

InfinID Technologies, Inc.

V-TAG Tag Placement Guidelines

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1.0 Introduction to V-Tag Asset Location and Tracking System

1.1 V-TAG Mesh Network

V-Tag Active RFID tags from InfinID Technologies are battery powered tags that have a read range of 150-300 feet. In addition, when the tag powers up, it coordinates with other tags to form a mesh network for communications purposes. Location is done by using fixed position tags that never move. The asset tags then calculate the distances to their nearest fixed position tags based on radio signal strength.

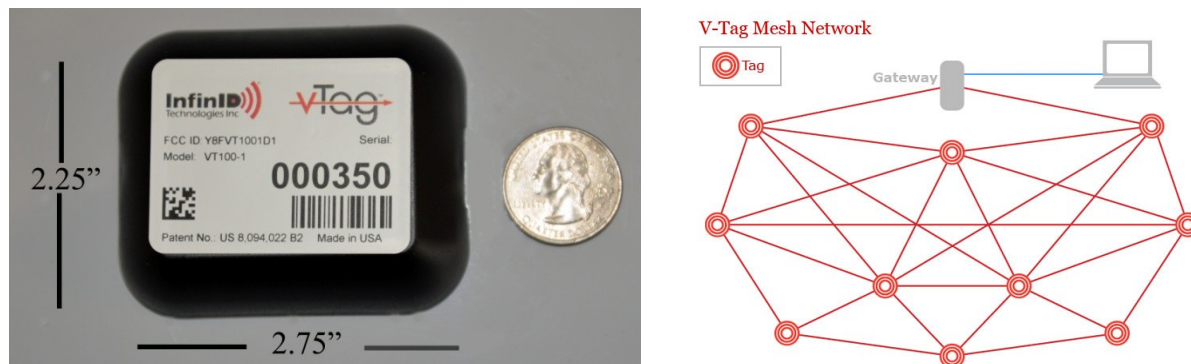


Figure 1-1 V-TAG Mesh Network

1.2 V-TAG Locations

The V-Tag system uses a mixture of fixed position tags and asset tags to locate assets to within a zone (known within the V-Tag system as a "location") which may be for example 20 ft x 20 ft indoors or 40 ft x 40 ft outdoors. Simply place a fixed position tag at the desired spot to define the location, and any asset tags nearby will associate with that fixed position tag allowing the asset to be conveniently located when needed.

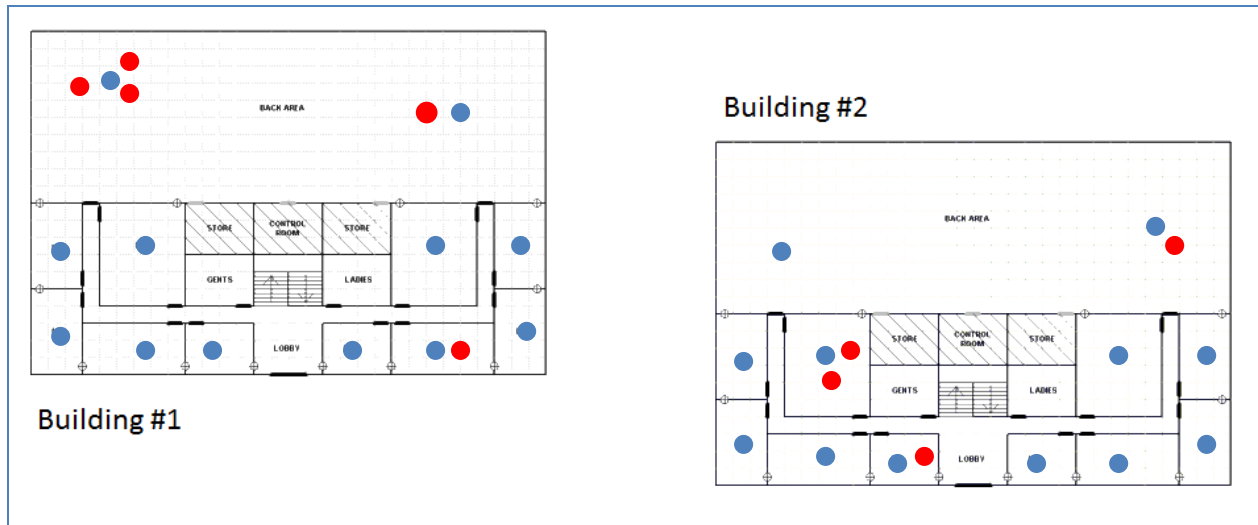


Figure 1-2 V-TAG Asset Tracking Example

In the example in Figure 1-2, fixed position tags shown in blue have been placed in all rooms of the two warehouse buildings shown, and the V-Tag system is able to report the current location of each of the assets shown in red. The system will support the identification of the building where the asset is located as well as the room number within the building. Although the example shows indoor locations or zones, the system could just as easily be set up with outdoor locations. In either case, tags can be located to the nearest location defined by the fixed position tags.

2.0 General Guidelines for Tag Placement

2.1 Understanding Radio Signal Strength

The tags use radio signal strength to determine their own locations. A basic understanding of radio signal strength is useful when you are deploying tags.

- Radio signals bounce off of metal
- Radio signals are weakened by brick and concrete
- Radio signals pass through other materials such as drywall and lumber.

The reason that this is important is that if there is a metal obstacle between an asset tag and its nearest fixed position tag, the metal obstacle may block the radio signals, and the asset tag may select a different fixed position tag to determine its own location. Careful selection of the locations of the fixed position tags can help to avoid this situation.

2.2 Tag Labels

Notice that fixed position tags and asset tags have different labels as shown in Figure 2-1 and therefore cannot be swapped. The reason for this is that fixed position tags are programmed to relay messages from tag to tag whereas asset tags are programmed to find the nearest fixed position tag to act as a relay. This allows the battery life of the asset tags to be substantially extended.

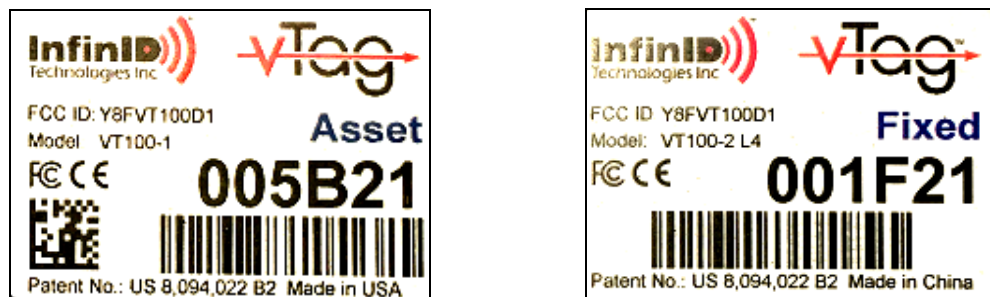


Figure 2-1 Labels for Asset Tags and Fixed Position Tags

3.0 Examples of Good Placement of Asset Tags

When setting up asset tags, attach each tag to the side of the object being tracked. The tag should be oriented so that the label on the tag is the right way up. The tag should be positioned at least 12 inches from the ground so that the signal can travel unimpeded. Avoid placing the tag within 3 inches of the ground. See Figure 3-1 and Figure 3-2 for examples of good tag placement.



Figures 3-1 Good placement of asset tag on a vehicle



Figure 3-2 Good placement of asset tag on a high value printer

Tags will transmit and receive well from the label side of the tag. Placement as shown allows the mounted tag to transmit and receive strong signals.

4.0 Examples of Good Placement of Fixed Position Tags Outdoors

When setting up the fixed position tags, the fixed position tags should be mounted at 50 to 200 feet intervals. The exact interval will depend on the degree of resolution required and the number of obstacles in the environment. The fixed position tags should be positioned 7 to 9 feet from the ground to provide good line of sight to other tags. The tags should be oriented so that the label on the tag is the right way up and facing into the area being monitored.

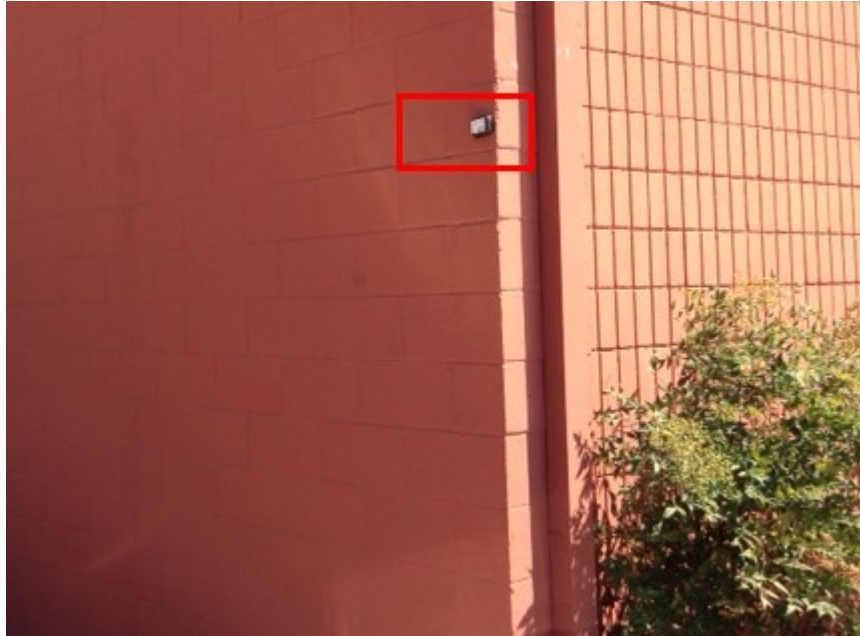


Figure 4-1 Good placement of fixed position tag on the side of a building

Tags transmit and receive well from the label side of the tag. Be sure that the label side of the tag is facing into the area being monitored.



Figure 4-2 Good placement of fixed position tag on a light pole

5.0 Examples of Good Placement of Fixed Position Tags Indoors

5.1 Indoor Area with Low Ceilings

If an indoor area has low ceilings, you can locate the fixed position tags on the ceiling of each room. This will give a strong signal within the area below the tag with very little overlap to adjacent areas. Tags transmit and receive well from the label side of the tag. Be sure that the label side of the tag is facing into the area being monitored.



Figure 5-1 Good placement of fixed position tag on the ceiling of a room

5.2 Indoor Area with High Ceilings

In the case of an indoor area which has high ceilings, such as a large warehouse, treat the large open space as being an outdoor area and follow the guidelines for outdoor areas that were given in previous chapters.



Figure 5-2 Good placement of fixed position in warehouse with high ceilings

6.0 Examples of Poor Placement of Asset Tags

Figure 6-1 has an example of poor placement of an asset tag. All of the RF energy is bouncing off of the metal roof of the car and being radiated into outer space, similar to the way a satellite dish works. Very little of the RF energy can be picked up by neighboring tags. It will be difficult to communicate with this tag and its position estimates will be wildly inaccurate.



Figure 6-1 Poor placement of an asset tag on a vehicle

Figure 6-2 has an example of poor placement of an asset tag in an indoors environment. When an asset tag is very close to the ground, RF reflections from the ground can interfere with transmissions causing very little signal to be received by other tags. In general you should avoid placing the tag within 3 inches of the ground.



Figure 6-2 Poor placement of an asset tag on an IT asset

7.0 Setting up a Breadcrumb Trail of Tags

Sometimes you may wish to establish tag communications over long distances by implementing a "breadcrumb trail" of tags. The best way to accomplish this is illustrated in Figure 7-1.

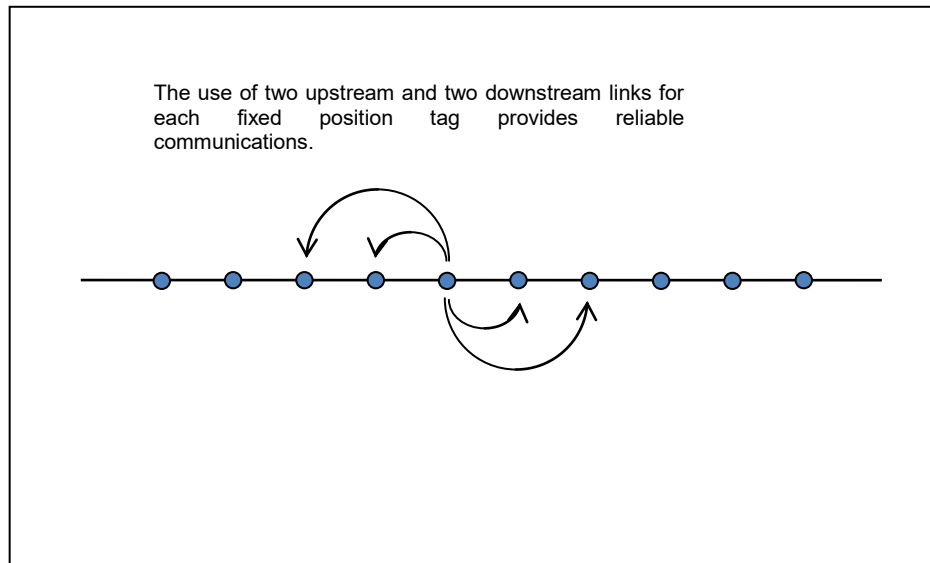


Figure 7-1 Good placement of Fixed Position Tags along Breadcrumb Trail

In Figure 7-1, tags are spaced 50 to 75 feet apart so that every fixed position tag can send messages to two upstream fixed position tags and two downstream fixed position tags. In this situation, if a message is dropped due to radio interference from the external environment affecting one of the links, the message is not lost because it will also be transmitted on the alternate upstream or downstream link.

You can also increase reliability by having the tag labels face towards each other on the breadcrumb trail. Tags transmit and receive well from the label side of the tag.

Note that metal obstructions will block radio signals, care is needed when mounting tags on metal poles or signs. The side that the tag is mounted on will transmit well but the other side will be blocked. This may impact the relaying of messages along the trail.

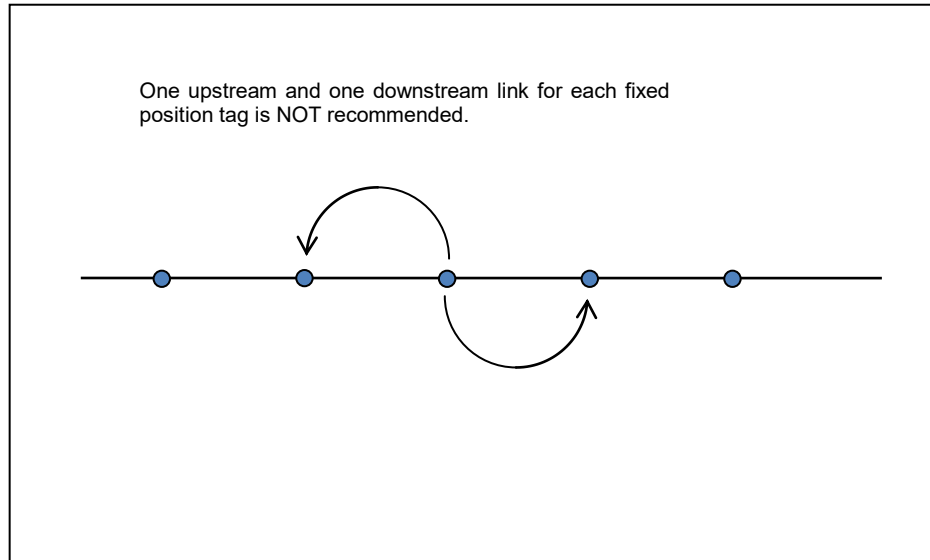


Figure 7-2 Poor placement of Fixed Position Tags along Breadcrumb Trail

In Figure 7-2, tags are spaced 100 to 200 feet apart, so that every fixed position tag can send messages to just one upstream tag and one downstream tag. In this situation, the network will initially appear to work but the performance will not be reliable. If a message is dropped due to radio interference from the external environment affecting one of the links, the message will be lost permanently. Use the setup of Figure 7-1 instead to take advantage of the reliability offered by routing of packets across multiple links.

Appendix A V-TAG Asset Location and Tracking Algorithms

For technically minded readers, this appendix provides further details of the V-Tag asset location and tracking algorithms. Most readers can safely ignore the material in this section.

A.1 Asset Location and Tracking Algorithm

V-Tag RFID tags support two asset location and tracking algorithms. Use the “Set Algorithm” command to select which algorithm is used by the tag. The default algorithm is the “Nearest Fixed” algorithm which calculates the asset location to put it close to the nearest fixed position tag that is picked up by the tag. The algorithms are:

- None
- Nearest Fixed

Position location using radio signal strength is challenging because if two tags are far apart, signal strength can be affected by obstacles and signal multipath interference as well as distance. So unless the tags are very close, there is a lot of uncertainty in inferring distance from signal strength. This is the reason that simpler algorithms perform better.

A.1.1 None

If the algorithm is set to “None” the tag will not carry out any location and tracking calculations, and will advertise its position as “Unknown.” This can be useful if you want a fixed position tag to act as a relay and not influence any location calculations. Set the location and tracking algorithm to None for the fixed position tag and it will only carry out packet relaying.

A.1.2 Nearest Fixed

If the tag location and tracking algorithm type is set to “Nearest Fixed,” tags will find the nearest fixed position tag based on received signal strength and randomly select a nearby location at a 1 meter distance from the fixed tag. On a map display, asset tags will be displayed in a circle around the nearest fixed position tag at a distance of 1 meter from the tag.

A.2 Accelerometer

When the accelerometer detects tag movement, a series of 10 location reports is sent at one minute intervals to provide updates of tag location.

A.3 Neighbor Discovery for Fixed Position Tags

To conserve battery, the fixed position tag spends 99% of its time sleeping. This means that it cannot instantly discover new neighbors. The following steps are used for neighbor discovery for fixed position tags.

- A background scanning process is constantly running. This will do a complete survey of the neighborhood in 1 hour if the tag has two or less neighbors, or 10 hours if the tag has three or more neighbors.
- A full scan runs when needed. The full scan takes 5 minutes. The full scan runs when the tag starts for the first time, when the tag detects motion, and when a tag detects its first neighbor in an otherwise empty neighbor table.

A.4 Neighbor Discovery for Asset Tags

To conserve battery, the asset tags only perform neighbor discovery after movement. They then perform a full scan to calculate their position which remains unchanged until the next time they are moved or shaken. The full scan takes 5 minutes. Be sure to move or shake the nearby asset tags if you place a new fixed position tag in an area so that the asset tags will discover the new fixed position tag. This applies mainly during the initial deployment of the V-Tag system when fixed position tags are being put in place for the first time.