



# How To Improve Your Public Safety Radio Coverage

Is Your Two-Way Radio Coverage not Measuring Up?

Whether you are tired of scratchy conversations in analog or alien noises in digital there is always a solution. This paper discusses the most common solutions for poor radio coverage. Throughout this paper I am only referring to public safety communications: Police, Fire, and EMS, not commercial radio coverage. Over the past several years most public safety agencies have purchased new radio equipment as part of the federal narrowband mandate. Unless your radio system was already overbuilt or your territory is not very large when you switched from a wideband to narrowband technology you probably experienced reduced coverage. There is nothing more frustrating than buying new equipment to only have it perform worse than the old. Yet that is exactly what happened all over the country in varying degrees.

Whether narrowbanding killed your coverage or it has always been bad, let's walk through this exercise and ask yourself what the symptoms actually are. Is your issue one sided? For example; are Fire Fighters receiving their page but can't respond back? Are you only having issues with portables? In-building only? Here we go...

## Maintenance

When was the last time your system had a full preventive maintenance check? Just like with a vehicle,

routine maintenance can keep your system performing. If your system has been slowly degrading over time, you may be overdue to have your entire system checked. This includes mobiles, portables, base stations, repeaters, and dispatch console. A thorough inspection of your radio sites can also identify any interference issues that you may or may not be aware of. Find out if your radio vendor offers maintenance contracts. In addition to a more reliable system, paying a fixed annual contract simplifies preparing your annual budget.

## Location, Location, Location

I have seen hundreds of radio systems that are exactly where they are because they are rent free. City Hall, the Fire Station, the retired fire chief's garage, etc ... And in my experience that is often not the best location. Sometimes it's better to include in your annual budget the cost to lease a good radio site than to let free rent dictate the performance of your radio system. If you have a lot of dead spots, ask yourself, Is there a better location? A good radio vendor can create predictive coverage maps to support a proposed location. But don't rely on maps alone. Always do actual coverage testing before relocating even it's just driving a mobile to the top of a hill and performing radio checks. Perhaps you already have a good location but you are at the bottom or the wrong side of a tower. Also, getting the best locations for free is not out of the question. As the wireless industry grows, more and more broadband and cellular companies will need local permits for new towers and this can open up negotiations for a rent free lease at a new site. Tell your planning and zoning

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officials to keep their eyes open for such opportunities. Just get it in writing and have an interference resolution clause.

## Repeaters

If you are still relying on a single frequency simplex base station to dispatch your first responders but are having issues with the responders not hearing each other then it's probably time to upgrade that base to a full duplex repeated system. A repeater does exactly that, it rebroadcasts all your radio traffic so everyone hears both sides of the conversation. I have several customers that utilize multiple repeaters to cover a larger area and configure them in a County North and South setup. The multiple repeater scenario requires some good radio discipline by the user and dispatcher, but can be managed with experienced staff. Other advantages of a repeated system includes allowing the system to be dispatched from multiple control points such as a backup Emergency Operations Center and upgrade possibilities such as radio voting and simulcast systems. I am not an advocate of using the dispatch repeater for operations at a fire scene however. All firefighters should switch to a simplex fire ground channel and let the command staff relay requests back to dispatch.

## More Power!

Well sort of... If you are relying on a single site for most of your communications then you probably need all the power you can get (within the limits of your FCC license of course). I am a firm believer that the most important goal of any emergency dispatch system is for your first responders to receive the message even if they are in an area where they cannot reliably transmit back to dispatch yet. This is particularly true of our volunteer responders that have a day-job in an adjacent town to where they serve. However, more power is only helpful if it's directed where you need it. High Gain base station antennas on a mountain are no good if they are shooting over the top of your town. Many antenna manufacturers make directional and down-tilt antennas if required. An exception to the more power rule is when your system is comprised of multiple repeaters such as simulcasting where transmitter overlap needs to be carefully controlled. Another often forgotten method of increasing system gain is to boost it on the receive side. A receiver preamp on your base or repeater can compensate for losses in your antenna system. I have actually seen a preamp regain the performance lost from narrowbanding. The exception to this method is on a site with a lot of interference. Some manufacturers even offer a receiver preamp on their mobiles.

## Vehicle Repeaters

What if all the transmissions from your low power handheld radio were received and rebroadcast through your high power mobile? Vehicle Repeaters do exactly that and are often a simple way to improve portable coverage. This can be ideal for a police officer on a traffic stop or an EMT working an accident scene. The only drawback to vehicle repeaters is that they require user intervention by activating the repeater before exiting the vehicle

and/or changing the channel on the portable to select the repeater. These issues can be mitigated with proper user training. Many radio manufacturers also offer Bluetooth solutions that allow wireless microphones for shorter range communications around your vehicle that accomplish the same goal as a vehicle repeater.

## In-Building Signal Boosters - aka Bidirectional Amplifiers - aka BDAs

An excellent way to improve in-building portable coverage is to install a BDA that boosts your public safety frequencies. This can be a costly endeavor if your community has a lot of concrete and steel structures or underground tunnels. College campuses are prime candidates for BDA's. The system works by installing a donor antenna outside the building that pipes your signal inside to the booster where it's distributed via an array of indoor antennas or leaky coaxial cable. These systems need to be designed by qualified personnel so as not to create destructive interference to your own system. In a simplex system the design is typically a hybrid solution with a Uni-Directional Amplifier with voting receivers.

New NFPA standards require that building owners provide radio coverage enhancement systems for first responders. If it's not already part of your city's zoning ordinances get them to add verbiage that requires construction projects to include systems that provide radio coverage for all frequencies that will be used inside during an emergency. Most BDA manufacturers' can assist with the correct wording.

## Voting

Unlike a political election, a radio voting system chooses the best signal to be rebroadcast back to dispatch and to your team members. The concept is simple, if you have locations that receive your Dispatch Center but cannot talk back then install a receiver in that area to solve the problem. You can fill in as many holes as you want with a voted receiver system. But keep in mind; it only improves the talkback from your units in the field. If the problems are in both

directions then you will also need multiple transmitters. The real challenge with voted receivers is getting connectivity back to your prime voter site. This can be achieved with telco leased lines, Microwave hops, RF Links, and even over IP.

## Simulcast - The big Kahuna of radio system technology

Wouldn't it be cool if your radio system was comprised of a wide area network of transmitters and receivers that saturated your entire service area? Yes, it exists and it has been around for a long time. So what's the catch? Cost and the experience to implement the system properly. So why is it so expensive and so difficult? Time to get technical: all electromagnetic radiation (this includes radio waves) travel at the speed of light, and as fast as that may sound; it's not fast enough for simulcasting. It takes 5.4 microseconds for your radio transmissions to travel 1 mile. So what happens when one transmitter is 10 miles away and another only 5 miles? They arrive at your portable radio at different times and this can cause destructive interference.

Optimizing a simulcast system requires a good backhaul system between the remote sites and the head-end along with the know-how to manage the launch times of your transmitters. Fortunately the cost of this technology is becoming more affordable. When purchasing a simulcast system, find a vendor that has the experience to install and optimize the system correctly. But keep in mind that as cool as this technology is, it's still not perfect because wherever you have multiple transmitter overlap you will always have some pockets of distortion. The trick is to minimize these pockets or push them outside your coverage area.

An entire paper could be written on each of these subjects but hopefully this got your wheels spinning on where to begin.

Chances are the solution to your coverage issues can be found within one or more of the above solutions.

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