HOBO® Data Node Deployment Guide

This guide explains how to deploy a HOBO ZW Series Wireless Network, including guidelines for selecting the best location for nodes and tips for ensuring optimal network performance. For specific steps on building the network and setting up each node, refer to the *HOBO ZW Series Wireless Network Quick Start Guide*.

Overview

There are three types of devices in a HOBO ZW Series Wireless Network:

Data Node	Router Node	Receiver
• Records data measured by internal and external sensors • Runs on battery power for approximately one year at a 15-minute logging interval • Operates as "dual-purpose" data/router node when AC powered	• Provides connectivity to other nodes • Operates as "range extenders" that expand the reach of the wireless network • Always runs on AC power with battery backup • Can be either a dedicated router or a data node doubling as a router	• Collects and stores data as the central hub of the network • Operates as the bridge between the network and the software • Stores network information and sends commands to nodes • Runs on AC power or USB with battery backup

The HOBO ZW Series Wireless Network uses a low-power 2.4 GHz 802.15.4 radio to transmit data wirelessly across the network of router nodes and back to the receiver. The low-power 2.4 GHz signals lose strength due to obstructions in the communication path. Placing router nodes to work around obstructions is crucial for successful communication. A backbone of router nodes is essential for strong communication within the network. This guide will help identify where to strategically place router nodes to compensate for obstructions.

Site Survey

One of the first objectives in deploying a wireless network is to analyze your site to determine equipment requirements, potential obstructions, and possible communication paths. This involves answering specific questions related to your particular application. Doing this before setting up the network will save time and ensure the most efficient and cost-effective system possible.

- **What do you want to measure?** Make a list of specific parameters to be measured (for example, temperature, humidity, voltage, current, pulses).
- **Where do you want to take measurements?** Determine where you want each node to take measurements by making a facility map. Note on the map distances between measurement locations and any obstructions between them that may interfere with radio communication, such as metal walls, water pipes/tanks, or appliances.
- **Will the location provide accurate readings?** Ensure the locations on the map will provide the most accurate readings for the measurements. If, for example, you want to measure temperature for an air flow study, the most appropriate location for the measurement would be in close proximity to the airflow instead of a location where airflow doesn't exist or where dead spots occur, such as in the corners of a building.
- **Do you need a concealed, inconspicuous location?** Nodes are designed to be small, inconspicuous, and tamperproof. If further security or concealment is required, choose inconspicuous or hard-to-reach locations for deployment.
- **How often will measurements be made?** Determine the logging interval for each measurement. Some may need to be made more often than others.
- **Where will you place router nodes?** Make sure an outlet is available at the locations on your map where you want to use router nodes. If the router node is also doubling as a data node, make sure that location is also a place where you want to take measurements. Remember that AC power is required for all nodes acting in router mode.

Deployment Guidelines

With your site survey complete, you can make a list of equipment needed (if you haven't already done so) and determine where to position router nodes and data nodes in the network. Most data nodes offer multiple channels, giving flexible measuring options with minimal equipment. An Onset Applications Specialist at 1-800-LOGGERS can also assist you in determining the right kind of equipment necessary once you understand the measurements you need.

On the facility map, mark where the receiver will be located. The receiver must be connected to the computer used to form the network. Next, mark the location for each data node, noting whether the data node will be plugged into a wall outlet to give it routing capabilities. Finally, start identifying where you may need additional router nodes to relay the data across the network back to the receiver and mark those locations on the map. Take into account the communication range, signal pattern, and sample network deployments as described in the following sections when mapping out node locations. Note that once you set up the wireless network, it may be necessary to alter the locations or add more router nodes.

Communication Range

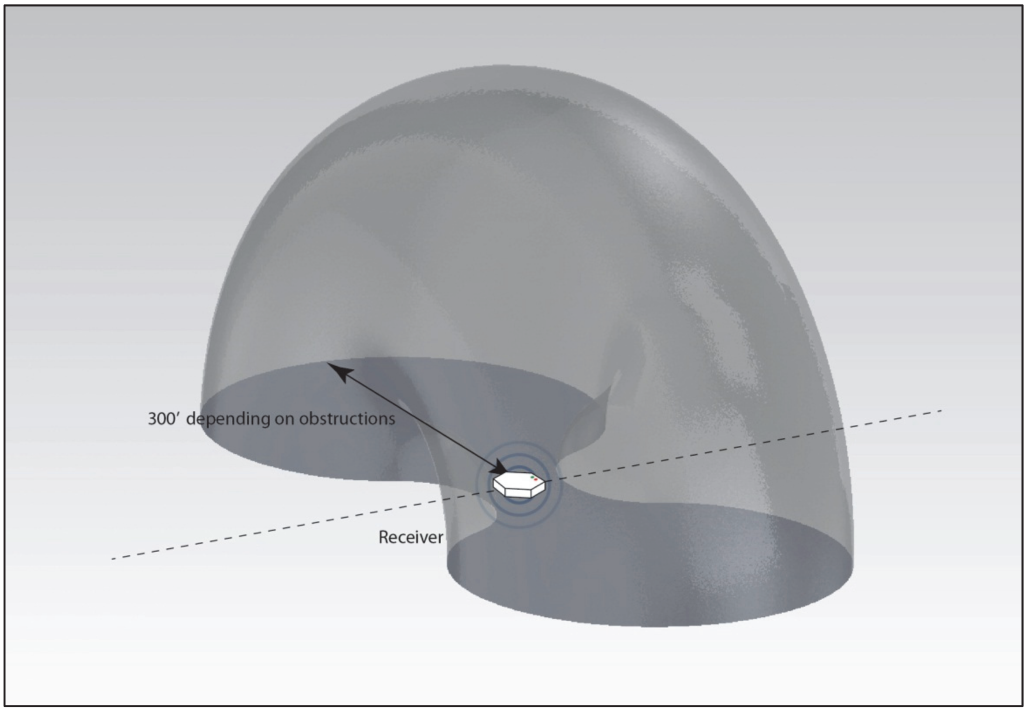
The maximum communication range for a node is approximately 150 to 300 feet assuming there are no obstructions or interference and there is a direct line of sight between the communicating devices. However, most sites have numerous obstructions that block the line of sight and reduce the communication range. If two nodes do not have a clear line of sight, then the obstructions may block or attenuate the signal, creating an RF shadow, or a region of no signal, that impacts connectivity. Obstructions to radio communications between nodes can be overcome by strategically placing a router to relay wireless data around the obstruction. The following table provides general guidelines on the degree of attenuation for common materials that may be present where you are deploying the network. Degree of attenuation is the gradual loss of signal intensity when passing through a medium. The higher the degree of attenuation, the more likely it is that you will need to add router nodes to transmit the data across the network.

Materials	Degree of Attenuation	Examples	Estimated Loss in Range
Air	None	Open space, inner courtyard	No loss
Wood	Low	Door, floor, partition	Minimal loss of range; communication is likely
Plastic	Low	Partition	Minimal loss of range; communication is likely
Glass	Low	Untinted windows	Minimal loss of range; communication is likely
Tinted glass	Medium	Tinted windows	Partial loss of range; communication is possible; router usage is recommended
Water	Medium	Aquarium, fountain	Partial loss of range; communication is possible; router usage is recommended
Living creatures	Medium	Crowds, animals, people, plants	Partial loss of range; communication is possible; router usage is recommended
Bricks	Medium	Walls	Partial loss of range; communication is possible; router usage is recommended
Plaster	Medium	Partitions	Partial loss of range; communication is possible; router usage is recommended
Ceramic	High	Tiles	Significant impact on range; communication is unlikely or very sporadic; router usage is strongly recommended
Paper	High	Rolls of paper	Significant impact on range; communication is unlikely or very sporadic; router usage is strongly recommended
Concrete or stone	High	Load-bearing walls, floors, pillars	Significant impact on range; communication is unlikely or very sporadic; router usage is strongly recommended
Bulletproof glass	High	Bulletproof windows	Significant impact on range; communication is unlikely or very sporadic; router usage is strongly recommended
Metal	Very high	Reinforced concrete, mirrors, metal cabinet, elevator cage	Major impact on range; communication is highly unlikely; router usage is required

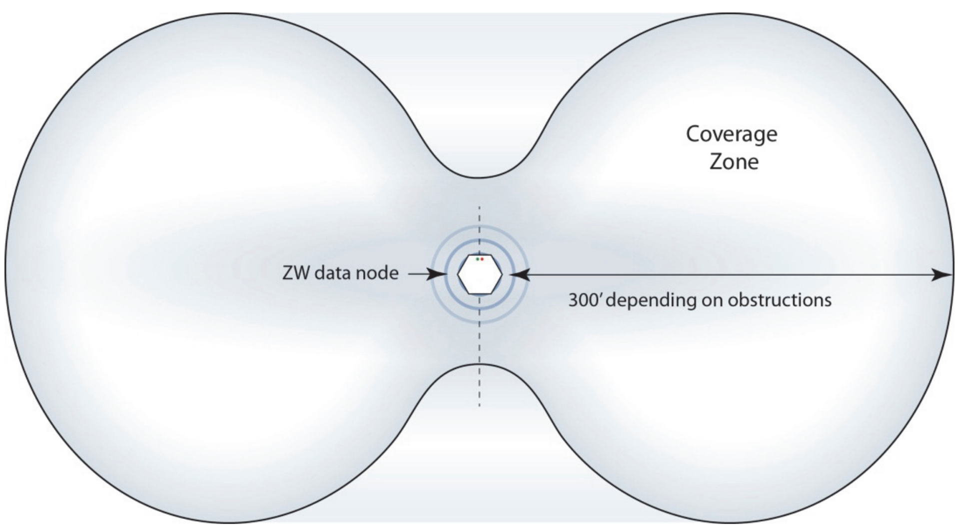
Note that walls of the same thickness may be constructed with different materials, which can impact the signal strength. Routers are recommended instead of relying on communication through a wall.

Signal Pattern

The communication path between nodes is also affected by the spatial patterns of the wireless signal itself. The following diagrams show the coverage area in a wireless signal emanating from the node.



Signal Pattern from a Node: 3D View



Signal Pattern from a Node: Top View

Each ZW node is packaged with a mounting bracket, which allows you to orient it to facilitate the node-to-node communication within the ZW network. Although the wireless signals are nearly omnipresent within the 300-foot communication range, the natural signal trajectories are such that, in rare cases, a neighboring node might be in an area outside the coverage zone. A minor change in orientation with the mounting bracket can help ensure that a neighboring node falls in the coverage zone without the use of an additional router node.

Note: You may find that nodes that were previously communicating occasionally go missing. This is expected for any wireless system. People and objects moving across the communication path between devices can cause nodes to go missing temporarily. A single router node losing its connection can cause multiple nodes to go missing. The system will automatically look for alternate routing paths and re-route the data when a path is found. Until the path is found, the nodes will save the data gathered in their on-board buffer memory.

Sample Network Deployments

The following sections show common network deployments. Use these diagrams to help you determine the best setup for your deployment. Diagrams in this section use the following key:

	Receiver
	Router Node (either dedicated routers or data nodes acting as a data/router node)
	Standalone Data Node (not operating as a router)
	Outlet

Basic Setup

Figure 1 shows an example of a basic setup where all active router nodes are plugged into an AC power outlet (recommended) and there are no obstructions. Data from some nodes may pass through other nodes to reach the receiver.

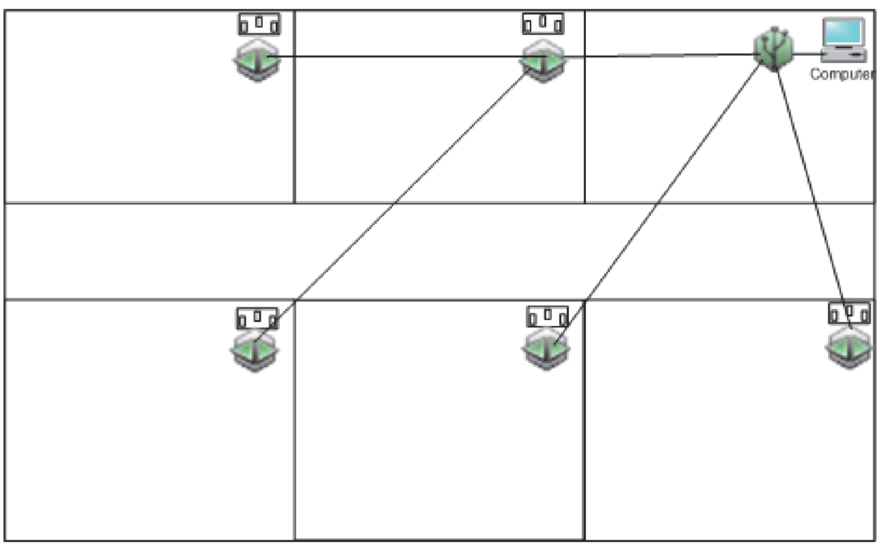


Figure 1: Basic Setup

Wall Placement
If you cannot get a connection to the receiver when deploying a node in your desired location, try repositioning the node, as shown in Figure 2.

A. Move the node side to side and up and down until you make a connection to the receiver.

B. Try turning the node on its side, pointing it towards the receiver or active router node with the help of the mounting bracket.

C. Try placing the node on a different wall in the room.

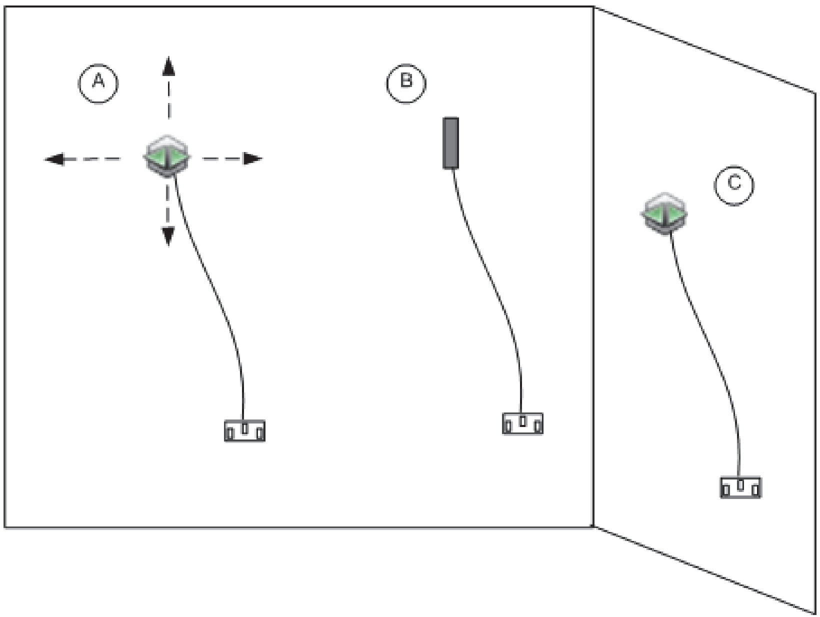


Figure 2: Placing a Data Node on a Wall

Overcoming Obstructions
Figure 3 shows a scenario where there are obstructions between some nodes and the receiver. Node A is placed in a position so that it can connect to the receiver (through active router node D), and also route data from active router node B (behind a metal door) and active router node C (behind an elevator shaft), which are obstructed from connecting directly to the receiver.

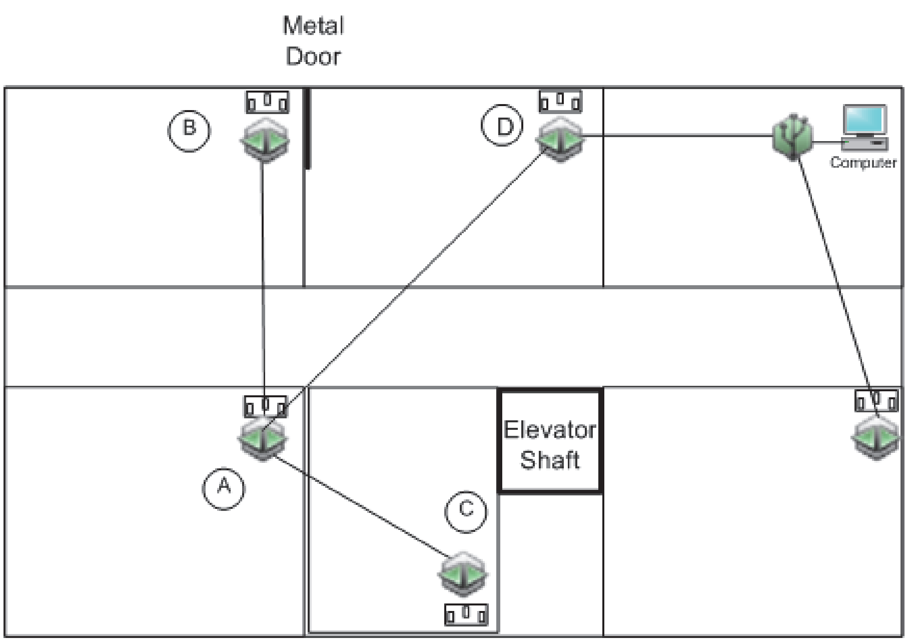


Figure 3: Overcoming Obstructions

Overcoming Distance Limitations

Figure 4 shows a scenario where nodes A and B cannot connect to the receiver due to distance.

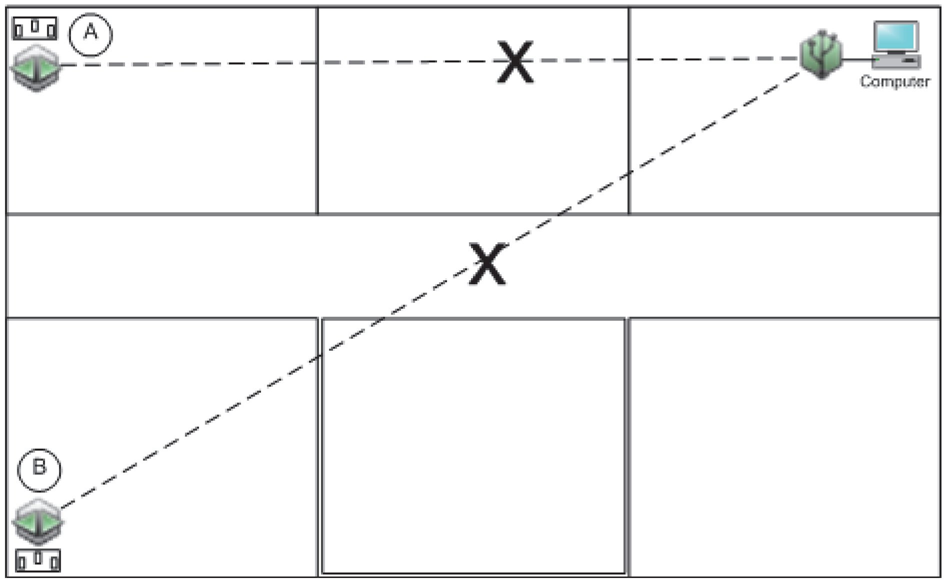


Figure 4: Data Nodes Cannot Connect to the Receiver

Figure 5 shows a router node added specifically to route data from router nodes A and B to the receiver. When you add a router node, position it to maximize the number of nodes it can connect to. Add additional routers if needed.

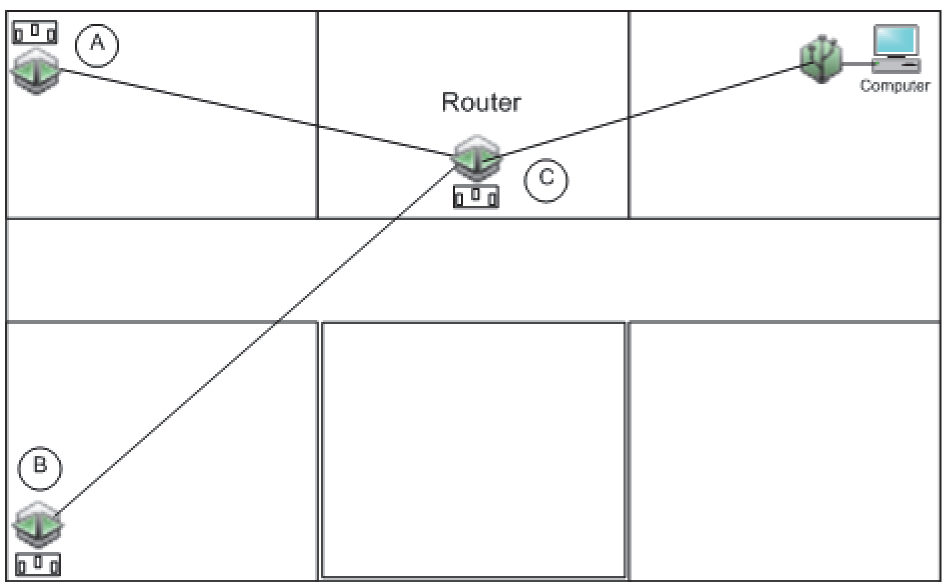


Figure 5: Adding a Router

Backing up a Critical Node

In Figure 6, node D is in a critical path between three other active router nodes and the receiver. If node D goes down, nodes A, B, and C will not be able to connect to the receiver.

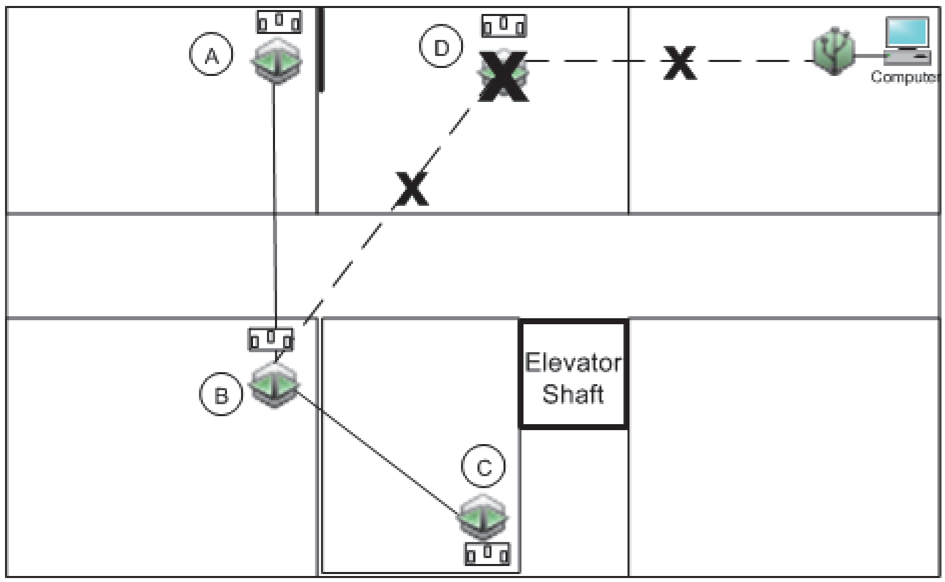


Figure 6: No Redundancy

Figure 7 shows how you can add a router node (node E) to a critical spot in the network to overcome the loss of a node. If node D goes down, node E will continue to route data from nodes A, B, and C.

Make sure the additional router node is in a slightly different location as shown here (node E is positioned away from node D). This helps to prevent against a lost connections due to a signal obstruction.

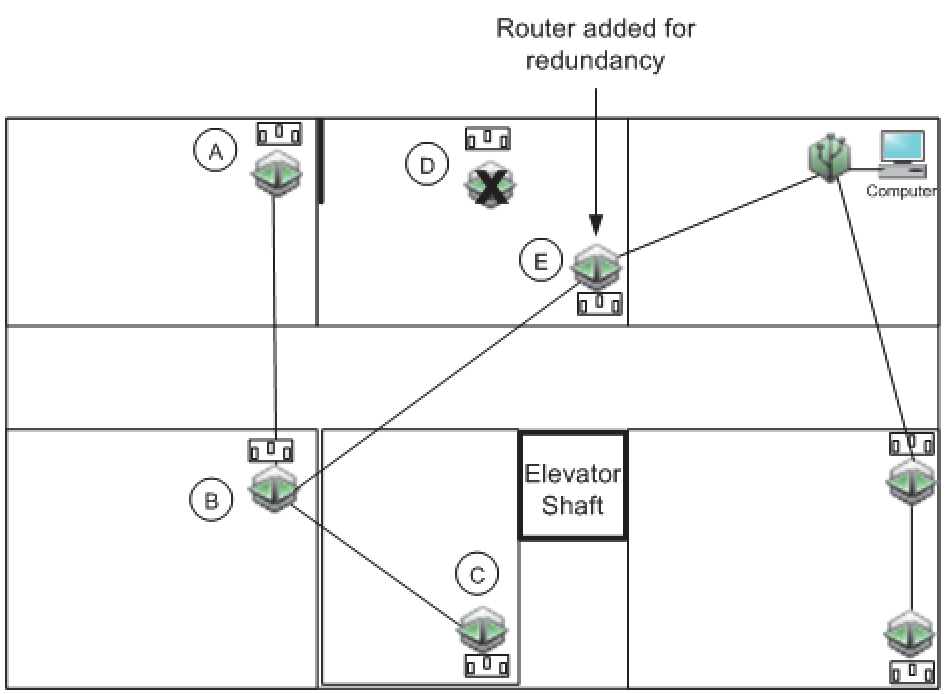


Figure 7: Redundancy

Automatic Rerouting
If a data node loses its signal, a node routing through it will automatically search for a new route to receiver. In Figure 8, active router node A was routing data through active router node B. When node B loses communication with the receiver, node A automatically searches for a new path and routes data through active router node C.

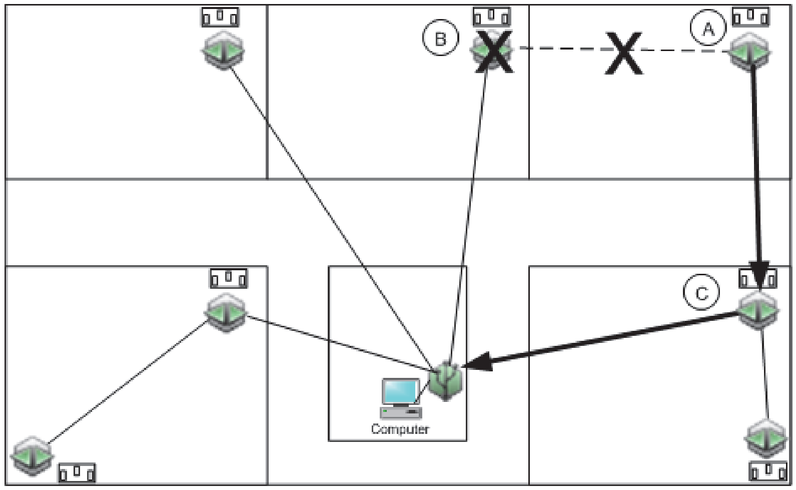


Figure 8: Automatic Rerouting

Non-Routing Data Nodes
Figure 9 shows a scenario where you have a node running on battery power only, and therefore cannot route data from other nodes. If node D was plugged into an AC power outlet, it would be able to route data from active router nodes A, B, and C, which otherwise cannot connect to the receiver due to distance or obstructions. Because node D cannot route data, nodes A, B, and C have no path to the receiver unless a router was added. Adding more routers in your network increases the redundant paths for sending data back to the receiver. This improves the self-healing capability of your network, making it more robust against the signal obstruction at the site.

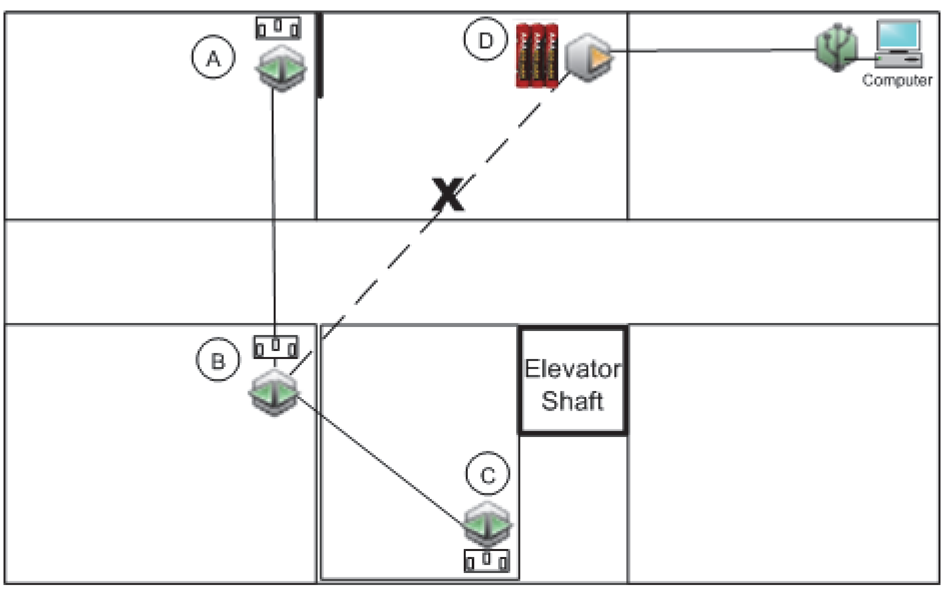


Figure 9: No Routing on a Data Node

Manage the Network

Use the tools in HOBOnode Manager to monitor your network once it has been deployed. Specifically you can:

- Check the device table and real-time plots for the latest readings from each data node.

- Change the logging interval (how frequently the data node records data) or the connection interval (how often the nodes send data back to the receiver).
- Create a map of the nodes (overlayed upon a facility map) in the software so that you can easily keep track of each node and see what corrective actions to take if a router in the network goes down.
- Set up alarms to notify you that the network is operational (a heartbeat alarm) or that a node is missing or has a low battery. You can also configure sensor alarms to trip when a reading is above or below a specific level or range.
- Configure data delivery, which automatically sends the latest readings to your email, an FTP site, or a shared folder.
- View the information on an internal website if the computer is part of a local area network. This can also be helpful while setting up the network because you can check the node status on other computers in the building besides the one connected to the receiver.

Refer to the online help in HOBOware or the *HOBOware User's Guide* on onsetcomp.com for details on these and other HOBOnode Manager features. See the Enabling Web Viewer topic for help with setting up an internal website.

Reference: LED Patterns

The LEDs on nodes blink in various patterns depending on the current status or action. Refer to the following table for details on each LED pattern.

LED Pattern Does This:	**When:**
Blinks **GREEN** every 5 seconds	Node is ACTIVE (on the network)
Blinks **RED** every 5 seconds	Node is MISSING (off the network)
Blinks **RED** and **GREEN** twice simultaneously	Node is transmitting data
Receiver: Blinks **RED** and **GREEN** continuously Router node: Alternating **RED** and **GREEN** blink continuously, then blinks **GREEN** twice, then both are continuously lit Data node: Alternating **RED** and **GREEN** blink continuously, then blinks **GREEN** every 5 seconds	Receiver is forming a new network Node is looking for a network to join
Receiver or router node with **RED** and **GREEN** continuously lit (no blinking)	Devices already on the network are looking for new nodes to join the network
Alternating **RED** and **GREEN** blinks for 2 minutes, then **RED** blinks continuously	Node could not join network because the receiver is out of range or there is interference.
GREEN blinks rapidly 10 times, then **RED** blinks rapidly 10 times, then both turn off	The button was pressed on the node to add it to the network, but the node did not enter Join Network mode. Try pressing the button again.
RED and **GREEN** blink simultaneously for 5 seconds, then blinks **RED** for 5 seconds, then both blink once, then both turn off	Node is initially powered using a wall outlet. **Note**: If you unplug the data node and then plug it back in within 30 seconds, there will be no LED indication.
GREEN blinks for 5 seconds, then **RED** blinks for 5 seconds, then both turn off	Node is initially powered using batteries only
RED and **GREEN** blink simultaneously for 5 seconds, then **RED** for 5 seconds, then **GREEN** once, then turn off	Node is initially powered using a wall outlet
RED blinks 10 times, then **RED** and **GREEN** stay on for several seconds, then both turn off	Node is removed from the network

FCC Compliance

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

Changes or modifications not expressly approved by Onset Computer Corporation could void the user's authority to operate the equipment.

To comply with FCC and Industry Canada RF radiation exposure limits for general population, the HOBO data nodes, receivers, and routers must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Canada

This device has been designed to operate with the antenna listed below, and having a maximum gain of 1 dB. Antennas not included in this list or having a gain greater than 1 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Approved antenna: Johanson Technologies P/N 2450AT45A100 1.0 dBi chip antenna

FCC Declaration of Conformity

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