

# Wireless Sensor Installation Guide



Nietzsche Enterprise Co., Ltd.

1978

V1.0

# Wireless Sensor Installation Guide

**■ Preface : What should I do when the communication quality of the wireless sensor is bad?**

When you are installing the wireless sensor, if you discover that the sensor cannot effectively connect to the wireless server, or if you are frustrated by network communication interruptions, possible causes of these phenomenon and the possible remedies will be explained below for installers' reference.

Wireless interference usually comes from three sources :

1. Wireless signals are blocked by walls, floors, or large furniture items.
2. Interfered by other wireless communication equipment with the same communication protocols
3. Affected by nearby devices producing other wireless signals in the same or different frequency bands

**■ What are the signs of wireless device interference? If your device encounters any of the above three interference sources, you may find your device's communication quality to be unstable. In other words, your network may be sometimes OK, sometimes not, or the network may be disconnected without warning. Besides, the return signal is very slow, or the signal is very weak. These circumstances may be reflected on the user interface as network disconnection.**

## NOTE

- ☞ For your wireless sensor, find the best installation spot by considering the communication range and the construction conditions of the installation site.
- ☞ Do not install NHR wireless sensors (except waterproof series models) in outdoor locations that are subject to water splash. If the installation involves communications among different buildings or different floors, an optimal number of routers must be used for improving communication quality to avoid communication instability.
- ☞ Metal objects and wallpapers with metal elements can affect wireless signal transmission. After installing your wireless sensor, please test your sensor's alarm function with the metal door opened and closed to ensure the effectiveness of the installation.



# Wireless Sensor Installation Guide

Below is the detailed explanation of frequently encountered interference types and some improvement plans for helping installers to find the best connection mode and to improve communication quality. The barrier and shielding effects of building structures, formed by doors, walls, and floors, can affect wireless communication significantly. Some of the commonly used building materials, such as wood and glass, have no significant effect on wireless signal transmission. However, there are some sturdy building materials, such as concrete, bricks, steel bars, or some metal composite materials, which can have significant impact on wireless signal transmission, resulting in the outgoing signal trapped in the room and cannot be sent out.

**Solution:** In this situation, you can simply move the wireless sensor to a new location without moving it to another room. Maybe you can see signal improvement with just two to three meters of sensor location migration. Some sensors or end devices use directional PCB antennas. For these devices please orient them toward the router or the coordinator/coordinator. Some sensors or end devices have external antennas, whose locations and orientations can be adjusted to get the best transmission mode.

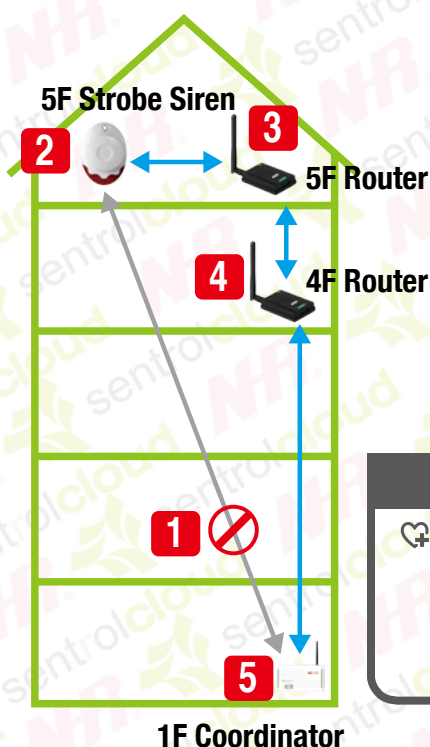
There are several factors that can reduce device transmission range at home:

1. Number of floors
2. Number of rooms and room floor areas
3. Furniture materials and shape
4. Materials and structures of buildings or apartments
5. Materials and design of drop ceilings and ceiling tiles
6. Fire hydrant pipelines, water pipes, gas pipes, and electrical wiring pipelines
7. Large electrical appliances with metal materials
8. Metal plates including metal wallpapers and metal heat insulation films
9. Large fish tanks, swimming pools, etc.

If wireless sensors or end devices are too far away from the wireless coordinator or the router, these devices cannot have stable communications with the coordinator or router.

As listed below, there are several ways to effectively improve wireless communication problems:

1. Move the wireless device closer to the coordinator or router.
2. Add a router at a crucial spot.
3. Adjust the router's antenna direction. Vertical direction is more suitable for communications within the same floor. Horizontal direction is more suitable for communications among different floors.
4. Use high-gain antennas for the router or the wireless coordinator.



- 1 The strobe siren on 5F is too far away from the wireless coordinator and is therefore unable to connect to the wireless coordinator normally.
- 2 Reorient the strobe siren on the 5F according to its antenna's wireless signal pattern (Appendix I) so that the strobe siren's left side faces toward the router on the same floor. Minimize the distance between the siren and the router for better communication quality.
- 3 For the router on 5F, because the wireless signal from the sensor (strobe siren) on the same floor cannot reach the wireless coordinator on 1F, the router is placed on the same floor to help relaying the sensor's signals to the wireless coordinator.
- 4 The router on 4F is dedicated for vertical signal transmission. Therefore its antenna is oriented horizontally to maximize its vertical communication distance.

## NOTE



This (4F) router is not absolutely necessary. It depends on whether signal transmission is noticeably improved after adding the 5F router. If signal transmission is not improved, then go ahead and add this (4F) router. The router placement principle is to be near devices with weak transmission range and not the exact center between two communication devices. In this example, the router should be placed near the strobe siren.

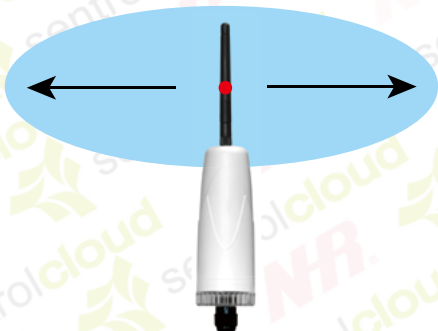
- 5 The coordinator on 1F uses an external antenna, whose optimal orientation can be set according to environmental conditions. A high-gain antenna can also be used for even better communication quality.

# Wireless Sensor Installation Guide

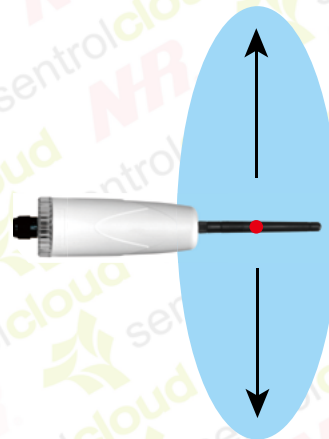
## NOTE

♥ A router using an USB power adaptor can be plugged directly to an AC outlet via the adaptor without requiring extra power lines. Or you can choose a DC-input router and provide an AC power line with AC outlets, reducing construction hassles.

### ♥ Antenna Directions and Applications



When the antenna is vertical, it will have the longest horizontal communication range. This antenna orientation is most suitable for communication within the same floor.



When the antenna is horizontal, it will have the longest vertical communication range. This antenna orientation is most suitable for communication among different floors.

## 2. Interference from other wireless communication equipment with the same communication protocols

In the ZigBee communication bands there are 16 channels to choose from. Usually when the wireless gateway is establishing connection with a wireless device, a channel with less interference will be used, and that channel will not be changed once the connection is established. In this situation, when a new device nearby uses the same communication channel, interference can easily occur. This phenomenon can be very easily discovered in cities or buildings with many wireless devices.

**Solution:** An NHR wireless sensor with the ability to automatically search for the less interfered communication environment, along with the NHR-exclusive Multiple Beacons Mechanism. Therefore when there are many packets to transmit across the sensor's communication channel, multi-packet mechanisms can be used, sending out many packets at one time to increase transmission success.

If the transmission instability still persists, you can use tools to monitor and analyze channel congestion to decide whether or not a manual channel change is necessary to improve connection.



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## NOTE

- ♥ For networking please first join the wireless sensor to the wireless coordinator before conducting physical installation.
- ♥ For NHR wireless sensors in the open-space environment, the normal communication range among devices is usually around 100 meters. However, due to various room partition types in home design, the communication range can still reach 15 meters without metal barriers.
- ♥ For the communication environment across different vertical floors, at least one router with external antenna(s) is recommended for each floor to ensure the best communication quality.

3. The application site can be affected by devices with the same or different wireless communication bands. In the communication environment, there can often be 2.4GHz equipment, such as Wi-Fi and Bluetooth devices, that can cause mutual interferences. Concurrently, some electronic equipment can emit electromagnetic waves large enough to affect wireless communications, and even some wired sensors can be affected to output erroneous messages. Some examples of such devices are wireless communication equipment, air conditioning compressors, wireless video systems, microwaves, and even some televisions that still use some electrical power in standby mode, which can cause short-distance wireless interference.

### Solution:











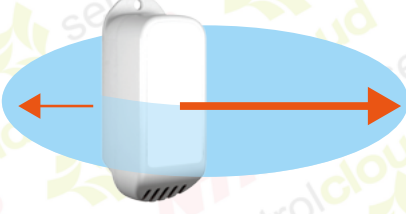
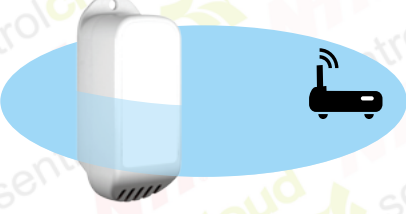
NHR wireless sensors or end devices usually use the 2.4GHz frequency bands for communication and therefore can potentially be affected by other wireless equipment using the same 2.4GHz frequency bands. You can reduce interference by reducing, removing, moving away, or powering off devices listed below, or you can use a spectrum analyzer (Appendix II) to find the optimal communication channel and change your devices manually to use that channel:

- 1) Cordless phones
- 2) Extra Bluetooth devices or Wi-Fi devices
- 3) Baby Monitors
- 4) 2.4GHz Wireless Video Equipment

# Wireless Sensor Installation Guide

## Appendix I:

For wireless sensors and end devices' wireless signal patterns and installation, the installer can reference each sensor's wireless signal pattern and then reorient the sensor to aim toward the coordinator or the router, thereby achieving optimal wireless communication.

Product	Antenna Pattern	Installation Recommendations
<b>STH-01ZB</b>  <div> <div>E</div> <div>R</div> </div>	 <p>Wireless signal pattern bias: Omnidirectional in the horizontal plane</p>	 <p>Coordinator/router can be placed anywhere horizontally*</p>
<b>STH-03ZB</b>  <div> <div>E</div> </div>	 <p>Wireless signal pattern bias: Directly in front of the device</p>	 <p>Best to place the coordinator/router in the front</p>
<b>STH-M02ZB</b>  <div> <div>E</div> <div>R</div> </div>	 <p>Wireless signal pattern bias: Directly in front of the device</p>	 <p>Best to place the coordinator/router in the front</p>
<b>S07-TH</b>  <div> <div>E</div> </div>	 <p>Wireless signal pattern bias: Directly in front of the device</p>	 <p>Best to place the coordinator/router in the front</p>

\*For wireless communication among different floors, the antenna can be oriented horizontally for better signal penetration among different floors.



End Device



Router



Coordinator



Coordinator




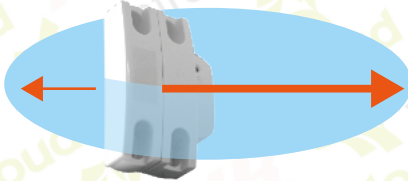










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## Appendix I (continued):

For wireless sensors and end devices' wireless signal patterns and installation, the installer can reference each sensor's wireless signal pattern and then reorient the sensor to aim toward the coordinator or the router, thereby achieving optimal wireless communication.

Product	Antenna Pattern	Installation Recommendations
<b>WZB-SMG02</b>  <b>E</b>	 Wireless signal pattern bias: Directly in front of the device	 Best to place the coordinator/router in the front
<b>WZB-SGB02</b>  <b>E</b>	 Wireless signal pattern bias: Directly in front of the device	 Best to place the coordinator/router in the front
<b>WZB-SPM03</b>  <b>E</b> <b>R</b>	 Wireless signal pattern bias: The device's right side	 Best to place the coordinator/router on the right side
<b>WZB-SPM05</b>  <b>E</b>	 Wireless signal pattern bias: Directly in front of the device	 Best to place the coordinator/router in the front

**E** End Device

**R** Router





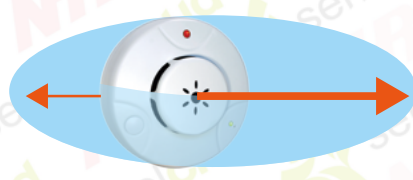





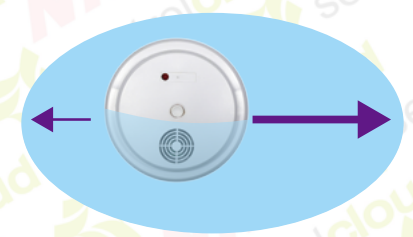
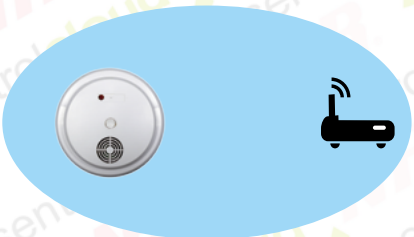
**C** Coordinator

 Coordinator

# Wireless Sensor Installation Guide

## Appendix I (continued):

For wireless sensors and end devices' wireless signal patterns and installation, the installer can reference each sensor's wireless signal pattern and then reorient the sensor to aim toward the coordinator or the router, thereby achieving optimal wireless communication.

Product	Antenna Pattern	Installation Recommendations
<b>SG-01 Series</b> 	 Wireless signal pattern bias: Directly in front of the device	 Best to place the coordinator/router near the direct front
<b>SG-02 Series</b>  <div style="position: absolute; bottom: 10px; right: 10px; border: 1px solid black; padding: 2px;">E R</div>	 Wireless signal pattern bias: Directly in front of the device	 Best to place the coordinator/router near the direct front
<b>SGS-920</b>  <div style="position: absolute; bottom: 10px; right: 10px; border: 1px solid black; padding: 2px;">E R</div>	 Wireless signal pattern bias: The device's right side	 Best to place the coordinator/router near the direct front
<b>SSM-706</b>  <div style="position: absolute; bottom: 10px; right: 10px; border: 1px solid black; padding: 2px;">E</div>	 Wireless signal pattern bias: The device's right side	 Best to place the coordinator/router on the right side















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## Appendix I (continued):

For wireless sensors and end devices' wireless signal patterns and installation, the installer can reference each sensor's wireless signal pattern and then reorient the sensor to aim toward the coordinator or the router, thereby achieving optimal wireless communication.

Product	Antenna Pattern	Installation Recommendations
<b>RC-02</b>  <b>E</b>	 <b>Wireless signal pattern bias:</b> On top of and directly in front of the device	 <b>Best to place the coordinator/router in the front</b>
<b>A10</b>  <b>E</b> <b>R</b>	 <b>Wireless signal pattern bias:</b> The device's right side	 <b>Best to place the coordinator/router on the right</b>
<b>A11</b>  <b>E</b> <b>R</b>	 <b>Wireless signal pattern bias:</b> On top of and directly in front of the device	 <b>Best to place the coordinator/router in the front</b>
<b>A08-RL</b>  <b>E</b> <b>R</b>	 <b>Wireless signal pattern bias:</b> Directly in front of the device	 <b>Best to place the coordinator/router in the front</b>

**E** End Device

**R** Router

**C** Coordinator

 Coordinator

# Wireless Sensor Installation Guide


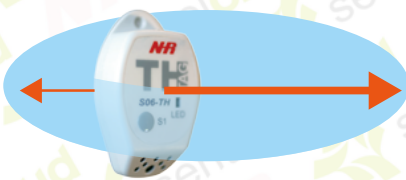








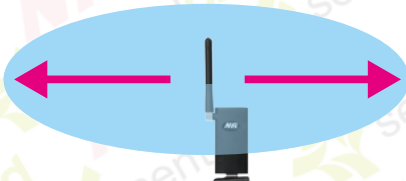

10

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## Appendix I (continued):

For wireless sensors and end devices' wireless signal patterns and installation, the installer can reference each sensor's wireless signal pattern and then reorient the sensor to aim toward the coordinator or the router, thereby achieving optimal wireless communication.

Product	Antenna Pattern	Installation Recommendations
<b>S06 Series</b>  <b>E</b>	 Wireless signal pattern bias: Directly in front of the device	 Best to place the coordinator/router in the front
<b>WZB-02485R</b>  <b>C</b> <b>E</b> <b>R</b>	 Wireless signal pattern bias: Omnidirectional in the horizontal plane	 Coordinator/router can be placed anywhere horizontally*
<b>WZB-01USB Series</b>  <b>C</b> <b>R</b>	 Wireless signal pattern bias: Omnidirectional in the horizontal plane	 Coordinator/router can be placed anywhere horizontally*
<b>WZB-01USBR</b>  <b>R</b>	 Wireless signal pattern bias: Omnidirectional in the horizontal plane	 Coordinator/router can be placed anywhere horizontally*

\*For wireless communication among different floors, the antenna can be oriented horizontally for better signal penetration among different floors.

**E**

End Device

**R**

Router

**C**

Coordinator



# Wireless Sensor Installation Guide








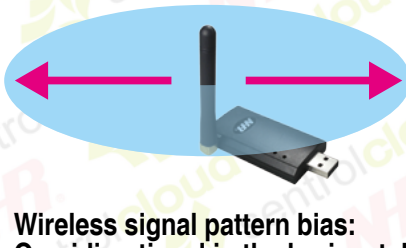




11

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## Appendix I (continued):

For wireless sensors and end devices' wireless signal patterns and installation, the installer can reference each sensor's wireless signal pattern and then reorient the sensor to aim toward the coordinator or the router, thereby achieving optimal wireless communication.

Product	Antenna Pattern	Installation Recommendations
<b>S05 Series</b>  <div> <div>E</div> <div>R</div> </div>	 <p>Wireless signal pattern bias: Omnidirectional in the horizontal plane</p>	 <p>Coordinator/router can be placed anywhere horizontally*</p>
<b>WZB-05ET Series</b>  <div> <div>C</div> </div>	 <p>Wireless signal pattern bias: Omnidirectional in the horizontal plane</p>	 <p>Coordinator/router can be placed anywhere horizontally*</p>
<b>A09</b>  <div> <div>E</div> <div>R</div> </div>	 <p>Wireless signal pattern bias: Omnidirectional in the horizontal plane</p>	 <p>Coordinator/router can be placed anywhere horizontally*</p>
<b>G07 Series</b>  <div> <div>C</div> </div>	 <p>Wireless signal pattern bias: Omnidirectional in the horizontal plane</p>	 <p>Coordinator/router can be placed anywhere horizontally*</p>

\*For wireless communication among different floors, the antenna can be oriented horizontally for better signal penetration among different floors.

**E**

End Device

**R**

Router

**C**

Coordinator



**Nietzsche Enterprise Co., Ltd. (NHR)**, est. 1978, is an ISO9001 certified manufacturer, has been engaged in wireless communication and power solutions for over 36 years and continues to focus on meeting current and future market needs in Wireless Sensing Network. NHR's design center and factory are in Taipei, Taiwan, with a commitment to solving constraints from wires and cables through delivering intuitive, convenient, reliable, and rapid return on investment wireless solutions to customers. Products and solutions include agriculture, logistics/transportation, energy & water management, security & maintenance, industrial, asset management, and aquatic.

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# Wireless Sensor Installation Guide

## Appendix III: NHR Coordinator Channel Selection

1. **Reset Coordinator:** Press and hold the S1 button over 5 seconds until the red and green LEDs light on simultaneously, then release the S1 button.
2. **Send the following commands to the coordinator:**

41 54 2B 09 08 53 43 00 01 97

- a. 41 54 2B : AT+ (head)
- b. 09 : data length (not include check byte)
- c. 08 : Frame type
- d. 53 43 : "SC" command for setting channel
- e. 00 01 : channel, from 11 ~ 26 Zigbee channel 0x0001 = ch11, 0x8000 = ch16
- f. 97 : check byte = 0xFF – sum(byte0~byte8)

3. **Restart the coordinator.**
4. **Begin to join devices.**

### NOTE



Once a device has been joined to the coordinator, the channel cannot be changed. Therefore the coordinator needs to be clean (reset) before selecting another channel.

# Wireless Sensor Installation Guide

## Appendix IV : Learning Sheet for Wireless Sensor Installation Engineers

1. If the wireless device on 5F cannot send signals to the coordinator on 1F, and the device and coordinator locations are confirmed to be unchangeable, then which floor is the best location for installing a router? (Multiple choice / multiple answers allowed)
- (1) 3F, because this is the midpoint between the device and the coordinator.
  - (2) 5F, because the device's transmission power is weaker than that of the coordinator, here a router is used to boost the device's transmission.
  - (3) 1F, because the wireless coordinator concurrently receives signals from many devices. Being closer to the coordinator means being more capable to receive signals from other devices.

【 Answer(s) : (2) 】

2. If the wireless device cannot send signals to the router or the coordinator on the same floor, how can this problem be solved or reduced? (Multiple choice / multiple answers allowed)
- (1) Move the wireless device as close to the router or coordinator as possible, minimizing communication distance.
  - (2) Understand wireless device's wireless signal pattern and adjust the device orientation accordingly to achieve the best communication orientation.
  - (3) Adjust the antenna(s) of the router and the wireless coordinator; vertical antennas are most suited for horizontal communications within the same floor.
  - (4) Add high-gain antennas or external antennas on the router or the wireless coordinator.

【 Answer(s) : All of the above 】

3. When adding a router, the signal is often interrupted after going through too many floors. How can the router's transmission be improved? (Multiple choice / multiple answers allowed)
- (1) Orient the antenna horizontally.
  - (2) Orient the antenna vertically.
  - (3) Use high-gain omnidirectional antenna(s).

【 Answer(s) : (1) and (3) 】

4. If adding a router is not possible in the vicinity of a wireless device with an exchangeable antenna, how can the transmission be improved? (Multiple choice / multiple answers allowed)

- (1) Use a directional antenna and aim the antenna's signal pattern toward the wireless coordinator
- (2) Use an external antenna with the same signal gain and move that antenna as close to the wireless coordinator as possible.
- (3) Use a high-gain omnidirectional antenna.

【 Answer(s) : All of the above 】

5. Before installing a wireless device, which tools and what kinds of information can be used for determining the best installation location and communication quality? (Fill in the blanks.)

【 Answer(s) :

- (1) Understand the wireless device's wireless signal pattern and find the best location accordingly.
- (2) Use a range tester to simulate communication quality.
- (3) Use a spectrum analyzer to analyze the interference extent of the communication channel and the frequency band, and then select the channel with the least amount of interference.
- (4) In the installation site involving multi-floor wireless communications, find the power supply location in advance to find the spot for installing the router.
- (5) Read the installation guide thoroughly, ensuring that the installers understand the characteristics of the wireless devices and the installation site. ]



# Wireless Sensor Installation Guide

**6. Which devices/equipment/facilities will NOT affect wireless communications? (Multiple choice / multiple answers allowed)**

- (1) Wood and standard glass material
- (2) Wallpaper with metallic materials
- (3) Metallic cubicles or large metallic equipment, such as a rectangular refrigerator
- (4) Concrete walls
- (5) Large water walls or fish tanks

**[ Answer : (1) ]**

**7. Which sequence of wireless device installation steps is correct? (Multiple choice / multiple answers allowed)**

- (1) Site survey > Join the device to the coordinator > Physically install the device and the coordinator in the application site.
- (2) Site survey > Physically install the device and the coordinator in the application site > Join the device to the coordinator.
- (3) Join the device to the coordinator > Site survey > Physically install the device and the coordinator in the application site.

**[ Answer(s) : (1) ]**

**Explanation 1 to the correct answer:** Site survey precedes device join because any necessary router(s) and installation locations need to be determined first to avoid continuously adding redundant routers.

**Explanation 2 to the correct answer:** Device join precedes physical installation because if the device and the coordinator are physically installed first, the device may fail to join the coordinator due to physical distance and barrier problems.

**8. When the application site owner requests repairs with complaints, how should the installation engineer(s) respond? (Multiple choice / multiple answers allowed)**

- (1) Empathize with client's complaints > Explain wireless characteristics > Let the client propose improvement plan(s).
- (2) Empathize with client's complaints > Do not explain wireless characteristics > Let the installation engineer(s) propose improvement plan(s).
- (3) Empathize with client's complaints > Explain wireless characteristics > Let the installation engineer(s) propose improvement plan(s).

**[ Answer(s) : (3) ]**

**9. Continuing from the last problem, what are the five improvement plans that the installation engineer(s) can explain to the client? (Fill in the blanks.)**

**[ Answer(s) : (1) Reduce some distance between the device and the coordinator.**

- (2) Adjust some antenna angles of the device and the coordinator.
- (3) Add a wireless device with router/extender capability.
- (4) Add a router.
- (5) Re-evaluate the feasibility of using the device in the application site, including evaluation for reducing equipment interferences in the application site. ]

**10. How should installation engineer(s) conduct site survey, and what are the key points of the survey? (Fill in the blanks.)**

**[ Answer(s) : (1) Understand the installation location to fulfill client demand.**

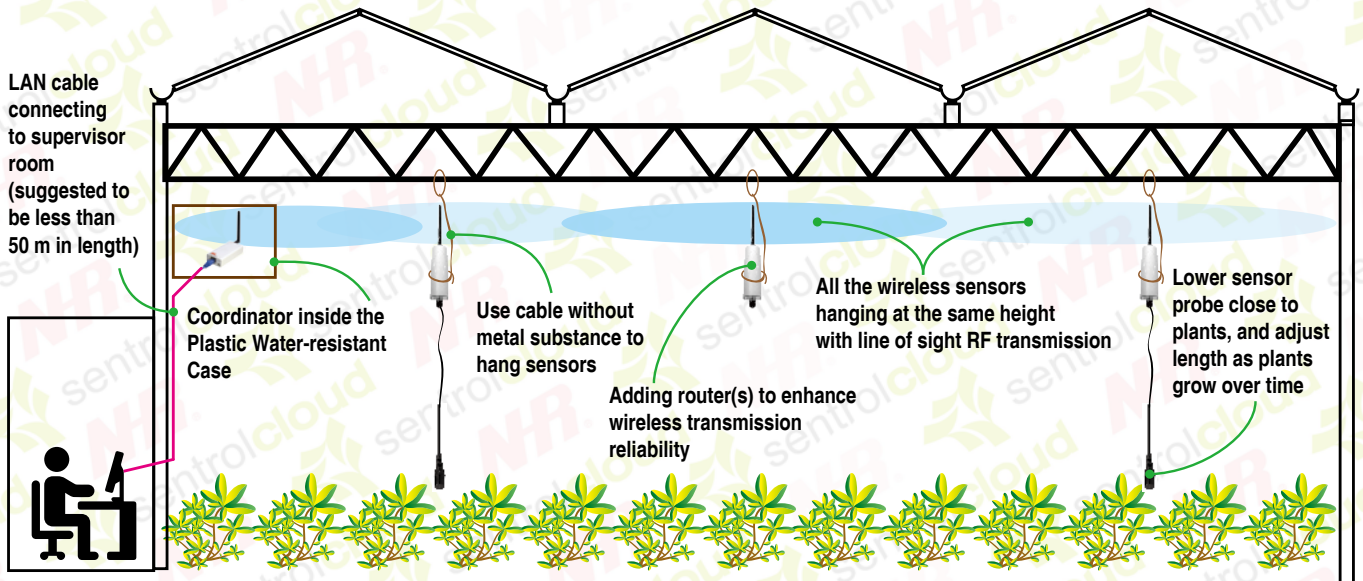
- (2) For the wireless device and coordinator to be installed, observe their relative positions and the distance between these two devices.
- (3) Observe any metal or concrete barriers.
- (4) Observe AC outlet and DC power supply locations for planning possible locations of any additional routers.
- (5) Observe presence of any 2.4GHz communication equipment that can potentially cause interference.

**More interfering equipment means more routers are needed to uphold wireless communication quality. ]**

# Wireless Sensor Installation Guide

## Appendix V : Installation Example for Large Greenhouse Planting

### Wireless Sensor Nodes Deployment Inside The Greenhouse







**Nietzsche Enterprise Co., Ltd. (NHR)**, est. 1978, is an ISO9001 certified manufacturer, has been engaged in wireless communication and power solutions for over 36 years and continues to focus on meeting current and future market needs in Wireless Sensing Network. NHR's design center and factory are in Taipei, Taiwan, with a commitment to solving constraints from wires and cables through delivering intuitive, convenient, reliable, and rapid return on investment wireless solutions to customers. Products and solutions include agriculture, logistics/transportation, energy & water management, security & maintenance, industrial, asset management, and aquatic.

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