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From Remote Mics & Telecoils to LE Audio & Auracast: Accessibility for All and The Evolution of Wireless Technologies in Hearing Aids - Part 1: Technology

Presenters: Juliette Sterkens, AuD, Brian Taylor, AuD

Thank you, Melissa. This is Brian Taylor. Welcome to our course. I'm very pleased to be with my friend and colleague Juliet Sturkens. I'll just say that you can see on the slide here the title of the course.

It's mainly around the evolution of wireless technologies and hearing aids. And you see the list there. We have remote. We're going to talk a little bit about remote microphones, telecoils, LE audio and oracast. This is a two part course.

Today, the first hour we're going to be talking about technology and next week we'll be talking more about accessibility and some other issues relative to selection and other important aspects of wireless technologies as they relate to clinical practice. I want to thank everybody for taking time out of their busy schedule to be with us. Just a few housekeeping items here you see some of the risks and benefits of the courses that are offered at Audiology Online and the content of this course here are the learning outcomes and I think the content will reflect these. And Juliet, if you'd like to maybe mention your disclosures unmute myself I retired from private practice and I am currently a consultant to the Hearing Loss association of America thanks to some grant funding from a family foundation and I'm also a board member of here in the Fox Cities. I receive a consulting fee through hlaa.

I have no other financial things to report and my disclosures my my role at WS Audiology as senior director. I also have a few other appointments in the in the industry that you see listed there. I do receive a salary from WS Audiology and as well as some funding from some of the other organizations that you see on the slide. I'm going to go ahead and get started. Part 1.

These are some of the items that we're going to cover. We'll do a brief introduction around this concept of network communication devices. We'll do an overview of some of the wireless technologies that are available today and how they've evolved over the last few decades. We'll spend some time differentiating those wireless technologies, especially around telecoils, LE Audio and oracast. And we'll give you some final thoughts at the end.

I want to start by answering or trying to at least answer this question. What are, what are wireless technologies exactly? And I think they represent a convergence of a couple of different audio technologies that you see listed here on the slide. I think until maybe the last 10 years or so, consumer electronics as they relate to audio devices like earbuds and hearing aids were confined to two very separate siloed categories. And in each of these buckets you kind of see some of the features that are commonly associated with each of those siloed buckets.

But I think what's happened over the last decade, it continues to evolve and maybe at a, at a faster pace as we move in the next five years or so as that these two different, these very different technologies that have historically been siloed are melding together at a faster rate. Obviously we've seen Bluetooth streaming and hearing aids for a long time, but the rise of Oracast and some other factors I think really do make hearing aids truly network communication devices, which is exciting for us and it's certainly an opportunity and very exciting for our patients. Here's sort of my way of trying to represent what a network communication device ecosystem might look like. You have all of these consumer electronics on the outside, everything from a laptop to a television to even a stereo that can be connected directly to hearing aids either via a telecoil, a smartphone, or as we will talk about, oracast, which is a new version of Bluetooth that has broadcast capabilities. My point here is that there's sort of the hub here is the smartphone and some of these other technologies in combination with the hearing aids.

And that's a very different ecosystem that I think a lot of us are used to. At least I won't speak for everybody, but for clinicians that are maybe older, older than 40, this ecosystem is very different than what we grew up with in our early years as an audiologist. I also want to share a few thoughts on what I think how we should think about wireless technologies as we move into the future, because I really do think it requires a shift in our thinking away from the world of accessories as kind of an afterthought or

an add on to existing hearing aids and more of must have technologies that exist in this ecosystem with a smartphone and hearing aids. If you around in the 20 years ago or before that even, I would argue that you lived in what I would call the accessory era, where we had you see the list there, infrared remote microphones, telecoils, some of these things of course are still viable and very much needed today. But at the, in this era that we've moved out of, I would say it was basically isolated and fixed in the sense that you would add one as a true accessory.

And of course that added expense and complication and it was, as I mentioned, more or less an afterthought. But we've moved into, away from this booted, isolated and Fixed area where you chose one accessory more to this network communication ecosystem where all of these technologies exist together. You can kind of pick and choose several of them, everything from a telecoil, a remote microphone and oracast to some of those other ones that are still existing today. And that's mainly because things are easier to use. They connect more seamlessly with our smartphone or directly into the hearing aid.

And it just gives both us as clinicians and our patients a lot more options, which I think is really important. I want to kind of share with you next some of the opportunities around this network communication device ecosystem that I mentioned, some of the opportunities for us and for our patients. And the first one that comes to mind as an opportunity is I think that a networked communication device, I think it has the real opportunity to enhance patient autonomy in some ways that we really haven't maybe seen. Not only do we have the hands free convenience of using our phones for calls and the ability to use the smartphone for controlling our hearing aid for fine tuning, but I think just that combination of having things like a telecoil on board the hearing aid and the ability to use the smartphone to make these connections really does for many of our patients boost their sense of agency and empowerment. And if you, if you've studied anything around empowerment and chronic conditions, we know that when we give our patients more of a sense of control and ownership, the

ability to do things independently as far as adjust and connect, that improves patient satisfaction in some pretty remarkable ways.

And you start, we're starting to see some of those boosts in overall satisfaction. This is market track information that goes back a few years. There's a new market track report that's set to be released very soon. But you see here, this is data from three or four years ago on thousands of hearing aid wares. And it tells a compelling story around the empowerment of using wireless technologies.

So you see some of the features there listed. Direct streaming, remote control, wear controlled apps. Those are three different types of wireless technologies. And you can see that individuals that have those features built into their hearing aid or used alongside their hearing aid have much higher satisfaction ratings. I mean, if you look at the bars in black there, showing an overall satisfaction rating of about 80%, which historically is quite good.

But we can add another 10% improvement on top of that when we embrace and our patients embrace some of these wireless technologies. Here's a similar study. This is one that Sergey Kochkin and Juliet were part of from about 10 years or so ago. And again, I think it shows you when patients have access to features like a telecoil, and that's the example shown here from the data, their satisfaction levels are significantly higher. And you might be asking yourself, you know, why is it that we're seeing such higher, much higher satisfaction levels for people that embrace these kinds of wireless technologies?

And many years ago, Kotchkin term this, he had this acronym called MELU M E L U, which stood for Multiple Environment Listening Utility. And that's something he talked about 25, 30 years ago. And I think it holds true even today. The more places we can help a person communicate more effectively in, the more likely they are to have higher overall satisfaction. And of course, wireless technologies and the ability to use those and access those are really an important part of a Milou strategy.

I also think it's important to think about in the clinic, when you're sitting down, face to face with a patient, when you're doing a case history, an intake interview, a hearing aid evaluation, whatever you might call it, that we have tools available to us that help us have a better, more effective conversation with their patients around the ability to use wireless technologies. I think the COSI does a pretty good job of that. Another tool that I think maybe is even better in regards to having conversations around access and usability of wireless technologies would be this tool called the Telegram, which Linda Thibodeau created many years ago. You see that Telegram, Telegram is an acronym across the top of the form there. And in my experience, using a tool like this, it enables you to have, I think, a deeper, more effective conversation around some of these wireless technologies that you can bring to the table to help a person hear better in some of the situations that are often the most challenging.

Which leads me to the next factor. In my mind, at least, I think probably the most important benefit, or at least the most important opportunity around wireless technologies is their ability to be used as what I would call a portable signal to noise ratio enhancement tool. Of course, there's all kinds of positives that stem from our ability to improve a patient's signal to noise ratio. You see them listed here on the screen. And I'm going to go ahead and turn it over to Juliet and she's going to go into more detail around portable SNR enhancement tools.

Thanks, Brian. So the question is, of course, why the need for wireless technologies? Right. And I think we have to be very frank with our patients about the fact that hearing aids do not restore hearing to normal and that there can be a substantial hearing deficit from post hearing aid fitting. And of course, that's significantly greater for people with more hearing loss, as opposed to those who come in for the very first time with a milder hearing loss.

And of course, hearing aids don't correct for auditory processing as measured by a speech or a speech in noise test. No matter what I will ever wear on my ears, I have a Dutch brain and I have trouble in

background of noise or when people speak fast or have a heavy accent. And I struggle in those situations. And then of course, the directional microphone limits. We put a lot of faith in directional microphones, but if you fit them in an open matter, the direct directivity index improvement is going to be small, on the order of maybe 2 or 3 dB.

If it's a fully occluding ear mold and very specific tests, it can be 5 or 6 dB. But if you do speech and noise testing, you know that your patients require a significantly greater signal to noise ratio improvement. And then of course, the issue of the effective range of microphones. And I want to show that effect by a recording. I won't play the recording, I'm just showing you the image.

This is taken with my iPhone. I use my iPhone to make a recording in a quiet restaurant with a little bit of background music. I held the phone right at my ear and you can see the speech signals. If you listen to the audio, you can just hear the person speak. Then I move the iPhone to the mouth of the speaker and you can see huge improvement in signal to noise ratio.

And then I move it back. If you ask people who wear hearing aids what the effective range of a microphone is, some will tell you two or three feet. And so we put a lot of faith in hearing aids. And for one on one quiet situations, they will work, but frequently not in the situations where they need them the most. And that of course, when we do that in a classroom, it becomes even more obvious, right?

We know that kids in classrooms, normal hearing kids in classrooms, need signal to noise ratios of plus 15 or plus 20 in order to understand speech easily. That means that the teacher's voice needs to be 15 or 20 decibels louder than the background noise. But in this image you can see how there is background noise in the classroom. And it's H Vac noise, it's students feet shuffling, it's whispering, it's chair scraping, it's all this background noise, the stuff that your patients will tell you that they can hear better than the voices that they want to hear. And the graphic makes it very clear.

Because of the inverse square law, frequently these students are listening at very, very poor SNR values, let alone if you're a child with hearing loss or an adult sitting in a large classroom. So what really happens when we hear speech in background of noise? And that I'm going to show you is the audiogram with the count dots shown, the speech banana from Meat Killian and Gus Mueller's counter dot audiogram. And we all know that each red dots, although some are covered in this particular graphic, shows 1% of the speech understanding. But when there is background noise, as shown by this blue graphic, it's going to cover up a lot of the low frequencies, but still allowing a person with normal hearing to hear 65% of the speech in OR.

And that, of course, is enough for that person to understand words in sentences. But what happens to a person when a person with hearing loss hears speech? Hears the left audiogram showing a sloping high frequency hearing loss. In this audiogram, only 56 is still audible for that person with hearing loss. And now when you couple this to background noise, suddenly speech understanding drops to 25, 26%.

Right. And if they're talking to somebody with a very quiet tone of voice or someone who speaks very fast or has a heavy accent, speech understanding literally disappears. And they will tell you they can hear in a lot of events, but they cannot make out what people are saying.

Oh, Brian, I'm clicking through your slides. It's all yours. Well, I wanted to thank you for that, Juliet. I wanted to sort of reinforce the point that you just made. I think that's an excellent point around the speech intelligibility index and the audiogram and how both noise and hearing loss, loss of audibility, get in the way.

I wanted to kind of build on that by showing some recent data that comes from Stanford Ear Institute under the direction of Matt Fitzgerald, who's done some fantastic work, he and his team over the last several years around the quicksin. And on this particular graph, you see SNR loss. If you look on the Y axis, you see the quicksand SNR loss by degree. The higher the number, as you go from the top of the

graph to the bot, the higher the number, the worse the SNR loss. And then you see for normal hearing individuals, people with conductive, mixed and sensorineural.

And the point that I want to make that I think reinforces what you just said around the SII is that there are a number of people, even people with normal hearing, and that's illustrated by my red circle there. There are a large number of individuals that have mild and even sometimes normal Audiograms that really struggle in background noise. And I think this, this data, the schematic really illustrates that point. Well, you see a lot of individual variability. Many people that have moderate and even severe SNR loss, even when some of them of those have normal hearing.

So that I think, think kind of reinforces why improving the signal to noise ratio with wireless technologies is such an important aspect of what we do. Back to you, Juliet. Yeah, And I'm certainly in that group with my normal hearing or near normal hearing, but with a Dutch brain that gets in the way. Right. And of course, the manufacturers have been working for years on technology to overcome the effects of background noise and distance and reverberation.

And the only way to do that is to bring the microphone closer to the mouth of the speaker to improve that snr. And certainly contemporary hearing aids have made inroads in improving those SNRs, but only in near field noise. And they offer very little support for hearing in far field like classrooms, theaters and auditoriums. And in 1968, phonic ear was one of the first companies to successfully market a personal FM system for children with hearing loss. But I did my student teaching in the classrooms where there were, you know, half a dozen kids using these systems and to get them on the kids and to get them to work right and make sure that they were on the right channel and that the teacher was wearing the microphone.

It was a huge, huge hassle. And of course, the later devices, and I'm showing you a Phonak device with a little boot on the bottom and the sleek microphones that were worn by teachers made a difference

and made it easier to mainstream these kids. But it continued to be an issue to get the right hearing aid, the right booth to make sure they were working, to have teachers who weren't very techy to make sure that their kids were able to use these systems.

And for those of you who've been around for a while like I have, you may be familiar with some of these personal wireless technologies. On the left is the Converser. I don't think I ever tried harder to try to get my patients to use these systems. I maybe had half a dozen who used them. They were made in Australia, if I remember correct, or in the uk.

And then on the right was the FM system by William Sound. We had just some people who bought these systems to use on their own. But to say that we were very successful in private practice to get people to use them and to pay for them privately is understatement. And of course, you know, Now I'm going to get into just a couple of slides with images of devices that you're hopefully all very familiar with. But as you look at these devices and these next few slides, it should become clear that what the biggest issue has been with all these accessories is a lack of cross brand compatibility and cost, I might add.

And these Phonak microphones will work, but really only work well with Phonak devices, which is a huge issue if the clients don't have Phonak hearing aids. And again, these are some devices by Oticon. And yeah, these are Oticon devices. Cross brand compatibility isn't just an issue for these educational microphones and devices, but it's also an issue for TV transmitters and streamers. They all have that compatibility issue.

And just to talk about one device, this is the Widex company.

The this device, the TV DeX, was a terrific device for clients because it was easy to use. I even had clients who were legally blind who were using these devices because they're intuitive, easy to use.

They could control the volume of the TV just by pressing up and down. No smartphone to use. And this button at the bottom here turned off the ambient microphone.

They could literally mu the microphones on the hearing aids and just hear tv. I know that a lot of spouses love these devices also, and I really believe that devices like this could help many of our clients enjoy TV more without the use of a smartphone.

We all like to couple a lot of devices to smartphones, but there's still a ton of people, and I meet a lot of these people as I am a consumer advocate and give public presentations who proudly raise their hand when they say they don't use a smartphone, but they will use this type of device because it's simple and intuitive.

And last but not least, as far as remote devices are concerned, I do want to show some devices where the manufacturers have of thought outside of the box. And more and more devices were being manufactured without built in telecoils. I think we're kind of seeing that swing back a little bit. But then they came up with a solution where the telecoil was in the remote control or in this table microphone from the Widex company. But, but in all honesty, consumers struggle with them.

They have to remember to bring them, they have to remember to charge them. They're a hassle to use if you give them to somebody and then you forget to take them back or they're left on lecterns. It's just a huge issue with these little wireless accessories. And you know, there's been a little progress made towards cross brand compatibility and that's the fact that you can use your iPhone as a remote microphone for iPhone compatible hearing instruments. And really the hope among hearing loss advocates that future wireless accessories based on Bluetooth, Le Audio and the AuraCast platform will eliminate the need for many of these expensive and brand specific accessories that I showed in my previous slides and will make connecting less troublesome.

And hopefully that will soon include remote microphone accessories that enable four way conversations in noisy environments. And I just spoke with one person at a large hearing aid manufacturer and I hear that they're already working on a four way system which is just terrific. Brian, you made a lot of great points around remote microphones. I just wanted to spend a couple of minutes or a couple use a couple of slides here to illustrate some of the points around the benefits of remote microphones and set aside the fact that they can be an expense, they can be rather complicated. We do have some progress that needs to be made around making multiple brands compatible with one another.

But let's remind ourselves of the the great benefit that remote microphone technology brings to us. Of course, we all know that it picks up somebody's voice and sends it directly to the hearing aids across many feet and that usually results in between 10 and 20 dB of signal to noise ratio improvement depending how close the speaker might place the microphone to their mouth when they're talking. If you put it on a tabletop, the S and R improvement is probably going to be closer to 10, maybe even a little bit lower if you're in a situation with multiple people using that microphone speaking into it at a tabletop versus somebody who might be speaking one on one directly into the microphone a few inches from their mouth, where you're likely to get an SNR improvement around 20. I remember I'm old enough to remember when remote microphone came, technology relied on FM systems and you had to use a neck loop or a boot to use the remote microphones. And that was incredibly complicated.

I remember 20 years ago sending individuals home that were experiencing tremendous benefit with remote microphone technology, but it was too complicated to use and they didn't acquire it. Luckily, these days we can rely on 2.4 GHz wireless, usually Bluetooth low energy these days, or Bluetooth Classic to connect and transmit the microphone to the hearing aids, which is definitely a good thing. It makes it a little bit easier. My final point around remote microphones are just the overall effectiveness. So here's some data.

I believe this comes from Canada a year or two ago and it's showing you if you look at the x axis, you have the signal to noise ratio. The more negative the number, the more adverse the listening situation. And it shows you in the blue shows you as a percent improvement across the different SNRs. Somebody with normal hearing in the unaided condition. And notice even someone with normal hearing when they're at minus 12 and minus 17, their understanding ability is less than 50%.

And of course somebody with a hearing loss is far worse than that. That, that's illustrated with the red lines. But notice the improvement for those individuals when they use the remote microphone technology. When we make claims that a person hears better than normal hearing, here's an example of that in very adverse listening situation. That potential is there when remote microphone technology is available.

Of course, individual results vary, but you can see here why we still continue to talk about remote microphones, because they work so effectively in these challenging situations. I'll turn it back over to you, Juliet.

Thanks very much, Brian.

And you make some really good points here. That people with hearing loss actually hear better than people with hearing loss. But yet the consumer, the typical consumer, thinks that when they hear that hearing aids have background noise reduction and special directional microphones, that it will do that for them in the real world. And the truth is they don't. You know, and, and it's basically been known since the invention of hearing aids that hearing aids, when used alone, don't overcome or typically don't overcome the hearing loss, particularly if the person has more significant hearing loss.

So enter the telecoil. You know, it's really the first wireless assistive listening technology for hearing on the phone in the 1930s. We're talking 100 years, right? And of course it's called T or telecoil because it

stood for hearing on landline telephones. And in this image from 1936, the telecoil is hidden in this little box.

Wasn't on board the hearing aid yet was hidden in this little box. And the first public hearing loop was essentially used already in 1953 by Winston Churchill so that he could hear in the House of Commons. He was quite hard of hearing in his later years. And he was able to hear in the hearing loop in the House of Commons as long as the other people spoke into the microphone. And in the late 50s, a lot of hearing aids were actually sold with a small loop pad that they could plug into the radio, plug into the tv, put their body hearing aid.

Because in those days it was basically just body hearing aids. They put the hearing aid onto the loop pad. And that's how they could hear the radio and tv. And here I'm going to date myself. I did my student teaching in the late 70s.

And in the Netherlands, many schools for the deaf and the hard of hearing were using hearing loops in the classrooms. Now, that whole interest in hearing loop technology kind of received a whole boost in the early 2000s when there was a hearing loop initiative started by Dr. David Myers from Hope College, and that then spread to other communities. I got on board in 2008. Now, the telecoil, of course, is mentioned in the law, in the ADA law in the U.S. and the standards that kind of show how that law is going to be implemented were updated in 2010, right around that time that these hearing loop initiatives started to spread and they mandated much clearer signage. But also that when assistive systems were in use, neck loops were to be provided so that users of hearing aids and then cochlear implants could also benefit from the signals.

So we're going to be talking a little bit more about the ADA law in part two. I do want to talk a little bit about hearing loops and how, in effect, how, how slick of a system they really are. And in this image I'm showing you what is called a phased array hearing loop, there are a number of wires installed generally

underneath the carpeting or in the ceiling of a facility. And if and when a person speaks into the microphone, that signal is routed to a loop amplifier. The loop amplifier creates a changing current in this wire that changes the magnetic field.

There's a fluctuating magnetic field that varies with the speech that the telecoil in the hearing aid picks up. And the whole cool thing about this is that in a hearing loop, the microphone on the lector or on the pulpit or in the hand of the presenter becomes the hearing aid microphone to the hearing aid. And literally we can be dealing with signal to noise ratio improvements of anywhere between 10 and 25 decibels. And it's the telecoil that is the receiver in a hearing loop. Now, you may wonder why such a large variation of maybe only 10 or 15 versus 20, 25 or 30 db signal to noise ratio improvement, it depends on whether the user's ear mold is open or closed.

If a user is using a hearing loop in a room and turns the microphone on the hearing aid off and only hears the signal coming from the speaker at the lectern, the signal to noise ratio improvements are going to be much greater than if that person has an open ear mold and can still hear some of the ambient sound. The big advantage of telecoils. And I've heard consumers say this time and time again, it sounds so clear when I'm in a hearing loop. Well, of course it sounds clear in the hearing loop. The telecoil picks up the sound, but it's the hearing aid that's literally providing the right kind of amplification for the user to hear indirectly in the ear.

Now, short of giving you a whole lecture on how hearing loops function and the type of hearing loops there are, you need to be aware that there are two different types of hearing loop systems, perimeter hearing loops and phased array hearing loops. Perimeter hearing loops tend to have a little bit more spillover, which not necessarily is a bad thing. That means in my house of worship, you can still hear the minister speak when you're in the bathrooms. And sometimes my patients would say, it's terrific. I can still hear in the gathering space, even though I'm no longer in the church itself.

But what you need to look at in this image is the area that's shown in white, yellow, and light green. This is where the hearing loop is creating a strong, even magnetic field. The same goes in this phased array hearing loop where there is a significant or very strong even magnetic field, but there is no overspill. That means you can have more than one hearing loop side by side in classrooms. One classroom can have a loop, and you can have immediately in the classroom adjacent another hearing loop installed.

But I want to draw your attention to the third hearing loop that I'm showing here. This is a poorly performing hearing loop. The hearing loop is, in effect, only working on the outside of the room where the signal is strong and in the white, light green, and dark green area and thus audible, and by the telecoil in the instrument. But in the center of the area, the signal is very, very weak. This is a hearing loop that doesn't meet the international IEC standard.

And it wasn't really until the IEC standard was developed and hearing loops were being measured very carefully that it was recognized that these hearing loops had to be very, very carefully designed and installed to provide a real benefit. The first induction loop standard was developed in 1981, and the last update goes to 2014. And literally, the hearing loop standard specifies that it can only be installed in area where there is very little electromagnetic interference, that the hearing loop provides a very broad frequency response from 100 to 5,000 hertz. And I've been in hundreds of hearing loops, and it's terrific to hear in a well adjusted, well installed hearing loop and that there is an even magnetic field in the seated area. You also need to know that hearing loops can work at ticket windows, behind glass or information desks, or even in buses and taxi cabs.

And audiologist Justin Burwinkel sought to document the benefits of telecoils in a variety of looped situations. And he made simultaneous out versus in the hearing loop recordings with a specially designed hearing aid by the Starkey company. And he then used Google speech to text to analyze the sound recordings and determine word recognition scores. So for example, at an information desk and

that's shown here in the image on the bottom right on the slide. This green bar shows how much Google was able to decipher the speech in the recording that was made in the hearing aid out of the loop.

And the improvement in speech understanding in the hearing loop. Part of that is because the microphone to this particular hearing loop is actually located lower and not right at the the mouth of the presenter. But a dramatic improvement is seen in the black bar condition. That's the airport ticketing area. There is zero percent speech understanding with just using the hearing aid alone and a 91% speech discrimination or at least recognition by Google in the looped condition.

I also draw your attention to two recordings made in different city halls. One city hall where they used boundary microphones and another city hall where they used podium microphones. Boundary microphone is a microphone that's hanging on the ceiling which is very far away for the hearing loop to pick up the sound. And the speech discrimination actually went down in that particular condition from 33% to 25%. Neither one is particularly great.

But in the city hall where they used podium microphones, where the city hall people actually made an effort to speak towards the microphone that they had in front of of them, speech understanding went from 57% to 91%.

And part of this slide and part of these results are where they learned lessons about microphones. And I want to keep have you remember this when we start talking about oracast is that that AuraCast may be transmitting the sound, but the question is what sound is it transmitting? And part of this for any kind of effective listening system is going to require good microphones and good placement of the microphones. By the way, the little QR code on this screen takes you direct to the real world recordings that just made through the hearing aids. So if you're interested in that, you can just go to that website.

So all too often when I talk to audiologists, they basically tell me yeah, well, you know, that may work for places where there are a lot of hearing loops, but I don't really fit a lot of hearing aids with telecoils because. Because there aren't a lot of hearing loops in my area. Right. But they may not understand fully that FM systems or radio frequency systems are the most common type of ADA assistive listening system used in the United States. In the United States.

And the ADA law requires that where FM systems are used, they must also provide neck loops. So they can work quite well with a neck loop. There is an issue that there is no FM installation standard. And I've been at large conventions where they provide an FM system that takes an audio out from the soundboard. It and this was a convention for about 1,000 attendees.

But in that particular situation the signal was set too low and it wasn't discovered until we were starting to use the FM receivers. And of course different frequencies are used with FM systems.

The telecoil can also be used for. For other devices. And if the telecoil isn't provided to a consumer, literally leaves them out in the cold. So telecoils are helpful for hearing loops. They're helpful for FM system and infrared systems.

When the neckloop is provided, they will be crucial once Auricast systems are going to be installed as part of an assistive listening system in public places. For users who don't have Auracast built in but do have telecoils. We're going to be talking more about that in part two. But telecoils are very helpful to our clients when they want to participate in a group tour. I've been on cruises where they provide a network loop with the little listening devices for people who use hearing aids and implants.

And museum guide systems work that way. They can even be used on airplanes. This is an image of the back of a chair in an airplane. And this is an amplified neck loop. Even though there is a fair amount of EMI in an airplane, if you use an amplified neck loop, this system can be turned up and the gain in

the hearing aid can be turned down as to not hear the EMI in the telecoil, but can also make computers and tablets compatible with the neck loop.

And this is not very much known. Circumaural headphones, the really large headphones that hearing aids blades will fit under provide enough of a strong magnetic signal that the telecoil can work.

So I'm going to have just a couple of slides left about telecoils and then I'm going to turn it on. Turn it over to Brian A little bit about telecoil programming. I just want to show you that here's a hearing aid with a perfectly located telecoil, vertically located. But if you're going to be programming a telecoil, make it a manual telecoil, do not make it an auto coil. And you need to know the difference between MIC plus telecoil versus T coil only.

I highly recommend telecoil only for more open, milder losses or for rig fittings. Generally, enough audio enters the ear past the little earplugs that are being used. But if you're dealing with clients who wear occluding or nearly occluding ear molds, you need to consider the situation. If they belong to a house of worship, if they need to hear their own voice or voices in the vicinity like they might want to do at an HOA ambient meeting, you want to give them a microphone plus telecoil and keep the mix about even. But the fitting most usually the fitting software allows you to modify the MT mix and then frequently I would turn the microphone down just a little bit so they don't pick up as much background noise, but they don't feel isolated just hearing in the T coil system setting only.

And as a rule you give less gain in the microphone setting for clients with poor discrimination. And of course, better yet, teach your patients how to use the app in the smartphone, because in most apps nowadays you can modify the mix of the telecoil versus the ambient sound. This is a Widex app app and this is from the Phonak company And then one of my last slides about reading telecoil specifications. And I will admit that I never really looked a whole lot at telecoil specifications until I started looping. And in this particular slide, when you do telecoil measurements or when you look at

telecoil specs, you need to know that we use DB SPL for sound measurements of the hearing aid.

How does the hearing aid respond to sound? But we put milliamp per meter into the hearing aid to measure the performance of of the telecoil. And what you will see are two different acronyms that will be used on spec sheets. You'll see the splits which is and I have to read this folks, coupler SPL for an inductive telephone simulator. And you'll see the spliv.

This is the telecoil measurement with the hearing aid held in the as it is worn on the ear position. So ideally, manufacturers should verify telecoils in the splive position in the position the way it's worn on the ear. So this is a spec from a resound company. What you see here is the reference test gain measured at 1600 hertz. And the reference test gain is 38 decibel.

And I apologize for the minute numbers on this slide. In the circle in the right, you see the high frequency average to a magnetic input in the split position. So in the position, the way it's worn on the ear, and. And the output is measured as 90 dB, which of course, or 99 dB, which of course is 39 dB of gain. And these two values match.

Here's a Widex hearing aid I looked on the spec. The splits or the spliv are not mentioned. But what you are seeing is a frequency response to a 60dB speech input, the dark black line line, and to a magnetic input of 31.6 milliamp per meter. And you can see that these two perfectly overlap, except in the low frequencies where there are very audible dots, so to speak. And with this kind of frequency response in a telecoil, you can be assured that your patient will hear well in a hearing loop.

And in the last image here is from an oton spec, they used the splits acronym to measure the telecoil, but they do show the acoustic input 60 dB, the magnetic input 31.6. As you now know, these are the same values. And again you see a beautiful matched telecom coil response. And of course, these are specs. These are what the hearing aid is doing in a test box.

But you need to be, if you want to be sure that the telecoil is appropriately programmed for your patients, you should do a quick verification of the telecoil in a hitbox. And the easiest one that at least I'm familiar with is in the verification fit 1 and 2. And this QR code takes you to a handout that spatna shows you step by step how to do the telecoil verification. But here's a screenshot of the speech map testing. And the hearing aid is measured with a 65dB input and compared to a test loop input of 65dB.

And you can see that these two match. And that's important because then you can be certain that when the client switches from mic to telecoil, he gets the same amount of gain. And if you really want to dive into this, Dave Schmiga has done an excellent class on audiology online on how to do telecoil test, testing and verification. Brian? Yes.

Hi, Juliet, thank you for that. I think it's fair to say, and I think a key message around telecoils is that they are and are going to remain an important and a vital part of a network communication device ecosystem. So telecoils are not going anywhere. And I see that we're, you're all going to get some bonus coverage today because we're going to go a little over the hour. I have about 15 minutes of material left.

We're going to talk the last, the remaining time around Bluetooth and some of the basics here in the first couple slides that I'll show. So, you know, Bluetooth has been in hearing aids for more than a decade now. I think most of you know that it's a radio technology that transmits over short distances. There's quite a bit of standardization around Bluetooth Classic as a wireless transmission signal. And the range in Bluetooth Classic at least is around 30ft.

Some of you may not know that there's actually a group out there called the Bluetooth SIG or Special Interest Group that's been working closely with hearing aid manufacturers for a number of years to bring a more thorough universal standard to market. And that's really kind of where AuraCast and Le

Audio has come from, from over the last couple of years. It's also important to remember that 2.4 GHz is more than just Bluetooth, that there's a lot of other proprietary signals in that bandwidth like MFI and asha, a few other, you know, as far as applications and hearing aids, we all should know about data sharing, which is when the hearing aids communicate. For example, the digital noise reduction setting in the left ear automatically activated in the right ear using data sharing. The key to that working is 2.4 GHz Transmission audio sharing, which is usually used in bilateral beamforming.

Some companies use 2.4 GHz, others use near magnetic field induction. But the bottom line, I think, and most germane to our presentation today is that there are these for existing wireless protocols that we rely on. Bluetooth Classic, MFI in the Apple world, Asha in the Android world, and now over the last couple of years, low energy audio. I wanted to take a couple of minutes using this chart here to look at some of the key differences between Bluetooth Classic and LE Audio or what some people might call LC3. You can see the connection type differences, you can see the latency.

You know, Bluetooth Classic works really well in a lot of ear to ear or point to point transmission situations when you're connecting your phone to your earbuds, for example, to listen to Spotify. But in the hearing aid world there are some shortcomings that I think really make LE Audio an attractive solution. Example, the power consumption and the audio quality and the latency tend to be much better in the LE Audio world. I think the key point here though is that many devices, including hearing aids, use both types of Bluetooth. I also wanted to take a minute or so just to kind of talk about, and this is maybe getting in more of the weeds than you want to, but the difference between Bluetooth low energy and LE Audio there, they're essentially the same thing.

But one of the key differences here is that you can think of Bluetooth low energy as the technology and LE Audio is one of the applications that sits inside of that. So we really talk because we're in the audio world. We talk more about Le Audio. Now let's talk a little bit about Le Audio versus AuraCast because

they are not not the same thing. Although you really need low energy audio to use AuraCast, but they are certainly not the same thing.

So just a couple of highlights here. A few years ago the sick group unveiled this new generation of Bluetooth auracast and low energy audio even came up with a new logo or at least a new a couple of new lines around that logo. Remember that LE Audio streams the audio directly between a smartphone and a hearing aid. The audio quality tends to be better because the latency is lower. And of course we're all happy that the energy consumption tends to be much lower.

And there are a growing number of, and I stress this non apple smartphones that come with low energy audio today. And hearing aids with low energy audio capability will make direct LE audio Bluetooth streaming simpler with improved sound quality. So that's kind of what we're all hoping for. But of course, until the entire world is filled with low energy audio, this is a bit of a pipe dream for many of our patients that are able to experience all the simplicity around Le Audio. How does that differ from AuraCast?

You need Bluetooth low energy audio to support this new one to many broadcast mode called AuraCast and those. So of course those technologies are linked together. You can have a device that is low and many of you have probably already experienced this in your clinic because it's fairly common nowadays or you're seeing more of it, that is to have a device that has Bluetooth low energy audio capability but not have oracast capability because you really need both a little bit around terminology. You're starting to hear these terms out there in the marketing literature of hearing aid manufacturers. Influencers within our profession are starting to use these terms.

So I wanted to spend a little bit of time talking about these terms. So we have this term ORACAST ready, which really means that the hearing aid has the ORACAST chip or the hardware on it, but it needs a firmware update for the ORACAST to be operational. And then the other term and you can

contrast that ready term with oracast enabled or oracast live, which means you can put that hearing aid on today, walk into a situation where there's AuraCast and you can actually connect your hearing aids to it. And here's a link to a website that tells you today what products might be ready versus which ones might be enabled. And there's an article that's linked there that goes into detail that's about a year and a half old now.

How does auracast broadcast audio? Actually I like the term they use one to many because that really I think describes how it's different than Bluetooth Classic. And that really means an unlimited number of in range ORACAST receivers can join an oracast broadcast from a nearby transmitter one to many and an Oracle, a transmitter advertises the availability. It's sort of like connecting to WI fi. For those of you that have used Oracle.

Any oracast receiver or assistant can listen for the broadcast and join at the user's request. And this one to many broadcasting really requires three parts. The transmitter which is a tv, a laptop or a PA system. The audio receiver which is in the hearing aid and a smartphone that has Bluetooth low energy capability. So you need those three things in today's world.

A couple other things to remember. A smartphone in theory at least. I think this is again kind of more of a pipe dream these days is not required to listen to an ORACAST broadcast audio stream. And the smartphone does not in this situation have to be involved in the process. So we have this listening to oracast with an assistant which is the smartphone.

And that's by and large what we have today. And then down the road we're going to see with hearing aids where you can do that without an assistant. So a little bit more detail on that here by far is the most common method that you would connect your hearing aids to oracast with an assistant which is the smartphone. And again this works similar to WI Fi where the smartphone scans for the availability of the broadcast and Then you can connect your hearing aids to it in a fairly simple, straightforward way.

And of course the ideal method and what's really exciting about this technology, but down the road, which is not really available yet, is that you wouldn't need the assistant, which is the smartphone.

So you see in the schematic here, the smartphone has disappeared and you would do this whole process directly through your hearing aid. So you can imagine how much easier this could be for a lot of patients that don't want to use their smartphone with their hearing aids. But again, not available yet. Let's talk a little bit about ORACAST obstacles and limitations. Because as exciting as this technology has the potential to be, I think it's important that we don't over promise the capability of oracast that we're realistic with their patients.

I think it's perfectly okay to take more of a conservative approach to think that telecoils and oracasts can be side by side and offer our patients some redundancy for several years down the road. So not to over promise, but to be realistic. And the reason I say that is because of some of the bullet points you see here. We have to acknowledge that as much as you might see influencers talking about it, you might see marketing for from some of our hearing aid manufacturers about it. Oracast is still very much in its infancy and we're not going to really see it in public places for at least another five or six years.

I think we would say it just needs time to mature, to become reliable. We have to develop some standards around it. And maybe most importantly, when you think that 65 out of 100 smartphones in the United States and Apple doesn't use low energy audio, that means there are a lot of people out there that have a, an iPhone that really can't tap into this yet. And again, that three part infrastructure that I've already mentioned, it's going to take a while for that to come to fruition.

And even more importantly, make be we don't have clear standards around installations of ORACAST in public areas. And if you're relying on somebody to install this and they're not using standards that don't exist yet, I think that's a recipe for a lot of inconsistency from location to location that might be using oracast requires some technical training to install. And I think all of that is going to take some

time. So you know, again, I think it's okay to be optimistic, but we don't want to over promise our patients and we want to be realistic. Here's some data from the SIG group that looks at Bluetooth audio streaming and market share.

You see Bluetooth Classic and dark blue. You see Bluetooth Classic with LE Audio in gray, and then you see LE Audio in light blue. And this kind of shows you over the next few years how a greater share of hearing devices are going to have both capabilities built into them, which is good, I think, and exciting for all of us. Just kind of see this slowly evolve and take off over time. Here's a nice slide that kind of shows you the advantages and disadvantages and not a only Bluetooth Classic and Bluetooth Low energy, but also made for iPhone and the ASHA protocols.

You know, I think that we live in a world where classic and low energy audio are going to be living side by side. So it's important to know what the advantages and limitations might be. And then I put this little chart together because it kind of shows you the lay of the land, so to speak, with all of these different components of a network communication device, device ecosystem. You see across the top the different components of it that we talked about today. And we're going to talk more about some of these next week in more, even more detail.

But you can see on the left margin there what can be used at home, what can be used in the car, what can be used for public listening, what needs additional equipment, what installation standards do or don't exist. And then next week we'll talk more about ease of use and expected patient benefit. Because I think all of you know, in the clinic those factors really depend almost exclusively on the individual and our ability to teach them, educate them, kind of get them up to speed, empower them and, and so forth. I want to kind of leave you though. We spent the bulk of our time talking about telecoils, hearing loops and oracast.

And I really like what HLAA says about these technologies. And the phrase they use is that these technologies are better together, which really means that we live in a world where both exist and there's a lot of redundancy available to our patients when they're able to have both of these devices available to them and at their fingertips.

So, conclusions? And Juliet, I'll let you chime in here if you'd like, but I think we really need to. We live in a world where we can't think of these as one off accessories that we live in a world where our patients have access to a network communication ecosystem and it's our job to sort of pick and choose which ones might be most beneficial for them to use in any given situation. Remember that MILU kind of concept from Kotchkin from many years ago? And of course it's the role of the audiologist or the hearing care professional to match the right wireless technology to the needs of the individual wear and of course to verify their performance to instruct them on how to use them successfully, which are topics we'll get into more detail with next time.

And again, I think some of the best advice that we can offer you is around redundancy where patients have the availability of both both an oracast ready system along with a telecoil on their devices. And Juliet, if you have any further comments please. I couldn't agree any more about this. I run into too many hearing aid users who say why didn't my audiologist tell me about this? I think we're not asking our clients the right question.

Question. Don't ask your clients whether they want the telecoil. You want to ask the question do you want to hear in the theater and in the church and in large meeting rooms and if the answer is of course going to be yes, then you're going to tell them and I'm going to set you up with technology that's going to help you do just that. We may not talk about it in your first visit, but but we are going to discuss these technologies and I'm going to make sure that you have everything that you would need in your hearing aids.

Well said, Juliet. No, I think that you've captured it well. I look forward to seeing you next week for part two and I think we'll go ahead and wrap it up and we'll hope that all of you rejoin us next week, same time for part two.