracking → Run Antenna Tracking*. This will initiate tracking. To halt tracking, select menu item: *Antenna Tracking → Stop Antenna Tracking.*
4. Select the menu item *View → Toggle Circles* to display circles showing the distance measured between antennas and the tracking devices. This can also be toggled to de-clutter the view.

5. Antenna Tracking can also be used to generate a heat map of antenna connectivity.
    1. Select the menu item *View → History Color Shows Number of Antenna Nodes.* A key will appear in the lower left-hand corner of the application. This key shows the color that will be used for historic data points with the given number of antennas.
    2. Select the menu item *View → Toggle Location History.* This option allows for the display of historic data points.
    3. Move the “Roaming Device” throughout the area, being sure to cover all areas of interest.

2.5 Saving Your Settings

When the system is sufficiently calibrated, save the setup via the menu option *File → Save*. If you ever close the program, you can load this setup and bypass the discovery, calibration, and settings steps by selecting *File → Open*. After loading a saved file you can immediately run tracking. If operating in an environment where only a single config is used, the menu item *File → Load Last Config On Start* can be selected. This will cause the last used config to automatically be reloaded when the program is started.

FCC Regulations

FCC Notice for USBV1.0, USB3V2.0, USB5V1.0, and USB5V2.0

1. **FCC Interference Statement (Part 15.105 (b))** 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 of the following measures: Reorient or relocate the receiving antenna. Increase the separation between the equipment and receiver. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. Consult the dealer or an experienced radio/TV technician for help.
2. **FCC Part 15 Clause 15.21 [Do not Modify warning]:** “Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment”
3. **FCC Part 15.19(a) [interference compliance statement]:-** “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.”

ISED Notice for USB5V1.0 and USB5V2.0 (Canada)

1. **ISED RSS-Gen Notice (in English and French):**
    1. “This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s). Operation is subject to the following two conditions: This

device may not cause interference. This device must accept any interference, including interference that may cause undesired operation of the device."

2. "L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : L'appareil ne doit pas produire de brouillage; L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

2. **ISED Canada ICES-003 Compliance Label (CAN BE PROVIDED ON LABEL OR in MANUAL):** "CAN ICES-3 (B)/NMB-3(B)"