

# “Infrared, Frequency/Digital Modulation, and Induction Hearing Loops: A Comparison of Assistive Listening Technologies”

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Hearing aids are remarkable. They help people with hearing loss engage in conversation with friends and family, even in crowded environments. They restore the ability to enjoy the pleasant sounds of life — birds chirping, children laughing, the everyday sounds —paper rustling, heels tapping — and the less pleasant but necessary noises —car horns beeping, sirens blaring. Hearing aids are truly modern miracles that pack very sophisticated technology and sound processing into the smallest of devices.

But sometimes hearing aids alone aren't enough. Much like regular tires are perfectly good for cars in the warmer months but snow tires are needed to drive in challenging winter conditions, hearing aids need a boost in situations where speakers are situated far from audiences, or a play is being held in a large auditorium where ambient noise interferes with speech, like during a graduation ceremony. That's where assistive listening technology comes into play. Hearing aid wearers aren't usually seeking more amplification when in public venues. What they need is better speech *understanding*, and the ability to suppress background noises while bringing speech to the forefront.

Public venues like churches have their own reasons for investing in this technology, including adherence to the [Americans with Disabilities Act \(ADA\)](#). The ADA mandates assistive technology is made available in public and government venues in order to give anyone with a disability equal opportunity to communicate, and be communicated with.

Currently, there are three technology options for assistive listening systems (ALS): infrared, frequency modulation (FM, also may be referred to as digital modulation, or DM), and induction hearing loops. The following is an overview of each option and a discussion of their associated positives and negatives.

## INFRARED

### What it is

Infrared (IR) systems project sounds as light waves to listeners wearing receiving devices. They are most often used at inside venues, such as movie theaters, many churches and playhouses.

### What it does well

Because listeners must be in the line of sight of the infrared light to hear there isn't any leakage of sounds into other rooms, which can be important if what is being listened to is proprietary or confidential. Conversely, outside transmissions will not interfere with the IR signal. IR provides high-fidelity sound that makes it easy for hearing aid wearers to discern speech. If someone owns an IR receiver they can bring it anywhere IR transmission is offered, as the devices are universally compatible with the transmitters. IR is wireless so users do not have to be confined to a particular seating section in a theater or auditorium.

### What are the negatives

IR does not work for outdoor venues because sunlight diffuses the light waves carrying sound to the receiver. And if there is any physical barrier between wearer and signal the listening experience will be disrupted. So if someone using IR is at a concert and a person stands in front of them, transmission of sound is interrupted and the music stops.

# FM

## What it is

FM systems use radio waves to transmit sounds from a speaker or performer wearing a microphone and transmitter to listeners wearing a receiver/headphone device. They are most often used in situations where a single speaker is at the head of the room or moving around, such as by a teacher in a school classroom or a religious leader in front of a congregation.

## What it does well

Since FM uses radio waves, not light, to transmit sound the system works indoors and outdoors. FM set-ups are wireless like IR systems, but they are more portable than IR. Many schools, houses of worship, and other venues have invested in FM systems throughout the US, more so than other ALS options. Schools use them most widely because legislation that includes the Individuals with Disabilities Education Act (IDEA) and particularly [Section 504 of the Rehabilitation Act](#) requires children be given equal access to instruction in the classroom. Sturdy and flexible, FM systems suppress chatter, shifting papers, and other noise while helping children hear their teacher speak clearly and consistently even if he or she is walking around the classroom.

## What are the negatives

FM signals can experience disruptive external radio interference and the sound can “leak”, allowing others to listen in on private broadcasts via other FM receivers. FM systems are more expensive than IR systems, which can deter venues from investing in their installation. In order to function properly, the transmitter and receivers must use the same FM frequency, so you have to rent a receiver at a venue. The need for a receiver necessitates standing in lines to rent conspicuous headsets— something many people are reluctant to do because wearing them makes it obvious the user has a hearing impairment. Renting also raises sanitary concerns about wearing headphones an untold number of people have worn before. Consequently, many hearing aid wearers who would benefit from the FM system choose not to use one and miss out on enjoying the presentation they came to see. These concerns may deter hearing aid wearers from going to venues they know require use of an FM system to hear clearly. This not only deprives those with hearing loss of entertainment or information, but also results in a loss of revenue for the business and a smaller audience for its featured performers and speakers.

In addition, children (particularly older kids and teens) may be embarrassed at having to wear a noticeable audio “shoe” —a rather large attachment they must plug into the bottom of their hearing aids in order to pick up the FM signal. And children who decide not to use their audio shoes in order to avoid drawing attention to the fact they have to wear hearing aids risk falling behind in school.

# INDUCTION LOOP

## What it is

Loop systems transmit sound directly into hearing aids equipped with a telecoil (t-coil) via an electromagnetic field contained inside a cable (the loop) surrounding the perimeter of a room or a set listening area. The listener sets their hearing aids to the t-coil setting in order to “tune in” to the signal. Transmitters include a microphone and special amplifier connected to a public announcement or audio system that sends signals through the physical cable installed around an auditorium, theater, lecture hall, or the like. More than 40 percent of all hearing aids, nearly all instruments for those with more severe loss and 100% of all cochlear implants on the market are equipped with t-coils. [Siemens Hearing Instruments](#) currently leads the field by offering a t-coil in nearly every model of hearing aid sold.

## **What it does well**

On average, listeners rate the quality of sound transmission very high. The loop system is also preferred by hearing aid wearers because it doesn't require renting and wearing a conspicuous receiver that draws public attention to their hearing loss. Instead, they can discreetly set their hearing aids to the t-coil option and are ready to listen.

Another benefit of a loop system is that it can handle productions involving multiple voices carried through several microphones in unison, such as at an opera. FM or IR systems are unable to capture and transmit from multiple mikes at the same time.

Induction hearing loops can be used in small, large, indoor, or outdoor public spaces and they work equally well in situations with single speakers, movies, or multiple performers. Loops are also universal, in that the same signal can be heard by everyone, no matter what manufacturer's hearing aid is being worn. And when it comes to transportation hubs (train stations, airports) and transportation vehicles (trains, planes, cruise ships, taxis) induction hearing loops are the only practical solution for transmitting announcements via PA systems directly and with pristine clarity into hearing aid wearers' instruments. This usability also makes them a good choice for houses of worship, theaters, concert and lecture halls, as well as teller windows, pharmacy and information desks.

## **What are the negatives**

Information about induction hearing loops has not been made readily available to U.S. venues, many of which don't even know about this ALS option. The majority of induction hearing loops can be found in the Midwest thanks largely to grassroots advocacy efforts, which has increased potential user demand, particularly from churchgoers. The cost is somewhat higher for induction hearing loops than IR and FM options because an actual cable has to be installed. It requires some effort to add to existing venues by tucking the cable under carpeting or hiding under ceiling trim for esthetic purposes. However, it should be noted though the initial investment may be higher than for IR or FM, more users will take advantage of discreet induction hearing loops, so the cost per user ends up being lower. If a public space has a goal of increasing user engagement —and what venue doesn't want more attendees coming to its provided information or entertainment? —then the higher initial cost becomes an investment in the location's long-term success.

It is interesting to note that in European countries where hearing aids are covered by medical benefits, they must include t-coils by law, which may be why so many more European venues have induction hearing loops in comparison to the U.S. Induction hearing loops also require qualified installers. Right now only two large companies in the U.S. offer equipment and training but there are a growing number of entrepreneurial [loop installation businesses](#) to be found in many regions of the U.S.

Some hearing care professionals have been reticent to suggest patients choose hearing aids with t-coils, as they didn't want to "confuse" older patients with explanations of their value and how to use the setting. However, as the number of venues with loop systems increases, more hearing care professionals are starting to advocate for induction hearing loops, encourage and train patients to use t-coils, and provide information on the benefits of loops to hearing aid wearers.

## Conclusion

According to the ADA and other government mandates, employers, government services, public accommodations and commercial facilities, and transportation locations need to provide equal access to the hearing impaired. Assisted listening systems support these requirements and improve the lives of hearing aid wearers.

Hearing aids are wonderful devices for everyday use, but in large crowds or situations where listeners are a distance away from an auditory source, an additional signal boost is necessary for understanding speech clearly. Venues from houses of worship to museums, theaters to auditoriums, would benefit from providing ALS options to encourage attendance by the ever-increasing hearing impaired population in the U.S. And while not yet required in domestic transportation stations, ALS technology should be provided as a reasonable accommodation for travelers with hearing loss who need to be aware of important announcements and safety warnings.

Of the three currently available ALS options, induction hearing loops offer the greatest versatility to the broadest audience. In many cases, hearing aid wearers already have the equipment required to tap into loop signal broadcasts with the touch of a button—no fiddling with inconvenient and obvious receivers necessary. Loops are extremely versatile and offer the only practical solution for transit hubs. While installation is required, which may concern some venues with regards to cost and effort, and more trained installers are needed, progress is being made on both of these fronts. Interest is growing throughout the U.S. in induction hearing loop systems, and so the number of installers is increasing. As for the expense, the per-user cost of induction hearing loops is actually *lower* than other options because there are more potential users of this technology than for IR or FM. Additionally, public spaces are prohibited from charging individuals for renting the ALS receivers in which these venues must invest for IR or FM to work. No receivers are required in induction hearing loop-enabled spaces for those wearing hearing aids with t-coils.

Hearing care professionals need to encourage patients to choose hearing aids with t-coils, explain their value, and demonstrate how to use them properly. Promoting hearing loops is a good way for professionals and hearing aid manufacturers that include t-coils in their instruments to distinguish themselves and their products. In turn, informed wearers should be encouraged to ask for loops at the public spaces they attend, as raising awareness and increasing demand will encourage more venues to consider this technology. Potential loop users may even be able to “crowd source” the cost of installing a loop system. As <http://loopwisconsin.wordpress.com> Dr. Juliette Sterkens says, “We have to start somewhere in the community—even individuals can make it happen.”

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