

*How to use long-range wireless  
access control and security devices to  
grow your business and profitability.*

# **LONG-RANGE WIRELESS**

**Multi-Mile Wireless  
Access Control and  
Security Devices**

[IntercomsOnline.com](http://IntercomsOnline.com)

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For security and access control dealers there are times when sales are lost simply because a customer doesn't have the budget to pay for the costly installation required to implement a wired system. Or the customer may not even be able to run wires in buildings with historical significance, or across paved areas outdoors.

For pre-existing construction the installation of security and access control devices at building and property entry points can be a challenge. Trenching for outside cabling and routing cable through walls and ceilings of buildings is both messy and expensive.

The use of long-range wireless access control and security devices make installation much easier and therefore much less expensive to install. Using these wireless devices, access problems can be quickly solved in as little as a single day. Installation consists of locating the proper location for a device, mounting it on a pole or wall, and providing power either via an electrical outlet, batteries, or solar power.

These devices consist of wireless base station intercoms and handheld two way radios, wireless call boxes with remote gate opening and keypad capability, long distance motion and vehicle proximity sensors, and there are even wireless public address and remote switch monitoring devices that can work with this system. All devices can communicate at ranges of up to a mile or more with use of external antennas. No FCC license is required, however many devices can also be programmed to work with existing licensed two-way radios.

One of the best benefits of these products is that they not only eliminate the expensive wiring, but they give mobility to monitoring personnel. Personnel no longer have to be tied to a desk to receive calls and alert notices. That means they can be more productive.

These wireless devices are not for use where more complex devices such as networked proximity or biometric card readers are needed, however, if simple, long-range two-way communications and remote gate/door opening with keypad entry will suffice, these solutions work well.

### ***MURS Radio Frequencies***

Up until recently if one of your customers wanted to use a long range wireless solution they had to either use overly crowded non-licensed radios with lots of chatter from kids, or they had to go through the cumbersome process of getting a license from the FCC. For customers who do not have existing two-way radios or who do not have a desire to get an FCC license, there is a relatively new license-free option for them.

Now there is a group of frequencies and products available for them. The FCC released these frequencies in 2000, but there are still few radios available and usage is very light in most areas.

This group of frequencies is called MURS (rhymes with furs), which is short for Multi-Use Radio Service. Any manufacturer can create compatible products for MURS.

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With MURS radios range is measured in miles, not feet. MURS has a power increase of four times that of commonly available unlicensed radios. Unlike these other radios, you can also add a larger or external antenna to improve range. The antenna can be mounted as high as 60 feet.

MURS has 5 channels and 38 privacy codes enabling you to pick up only conversations from radios transmitting your privacy code.

If you have existing licensed two-way radios, most of the devices talked about here are available in licensed VHF and UHF frequencies as well.

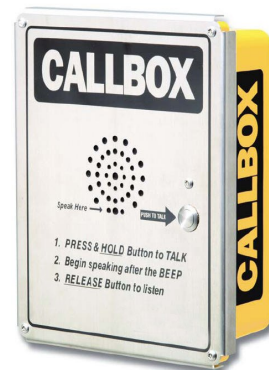
## Product Applications

Below are example applications where these products have been used.

### ***Wireless Security Gate Intercom***

A wireless security gate intercom provides long range, 2-way voice communication to a two-way radio or wireless intercom. They can be used to open gates or doors from remote locations, which means monitoring personnel do not have to be confined to a desk. These intercoms are also called "wireless call boxes" and are essentially long-range two-way radios in a water and vandal resistant case with some added features. There are no air-time or telephone service fees with these systems.

A wireless gate intercom makes it possible to quickly implement a communication system without expensive and messy trenching. These gate opening intercoms have a range of up to a mile, or even further with use of external antennas.



These call boxes use either UHF or VHF frequencies to communicate over long range. Most of these wireless frequencies require an FCC license, but the VHF version has the unlicensed MUR frequencies as well. These call boxes can be programmed to be compatible with virtually any brand of VHF or UHF business band radio.

If the gate application requires unlocking a gate or door from a remote location, then a call box with a relay that can be controlled by pressing a button on a [wireless intercom](#) or two-way radio with the 2-tone encode feature is needed. A callbox with an entry keypad is also available that enables people to enter a code at the call box to open the gate or door. In addition to opening a gate or door, the callbox relay could be used to activate a switch output that turns on a light, sounds an alarm, or any application where remote control of an On/Off switch is required.

The callbox relay can be programmed to operate in several ways:

- **On/Off Code:** The switch will close when a preprogrammed code is received, and open when it is received again. The switch will also open by itself when the Callbox's preprogrammed Automatic Turn Off feature is activated.
- **Switch On When Called:** The switch closes when the callbox first receives the call and it remains on until its Talk button is pressed, or a programmable timer expires (1-255 seconds).
- **Switch On When Callbox In Use:** The switch will close when the Callbox first sends or receives a call and remains closed until a preprogrammed timer expires.
- **Switch On When Active Includes Turn-Off Code:** Switch closes when the Callbox sends or receives a call with the added ability to open the switch when the Callbox receives a preprogrammed code.
- **Momentary Close:** Switch will close for 1-255 seconds when a preprogrammed code is received.
- **Alternate Open and Close:** Switch will toggle between open and closed when it receives a preprogrammed code. The Callbox transmits a single beep when open and a double beep when closed.

There is a version of this callbox that also can store recorded messages. This callbox can play a message when someone presses its button. This could be a message that gives the caller specific instructions on what to do. These units can also send a second and different voice message alert to the monitoring central location or portable radios. This message could give the call boxes location or it could be an emergency message of some type.

There can be a total of 5 event messages as follows:

- **Greeting Message:** This message plays when a user presses the Talk button on the Callbox. You can use it to record instructions for the user to follow such as "*Welcome to our facility. An attendant will be with you shortly.*"
- **Identification (ID) Message:** The ID message is transmitted automatically when the Talk button is first pressed. This message identifies which Callbox has been activated. A typical message might be, "*South delivery entrance*" or "*Main Gate.*" The message will be retransmitted every time the Callbox is pressed until it is answered. If the Greeting Message is used, the ID message is transmitted after the greeting is played. The ID message can be periodically until the Callbox is answered. It is also sent ahead ahead of a Sensor Detect or Low Battery/Power Fail messages.
- **Low Battery/Power Fail Message:** This message is automatically transmitted when low voltage is detected on the Callbox. The message may say something like "*Power failure*" or "*Low Battery.*" The ID Message is sent immediately before this message.
- **Sensor Detect On Message:** This message is automatically transmitted when a switch attached to the Sensor Input is closed. A typical message may be something like, "*Door opened,*" "*Motion detected,*" or "*Vehicle present.*" The ID Message is sent immediately before this message. A typical message may be something like, "*Main Gate,*" "*Vehicle present.*"
- **Sensor Detect Off Message:** This message is automatically transmitted when a switch attached to the Sensor Input is opened. A typical message may be something like, "*Door opened,*" "*Motion detected,*" or "*Vehicle present.*" The ID Message is sent immediately before this message.

If no AC power is available at the gate, these callboxes can be powered by six D-cell batteries or by a solar power system. If AC is available, an optional AC to DC 12 volt transformer is available.

If several callboxes are in use and the location of the unit calling needs to be known, a unique numeric identifier can be transmitted to a radio that has the ability to decode this identifier. This is like having a telephone with Caller ID capability. Or if fewer than five callboxes are needed and the five MURS unlicensed frequencies are being used, then separate channels can be assigned for each callbox.

For wireless gate communications, a wireless security gate intercom like the [Callbox XT Outdoor Wireless Intercom](#) offers clear wireless voice communication and remote gate unlocking, quickly, without expensive trenching and monthly air-time fees.

### ***Delivery Door/Loading Dock Intercom System***

Many industrial, retail, and other businesses have delivery doors or docks where the delivery companies drop off packages, inventory, and supplies. If these doors are locked, they usually have a doorbell to alert personnel of a delivery. Or they remain unlocked so delivery people can enter.

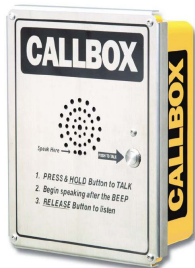


The problem with having a doorbell, or nothing at all, is that personnel don't always hear the ringing or knocking, or by the time they can respond the impatient delivery person is already pulling away. Then the delivery waits for another day.

For those businesses that leave their delivery doors unlocked so they won't miss deliveries, they leave themselves open to a huge security risk. The loading dock or delivery door in a business, hospital, or college is a portal that exposes an organization to all sorts of risk. Anyone can walk in and have full access to the building. Adding security personnel to monitor the dock is an expensive proposition that is usually not an option.



The solution to both these problems is to lock the delivery doors and provide an intercom system for delivery people to use when making deliveries.



With a ***Callbox XT Outdoor Intercom*** installed by a delivery door, and at least one of the staff carrying a two-way radio, the delivery door can be secured without missing deliveries. Base station intercoms could also be placed on several desktops allowing office personnel to monitor for deliveries as well. Using these wireless intercoms, a business can still get important deliveries without compromising security.

The Callbox XT Outdoor Intercom is a metal and fiberglass box with two-way radio circuitry that enables someone to press a button to call for assistance. Two-way communication can



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occur so personnel can tell the delivery person they are on the way to let them in. If the delivery door needs to be remotely unlocked, a signal can be sent to the callbox to activate a door lock. Then the delivery person can bring the packages in without anyone going to the door.

The benefit of a wireless callbox is that there is no high cost of running expensive cable to the unit. There are also no air-time or telephone service fees to pay. Another benefit is that people monitoring the units can carry handheld radios to communicate with the call box. This enables monitoring personnel to be mobile.



The callbox range can be up to a mile, which can be extended by adding an external antenna.

If existing two-way radios are in use, these callboxes can be programmed to be compatible with virtually any brand of VHF or UHF business band radio.

Using a callbox at the delivery door, base station intercoms on monitoring personnel desks, and hand-held two way radios on mobile personnel, there will never be a reason to miss a delivery again.

### **Wireless Emergency Warning System**

When an emergency occurs on a university or business campus, getting the word out quickly could save lives. While many of these campus environments may already have some type of warning system installed, they are often missing a critical element of an emergency warning system.



Campus emergency notification systems often send text or verbal messages to cell phones, but not everyone carries them, has them turned on, or is paying attention to them. So these devices can't be relied on solely.

Plus there is a time lag while a person enters the message into the system, and a delay in the time the last person receives the message. That delay could be 20 to 40 minutes or more if someone isn't checking their messages. If an off-site hosted system is used, delays can even be higher.

Sirens are also usually used to alert people of an emergency, but a siren can't tell people what type of an emergency it is. Besides that, people are so used to hearing sirens they can have trouble distinguishing a campus warning siren from one use by police, fire, ambulance or even car alarms.



The missing element of many warning systems is a verbal announcement that tells people exactly what the emergency is and what to do about it. The

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cost of implementing such a system is often prohibitive due to the high cost of running wires to install it.

This is where the use of a wireless public address (PA) system in conjunction with existing two-way radios can fit the need. Not only does a wireless PA system eliminate the need for expensive wiring, it also allows security personnel to make announcements no matter where they are. They can be at the scene of an emergency and give immediate updates.

A wireless PA system consists of a long-range receiver unit with antenna that receives transmissions from a mobile or desktop two-way radio, amplifies them, and then sends them to attached PA horn speakers.

The wireless PA is available in UHF and VHF frequencies and can be programmed to work with existing campus two-way radios.

These units strategically placed across a campus enable security personnel to quickly broadcast clear emergency messages and live updates. These real time messages reduce the calls to emergency response personnel who are too busy to be handling dozen of calls from people looking for more information.

If broadcast pre-recorded messages are needed, the Wireless PA system can also be used in conjunction with a [Voice Notification Wireless Monitor](#) device, which is a wireless radio transmitter that reports changes in the status of switches connected to it. When a switch is closed, it transmits a user-recorded voice message to the PA system. It can be used for messages triggered by some device, or a button can be connected to it for manually activated pre-recorded messages.

So whether a natural or manmade disaster occurs such as a tornado or terrorist act, an inexpensive add-on wireless PA system makes sense when an immediate emergency response is needed from a large number of people.

### ***OSHA Employee Emergency Evacuation System***

OSHA's Environmental Health & Safety (EH&S) requirements can be extremely costly to implement, but there are ways to save tens of thousands of dollars on the *employee emergency evacuation system* part of their requirements, which is also known as an employee alarm system.

What is an employee alarm system? According to OSHA's Employee Alarm System standard 29 CFR 1910.165, "An employee alarm system can be any piece of equipment and/or device designed to inform employees that an emergency exists or to signal the presence of a hazard requiring urgent attention."

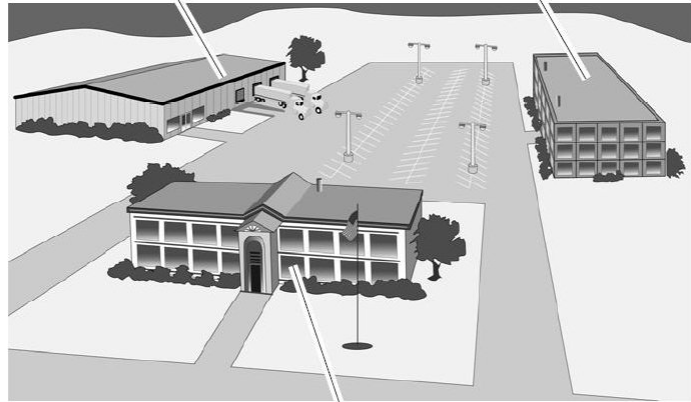
Normally installing an emergency mass notification system to meet this OSHA standard requires running thousands of feet of wire. With the labor cost involved, the cost of installing this wire is significantly more than the cost of the equipment needed for the system.

This cost can be greatly reduced by installing a wireless notification system instead of a wired system. Plus, installation time can be reduced to a day or two for a complete working system.

The heart of the system is a wireless PA (public address) device that is placed around various locations of a building or property. This is what enables personnel to broadcast an emergency message without having to run wires everywhere.

The PA system consists of a receiver unit with antenna that receives transmissions, amplifies them, and then sends them to attached PA horn speakers. Each receiver location can be set to different volume levels depending on the environment.

- Single receiver with 2 speakers.
  - One speaker is located inside the warehouse and the other is located outside for the loading dock.
  - Speaker volume is set to 50% for the warehouse environment.
- Single receiver with 1 speaker.
  - The speaker is located inside the cafeteria area.
  - Speaker volume is set to 25% for the restaurant environment.



Employee Emergency Evacuation System

- Single receiver with 1 speaker.
- The speaker is located inside the Sales office.
- Speaker volume is set to 10% for the office environment.

To activate this emergency notification system, there are a couple of options available. For one, the transmitter sending the message can be in the form of a portable 2-way radio, mobile vehicle radio, or base station intercom that can be used to make live voice announcements from anywhere. These announcements can be used to make guided evacuations or to tell employees to take cover if bad weather is approaching.



The second option is to use a device called the *MURS Voice Notification Wireless Monitor* that broadcasts a previously recorded message when someone presses a button. Two messages can be recorded with two separate buttons to activate them.

Another benefit of a wireless PA system over a wired system is that handheld two-way radios can be used to make announcements. So no matter where emergency personnel are, they can make announcements. Even if they are up to two miles away or more with the use of external antennas. If a wired PA system is already in place, a *Wireless PA System Interface* device is available that will receive transmissions from radios and then broadcast those transmissions over a wired PA system.

These wireless PA units are available in both UHF and VHF frequencies so they can be used with existing two-way radios. The VHF model has several frequencies that do not require an FCC license.



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One more benefit of a wireless system is that the VHF [MURS Wireless PA](#) version of these units can also be programmed to receive automatic transmissions from NOAA Weather Radio so employees instantly know when bad weather is approaching.

The world's leading chemical company, saved money by implementing a system like this. They looked at a wired system and got a quote for about \$70,000 to install the system. Installing this wired system would have required running thousands of feet of wire and the labor cost alone was over \$40,000.

They instead turned their focus to this wireless solution. What they discovered is that not only is the cost of a wireless system far less, but they could install the system in as little as a day or two.

The cost of the wireless equipment they needed was less than \$12,000 versus the \$70K for a wired system. They installed the system themselves so installation cost was also greatly reduced. The result was over \$50K in savings.

So when an employee emergency evacuation system needs to be implemented, a wireless system can be quickly installed without all the hassles and expense of installing a wired system.

### ***Use Wireless Callboxes for ADA Compliance***

No matter what industry a business is in, the American Disabilities Act (ADA) likely has some impact on it. Wheelchair accessibility to a building is one of the more common requirements of the ADA.

If you a business has two public entrances, in most cases, only one must be accessible. When one entrance is not accessible and another entrance is accessible, a sign must provide direction to the accessible entrance. The alternative entrance must be open during store hours.

If the alternative accessible entrance remains locked due to security concerns, an accessible way for notifying staff to open the door must be provided. A wireless callbox provides a good way to alert staff provided it is located on an accessible route and mounted at an accessible height (generally not more than 48 inches above ground).

To assist businesses with complying with the ADA, Section 44 of the IRS Code allows a tax credit for small businesses and Section 190 of the IRS Code allows a tax deduction for all businesses. The tax credit is available to businesses that have total revenues of \$1,000,000 or less in the previous tax year or 30 or fewer full-time employees. This credit can cover 50% of the eligible access expenditures in a year up to \$10,250 (maximum credit of \$5000). The tax credit can be used to offset the cost of undertaking barrier removal and alterations to improve accessibility; providing accessible formats such as Braille, large print and audio tape; making available a sign language interpreter or a reader for customers or employees, and for purchasing certain adaptive equipment. The tax deduction is available to all businesses with a maximum deduction of \$15,000 per year. The tax deduction can be claimed for expenses incurred in barrier removal and alterations.

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Purchasing [wireless callbox](#) equipment could be tax deductible, but you will want to seek advice from a tax accountant on this.

The [MURS Callbox XT Outdoor Intercom](#) is a good choice for this application since it does not require getting an FCC license and it can communicate directly with [two way radios](#) or base station intercoms.

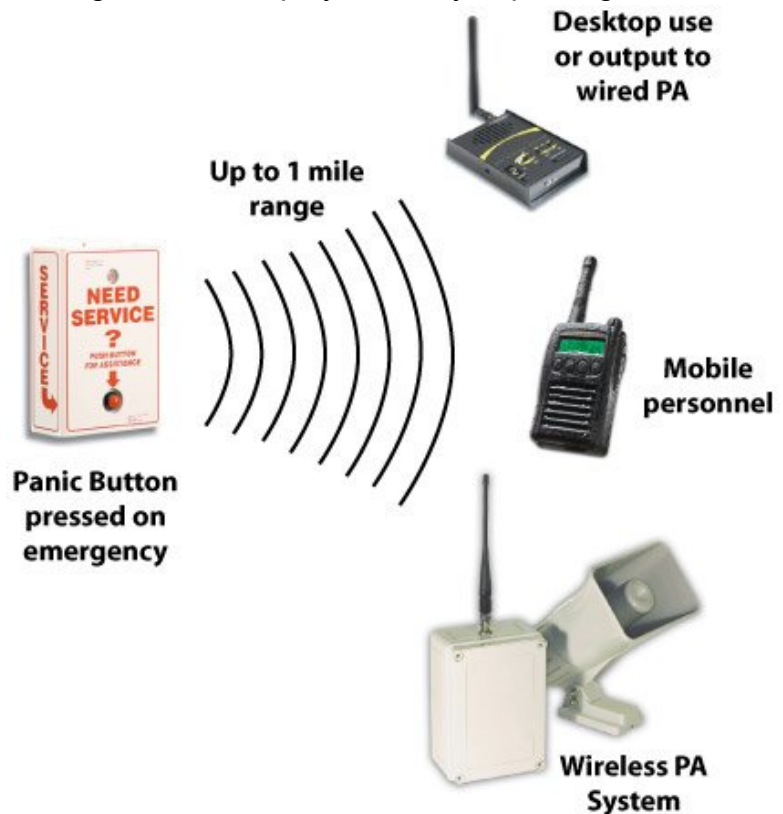
### **Employee Safety in Parking Lots**

Most businesses do a pretty good job of ensuring the safety of their employees within the walls of their business. But what is often neglected in employee safety in parking lots. Parking lots can be prone to accidents and other incidents.

One way to improve parking lot safety is to install wireless callboxes in parking lots so employees can call for assistance.

If an employee's car won't start they can use the callbox to call for jump starting. If a woman notices a van with tinted or no windows parked next to her car, which is a tool sexual predators use, then she can use the callbox to call for an escort. If an accident occurs employees can call for help.

The MURS Callbox XT Outdoor Intercom works well for this application. It can be battery, solar, or AC powered. With a push of a button an employee can reach your security personnel who are on a two way radio or [base station intercom](#).



### **Emergency Notification Call Button**

There are some situations where placing a phone call to notify an emergency response team is just not fast or reliable enough. What is needed is an emergency notification system that just requires a simple press of a button to notify everyone that needs to know.

A chemical manufacturing facility would be a good example of a need for this type of a system. If a chemical spill occurs, there is no time to make several phone calls. Assistance from multiple people is needed immediately.

A [MURS Indoor Customer Service Callbox](#) can be used as a panic button that when pressed sends a recorded message to two-way radios, base-station intercoms, or to a wireless or

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wired public address system. Any voice message or a even a siren sound could be recorded that will play when the button is pressed. If there are multiple areas where a panic button is needed, then a way to distinguish between the recordings is needed so help can be sent to the appropriate area.

The second option for a panic button is to use a device called the MURS Voice Notification Wireless Monitor that broadcasts a previously recorded message when someone presses a button. Two messages can be recorded with two separate buttons to activate them.

If there is no existing PA system, then the [MURS Wireless PA System](#) can receive calls from the callbox without running expensive cabling to install it. If there is already an existing PA system, then a Two Way Radio MURS Wireless PA Interface will interface with it to receive wireless transmissions from the above devices.



No matter what the industry, if there is a situation where an emergency can occur, this system ensures that help occurs rapidly.

### ***How Far Can Wireless Radios Communicate?***

If you're going to sell long-range wireless products, you'll need a basic understanding of wireless frequencies and communication distances, which is covered here.

One of the most common questions people ask when they are in the market for a two-way radio or wireless [intercom](#) is how far do they communicate? Unfortunately asking this question is along the lines of asking, "How far is up?" There are lots of variables involved and no easy, definitive answer. A brief lesson on radio signal transmission is required to understand the whole range issue.

If you are old enough to remember when AM radio was popular you may remember listening to radio stations that were hundreds of miles away. For frequencies like these below 2 Megahertz (MHz), these signals follow the Earth's curvature because they are reflected off the atmosphere. So AM radio signals in low-noise environments can be received by radios that are way below the horizon hundreds of miles away.

The two-way radios and intercoms available for you to purchase usually fall in the frequency range of 150MHz to 900MHz. Unlike the AM radio waves, radio waves in these frequencies travel in straight lines and as a general rule cannot travel over the horizon or behind solid obstacles.

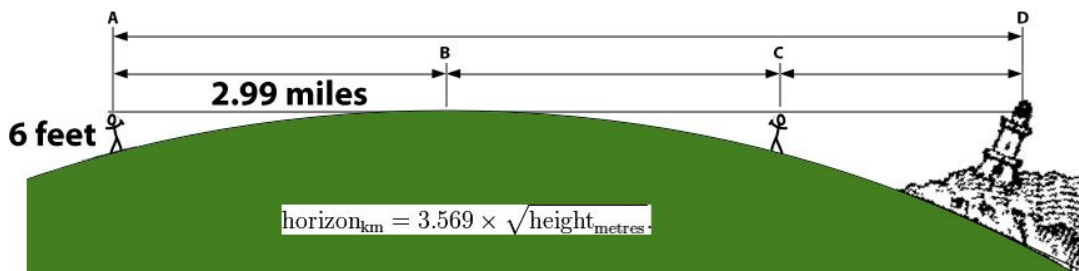
But as in all general rules, there are exceptions to the rules. Even though these frequencies travel via "line-of-sight" paths, radio signals can travel through many non-metallic objects and be picked up through walls or other obstructions. Even though we can't see between antennas of a transmitter and receiver, this is still considered line-of-sight to the radios. Also, radio waves can be reflected, or bounce off surfaces so the straight line between radios, may not always be so straight.

Knowing that our radio waves travel in straight lines, then to figure out their maximum range for a two way radio we have to factor in the curvature of the Earth. When you stand on Earth

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and press the talk button on your radio, the radio waves are going straight and they will eventually just go straight off into space once they pass the horizon. So the distance of the horizon is technically the maximum communication range for a two way radio. But you have to factor in antenna height as well.

To find the line of site distance to the horizon for a given antenna height we can use this formula: horizon in kilometers = 3.569 times the square root of the antenna height in meters. Figure 1 illustrates this formula.



**Figure 1**

So if the antenna height of a radio is at 6 feet, or 1.82880 meters tall, the horizon is 4.83 kilometers, or 2.99 miles away, which is Point B in the illustration. Of course this calculation assumes the receiving antenna is laying directly on the ground so raising the height of it would extend line of site.

Point C in the illustration shows another radio with the antenna at 6 foot so theoretically you should be able to communicate almost 6 miles. So realistically, for two people carrying a handheld two-way radio, the maximum communication distance on flat ground with no obstructions is around 4 to 6 miles.

So you may be wondering why you see radios that have range claims of 25 miles or higher. Technically they could communicate that far. Point D on Figure 1 shows a tower sitting on top of a mountain. If you are standing on top of this tower, now your antenna height overcomes a whole lot of the Earth's curvature and you can communicate much further.

There are other factors that affect the range of a two-way radio too such as weather, exact frequency used, and obstructions. The radio's power output has a factor too.

### **Radio Power**

Another important factor in the distance a two-way radio will communicate is its power output. This power output is measured in "watts." You've likely heard an FM radio station say they are broadcasting at 50,000 or 100,000 watts. Well, a handheld business-type two-way radio usually broadcasts at 1-5 watts. A vehicle mobile radio may broadcast anywhere from 5 to 100 watts. The more watts a radio has, the farther it can transmit.

Why is this? When water moves through a pipe it loses pressure along the way. When electricity flows along a wire it loses current. When an object is rolling, it will eventually stop rolling due to friction. Radio waves operate by the same laws of physics as everything else so

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there will be signal loss along the way. But if you apply more water pressure, more electrical current, or get the rolling object moving faster, you'll get more distance out of all of them. The same is true for a radio signal. Increasing the power in watts at the source helps overcome any "resistance" along the way.

Keep in mind that for battery-powered handheld radios more watts is not always a good thing. The higher the wattage, the quicker your batteries run down.

### **Radio Frequencies**

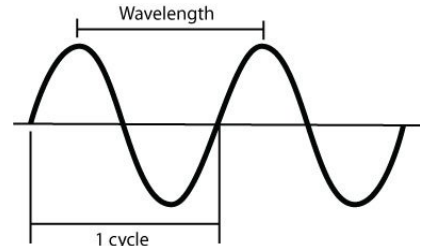
One more factor in determining how far a two-way radio will communicate is the frequency it uses and the environment that frequency is used in.

There are two major formats for most two-way radios. They are Ultra High Frequency (UHF) radio and Very High Frequency (VHF) radio. Neither frequency band is inherently better than the other. They each have their pluses and minuses. Both formats are effective ways to communicate with another person so deciding on the right radio for you depends on your application.

Two-way radios communicate with each other through use of radio waves. Radio waves have different frequencies, and by tuning a radio receiver to a specific frequency you can pick up a specific signal.

Radio waves are transmitted as a series of cycles, one after the other. You will always see the "Hz" abbreviation used to indicate the frequency of a radio. Hertz is equal to one cycle per second.

Radio waves are measured by kilohertz (kHz), which is equal to 1000 cycles per second, or megahertz (MHz), which is equal to 1,000,000 cycles per second--or 1000 kHz. The relationship between these units is like this: 1,000,000 Hertz = 1000 kilohertz = 1 megahertz.



You may also hear the term "wavelength" when you hear about radio waves. This term is from the early days of radio when frequencies were measured in terms of the distance between the peaks of two consecutive cycles of a radio wave instead of the number of cycles per second. Lower frequencies produce a longer wavelength (the width of each cycle gets bigger on lower frequencies).

What is significant about wavelength for two-way radios is that it affects transmission range under certain conditions. A longer wavelength, which corresponds to a lower frequency, as a general rule lets a radio signal travel a greater distance.

Lower frequencies or longer wavelengths also have greater penetrating power. That's one of the reasons they are used for communicating with submarines. VLF (Very Low Frequency) radio waves (3–30 kHz) are used to penetrate





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sea water to a depth of approximately 20 meters. So a submarine at shallow depth can use these frequencies.

So from what you read above you may think VHF is always the better choice for a two-way radio no matter where you are using it since it has a lower frequency than UHF and the signal can travel a greater distance. That's not necessarily true. Even though VHF has better penetrating capabilities and can travel farther, that doesn't necessarily make it the better choice for use in buildings. Remember the conversation about wavelength above? Wavelength has a big impact on transmission distance.

To explain this let's assume we are communicating from one side of a metal commercial building to the other. In between these two points is a metal wall with a three foot doorway. Metal is an enemy to radio waves and they typically don't pass through it.

For our example let's assume that the UHF wavelength the radio uses is about a foot and a half wide and a similar VHF radio is around five feet wide. These are in the ballpark of their normal wavelengths.

When the UHF radio transmits its signal the foot and a half wide wave will pass through the door since the door is wider than the wavelength. The VHF signal will be totally reflected since it is wider than the opening to the door.

Your microwave oven provides an example of this. The glass front door has a metal mesh with very small holes. Microwaves being an extremely high frequency have wavelengths that are only several inches long. The mesh keeps the microwaves trapped in the oven but it allows you to see inside because light waves have a microscopic wavelength.

Just imagine walking through the building carrying a five foot wide pole. You will encounter the same challenges a VHF signal encounters. Now imagine walking through the building with a pole that's only a foot and a half wide like a UHF wave. There are lots fewer doorways you couldn't get through.

The one caveat is that wireless signals will penetrate through drywall, masonry, human bodies, furniture, wall paneling, and other solid objects. All these objects will reduce the signal strength though. The more dense the object, the more it reduces the signal. VHF will penetrate these obstacles better than UHF, but that doesn't necessarily mean that VHF is better for indoor applications as we continue to discuss the reasons why in the UHF section below.

In our example above we assumed you had a metal wall with an opening. If you reverse this and you have a three foot metal object in front of the transmitting radio, then VHF would win. Since the object is three foot wide it will totally block the UHF signal whereas the VHF signal will get around it. Lower frequencies such as VHF diffract around large smooth obstacles more easily, and they also travel more easily through brick and stone.

For most applications, lower radio frequencies are better for longer range. A broadcasting TV station illustrates this. A typical VHF station operates at about 100,000 watts and has a

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coverage radius range of about 60 miles. A UHF station with a 60-mile coverage radius requires transmitting at 3,000,000 watts.

So there is no clear choice for which is better, VHF or UHF. There is a lot of “black magic” to radio technology so it’s not always easy to tell which will work better for your application. To help you decide on the best technology for you, more detail about each one is included below.

### ***UHF Radio***

The UHF radio band for commercial radios is between 400 to 512 MHz. Until recently, it wasn’t widely used. Now, the UHF radio frequency is used for two-way radios, GPS, Bluetooth, cordless phones, and WiFi.

There are more available channels with UHF so in more populated areas UHF may be less likely to have interference from other systems. The range of UHF is also not as far as VHF under most conditions, but this reduced range may be a positive in some cases. Since UHF has lower range, there is less chance of distant radios interfering with your signal.

While VHF may be better at penetrating physical barriers like walls that doesn’t mean it will give you greater coverage in a building. The shorter wavelength of UHF means that it can find its way through more spaces in your building as we discussed above. In the walking around with a pole example we gave you, the UHF signal has fewer obstacles that totally block it.

To highlight the differences in indoor range, below is an excerpt from a brochure of a leading two-way radio maker on the predicted range of one of their lines of handheld VHF and UHF two-way radios:

“Coverage estimates: At full power, line-of-sight, no obstructions the range is approximately 4+ miles. Indoor coverage at VHF is approximately 270,000 sq ft and 300,000 sq ft at UHF. Expect about 20 floors vertical coverage at VHF and up to 30 floors at UHF. Note: Range and coverage are estimates and are not guaranteed.”

The greater wavelength of VHF makes it more difficult for it to bounce its way through walls, buildings and rugged landscape. Therefore range will be reduced for VHF radios in these environments. That may not necessarily be a problem if the range needed is only a few hundred feet. You can also add an external antenna to an indoor VHF base station that will reduce or eliminate some of the problems encountered.

One of the downsides to UHF is that the FCC requires you to get a license to operate in these frequencies, although many frequencies in the VHF business band also require a license too. If you choose a radio in the VHF MURS frequencies you can operate it without a license (discussed below).

One other advantage of the short wavelength that is produced by the higher UHF frequency is that the antenna on the radio can be shorter than an equivalent VHF radio. That can make

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it more convenient to carry around as a portable radio, although most manufacturers find a way to make the antennas shorter on their VHF portable radios.

### **VHF Radio**

FM radio, two-way radios, and television broadcasts operate using VHF. The VHF radio band specifically for commercial radios is between 130 – 174 MHz.

Both UHF and VHF radios are prone to line of sight factors, but VHF a little more so. The waves make it through trees and rugged landscapes, but not always as well as UHF frequencies do. However, if a VHF wave and a UHF wave were transmitted over an area without barriers, the VHF wave would travel almost twice as far. This makes VHF easier to broadcast over a long range.

If you are working mostly outdoors, a VHF radio is probably the best choice, especially if you are using a base station radio indoors and you add the external antenna. The higher you can place the antenna, the further you can transmit and receive. One exception to using a VHF radio outdoors is if you are using it in a heavily wooded area. Under these conditions a UHF radio may be able to transmit better through the trees.

VHF radios also have a smaller number of available frequencies. Interference with other radios could be more likely to be a problem. However, the FCC recently made this less of a problem when they opened up a two-way radio spectrum called the MURS service. MURS stands for Multi-Use Radio Service. This service is for use in the United States and some countries that follow FCC regulations. It is a low power, short range service in the VHF 150 MHz radio spectrum. There are 5 channels in the MURS frequencies with 38 privacy codes under each one that enable you to only pick up conversations from radios transmitting your code. The FCC does not require users of products for MURS to be licensed.

With MURS you can add a larger or external antenna to improve range. If you want to put an antenna on top of your building or a tower, you can do it with MURS. Some antenna manufacturers claim an external antenna can increase the effective radiated power of a transmitter by a factor of 4. These MURS intercoms can transmit up to several miles, and perhaps more with an external antenna depending on the terrain and height of an antenna (can be up to 60 feet above the ground).

One benefit of VHF wireless radios is that battery life is almost always better than for similar UHF units. For handheld radios this is a plus.

In summary, if you are planning on using your two-way radios mainly inside buildings, then UHF is likely the best solution for you, but in lots of applications VHF could still work fine since it doesn't have to transmit far. If you are mainly using your two-way radios for communication outside, then VHF would be a good choice, unless the area you are covering is heavily wooded or there are lots of buildings in the way of the radio signal.

Either radio technology can work for you if you don't really have a long range to cover. There are also repeaters you can install that relay a UHF signal, but this is usually very complex to do. You may be able to find a repeater service in your city that will do this for you for a

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monthly fee. For most applications a repeater is not necessary and VHF or UHF radios by themselves will do the trick.

### ***About IntercomsOnline.com***

IntercomsOnline.com solves communication problems in homes and businesses. Their ecommerce store specializes in intercoms, wireless intercom systems, two way radios, wireless call boxes, and other communication devices. Through 20 years of product expertise in communication systems, they have been able to simplify the ordering of otherwise complex assemblies. Their site has ample product information needed to make an informed buying decision. Go to <http://www.intercomsonline.com> for more information. To join their dealer program click here: [IntercomsOnline.com Dealer Program](#)

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