AWASH IN A STREAM

of Wireless Solutions

By Jason A. Galster, Ph.D.

A quick look at today's hearing aids will show many that offer wireless communication. As with any novel technology, companies developing new hearing aid technology clamor to find the ideal method for wireless connectivity; the various methods for wireless connectivity offer different features, benefits, and constraints. As experts in the treatment of hearing loss through amplified listening we are charged with understanding each of these technologies, the differences among them, and making a selection that is consistent with the treatment plan they have selected for a given patient. Although there are a wide range of wireless features in hearing aids, this article aims to clarify modern techniques for wireless audio streaming from media sources (e.g. a television) or a mobile telephone.

First, wireless technology in today's hearing aids can be classified into one of three types: near-field magnetic induction (NFMI), 900 MHz, or 2.4 GHz. These three technologies span a wide wireless frequency range. NFMI uses the lowest range of frequencies and will be referred to as near-field wireless communication. The NFMI wireless signal easily passes through and around objects such as the human head, making it a favorable option for ear-to-ear signal processing. The disadvantage of NFMI is a relatively short—near-field—wireless transmission range of approximately 1 meter. For this reason, NFMI requires an intermediate relay, typically neck worn, for audio streaming at distances over 1 meter. Using an intermediate transmission frequency, 900 MHz offers both ear-to-ear communication between a pair of hearing aids and what will be referred to as far-field wireless communication. In the context of hearing aids, far-field wireless systems offer wireless communication of approximately 5 meters. Finally, at the highest transmission frequency for wireless hearing aid technology is 2.4 GHz; this high-frequency signal allows for effective far-field connectivity, again up to 5 meters, however the high-frequency nature of 2.4 GHz may constrain the robustness of ear-to-ear signal processing, as the signal does not propagate through or around obstacles with the efficiency of lower frequency signals. Galster (2010) offers additional review of these technologies.

Connecting to a Media Device

In order to transmit an audio signal from any media device, using a television as the example, the audio signal must first be routed out of the television and converted into a far-field wireless signal; this means that all wireless audio streaming must begin with a transmitter attached to an audio output from the television. The far-field wireless signal might be a Bluetooth audio stream, a 900 MHz audio stream, or a 2.4 GHz audio stream. In the case of hearing aids that use a near-field technology, the audio stream is sent from the transmitter near the television to a relay device either worn by or held near the patient. This relay device changes the far-field signal into the near-field wireless format used by those hearing aids, providing wireless audio streaming. Figure 1 illustrates the stages of audio streaming in hearing aids using near-field wireless technology. An advantage to this strategy is that much of the power consumption required for wireless streaming can be absorbed by the battery in the intermediate streaming device. If however, that rechargeable battery fails during a movie or television show the patient must wait for the device to charge again before having access to their streamed audio.

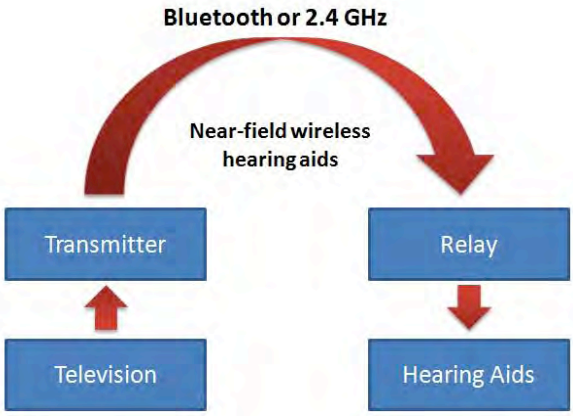

Figure 1. The stages of wireless audio streaming for near-field wireless hearing aids are illustrated.

In the case of hearing aids with far-field wireless capabilities, the wireless signal is sent from the transmitter near the television directly to the hearing aids, eliminating the requirement for a relay device near the patient. This ability to receive a far-field wireless stream by the hearing aid also avoids the cumbersome transcoding of a Bluetooth audio signal. Figure 2 illustrates the stages of audio streaming in hearing aids using far-field wireless technology.

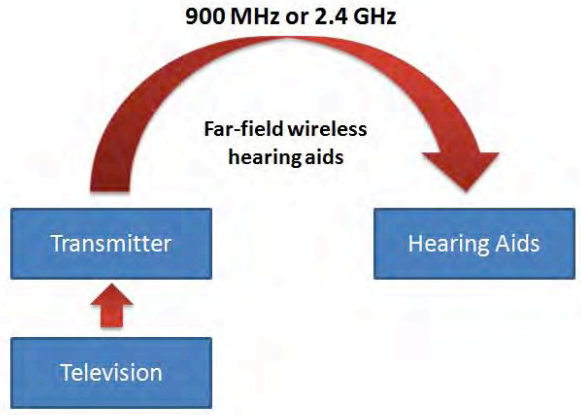

Figure 2. The stages of wireless audio streaming for far-field wireless hearing aids are illustrated.

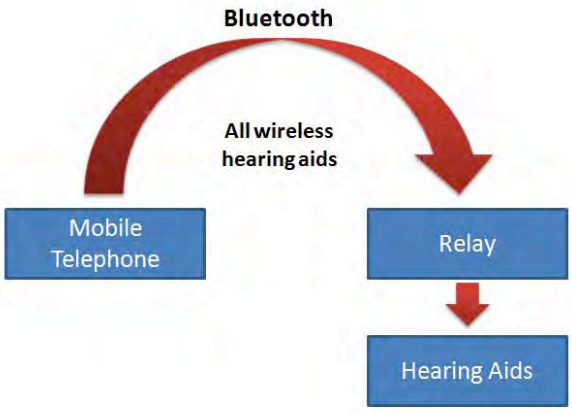

Figure 3. The stages of wireless audio streaming from a mobile telephone to hearing aids are illustrated.

Connecting to a Mobile Phone

The telecommunications industry has adopted the Bluetooth protocol as the standard format for wireless communication through mobile phones. For reasons, largely related to power consumption, modern hearing aids are not designed to directly receive and transmit wireless information in the Bluetooth format. Because of this, all hearing aids must use a relay device that receives the Bluetooth signal and translates that wireless signal into a signal that can be used by the hearing aids. This is illustrated in Figure 3. Regardless of the wireless technology, near- or far-field, the patient must use this body-worn relay in order to communicate with the mobile phone. Most often, these relays are worn around the neck or clipped to a lapel; this placement has the benefit of orienting the microphone near a patient's mouth allowing for discreet

hands-free conversation. Connectivity with a telephone also offers the option of bilaterally streamed audio that can overcome some limitations related to ambient noise and poor signal-to-noise ratios (Picou & Ricketts, 2011). Wireless connectivity between a mobile phone and hearing aids also allows for the added safety of hands-free phone use while driving.

Wireless features have introduced a new listening experience to many of our patients. To this point, below is a quote from a first-time user of hearing aids featuring wireless technology:

"Last night was the first time I tried listening to the television wirelessly! It was like being in a movie! The commercials that I've been watching in the last couple weeks made more sense last night. I didn't realize commercials had a valid reason to be on. It was just really nice to be able to enjoy the shows. I'm sure you guys have heard these things before but I just wanted to let you know it was awesome! I was a kid in a candy store!"

The opportunity to hear the television directly through one's hearing aids overcomes the disadvantages of distance, ambient noise, and low quality speakers that are often found in televisions. Wireless audio streaming from a telephone improves convenience with added safety and the opportunity to overcome challenges of ambient noise. Each of these features provides a benefit unique to hearing aids; the audio is frequency shaped to the patient's hearing loss improving audibility of the streamed signal. These advancements allow patients to enjoy a wider variety of content and communication in more situations than were accessible without accustomed to without the benefits of wireless audio streaming. For many patients the ability to access streamed audio can be a large part of their daily routine, providing additional benefit and assisting them toward successful and routine use of their hearing aids. ■

References

Galster, J.A., (2010). A new method for wireless connectivity in hearing aids *The Hearing Journal. 63* (10), 36-39.

Picou, E.M. & Ricketts, T.A. (2010) Comparison of wireless and acoustic hearing aid based telephone listening strategies. *Ear and Hearing 31*(6), 1-12.

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Wireless Routing Technology: Clinical Tips and Tricks

by Brian Taylor, AP Editor

All major hearing aid manufacturers offer products that utilize some type of wireless connection between consumer electronic devices, such as cell phones & televisions and the hearing instruments. Additionally, many manufacturers allow for wireless communication between two devices worn by the end user. Currently, there are three types of wireless transmission options, which were outlined in the previous article. Each manufacturer relies on one of these three options in their current wireless product portfolio. For each of these three wireless choices currently available to audiologists, there are advantages and limitations. When comparing these three wireless routing options, the prudent audiologist is encouraged to talk to the manufacturer representatives in order to gain a better understanding of the pros and cons of each specific device. Variables such as transmission distance, ease of use for patients, potential to interfere with medical devices, "future proofing" and battery life are some of the important considerations that need to be discussed with each manufacturer's representative.

Given the potential of wireless routing to improve communication and overall patient satisfaction in many challenging listening situations, audiologists are advised to include wireless routing benefits as part of the pre-fitting dialogue with all patients. One tool that has potential to enhance this patient-provider dialogue is the TELEGRAM, developed by Linda Thibodeau, Ph.D, of the Callier Center at the University of Texas at Dallas. The TELEGRAM is shown in Figure 1. Each of the letters of the TELEGRAM denotes a specific listening situation. Many of these listening situations have the potential to be improved (e.g. cell phones) when patients are able to utilize wireless devices. Furthermore, the TELEGRAM allows audiologists to evaluate communication in the unaided and aided condition on a 1 to 5 Lickert scale, thus, the TELEGRAM can be used to measure real world benefit of the consumer device audiologists choose to wirelessly connect to the hearing instruments. In an age where measuring real world benefit of hearing aids is required; the TELEGRAM is an essential tool. Audiologists are encouraged to incorporate it into their pre-fitting communication assessment and post-fitting follow-up protocol routines. ■

Reference

Thibodeau, L. (2004). Maximizing Communication via Hearing Assistance Technology: Plotting beyond the Audiogram! Special Issue: Assistive Listening Devices. Hearing Journal, 57,46-51.

NAME:_____ Date of Birth:_____ Person completing Telegram:_____

	T	E	L	E	G	R	A	M
	Telephone	Employ-ment	Legislation	Entertain-ment	Groups	Recreation	Alarms	Members of
RATING 1 No Difficulty								
2								
3 Some Difficulty								
4								
5 Great Difficulty								
	C-Cell phone L-LandLine	J-Job S-School	P-Public Listening A-ADA	T-TV M-Movies	C-Church P–Parties M-meetings	_____ _____ _____	S-Smoke D-Doorbell C-Clock	Check all that Apply

Live with Normal Hrg Adult

Live with Young Children

Live with Teenagers

Live with Adult with Hrg Loss

Live Alone

Three Main Problems to Address:

_____

_____

_____

Recommendations:

T_____ E_____ L_____ E_____ G_____ R_____ A_____ M_____

_____ _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____

Figure 1. The TELEGRAM questionnaire created by Linda Thibodeau, Ph.D. Reprinted with her permission.

TELEGRAM Rating Scale Key

Topic	Question	Rating
T	Are you having difficulty with communication over the **telephone**?	Difficulty 1=None, 2=Occasional, 3=Often, 4=Always, 5= Can't use the phone *Use"L" to designate Landline and "C" to designate Cellphone.*
E	Are you having any difficulty with communication in your **employment** or **educational** environment?	Difficulty 1=None, 2=Occasional, 3=Often, 4=Always, 5=Stopped working
L	Do you know about **Legislation** that provides assistance for you to hear in public places or in hotels when you travel?	Knowledge 1=Vast, 2=Considerable, 3=Some, 4=Limited, 5=None
E	Are you having difficulty with hearing during **Entertainment** activities that you enjoy such as television, movies, or concerts?	Difficulty 1=None, 2=Occasional, 3=Often, 4=Always, 5= Stopped Going
G	Are you having difficulty with communication in **Group** settings?	Difficulty 1=None, 2=Occasional, 3=Often, 4=Always, 5= Can't hear at all in groups
R	Are you having difficulty with hearing during **Recreational** activities such as sports, hunting, or sailing?	Difficulty 1=None, 2=Occasional, 3=Often, 4=Always, 5= Stopped the activity
A	Are you having difficulty hearing **Alarms** or **Alerting** signals such as the smoke alarm, alarm clock, or the doorbell?	Difficulty 1=None, 2=Occasional, 3=Often, 4=Always, 5= Can't hear alarm *Use"S" for Smoke Alarm, "D" for Doorbell, and "A" for Alarm Clock*
M	Are you communicating with **Members** of your family?	1=Live with Normal Hrg Adult, 2=Live with Young Children, 3=Live withTeenagers, 4=Live with Adult with Hrg Loss, 5=Live Alone *Check all that apply*

Figure 2. Key questions to ask patients when completing the TELEGRAM are listed in the left column. The 1 to 5 rating scale is listed in the right column.