Audiology Today

JanFeb2011

Volume 23 No.1

Audiology 24 Today | JanFeb2011

Access America: It's About Connectivity

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There are multiple factors that impact the acceptance of the connectivity system by the enduser, including

cost, portability, performance, ease-of-use, cosmetics, and more.

Dictionary.com defines connectivity as "the state of being or being able to be connected, or the state of

being connected to the Internet…to be connected to other machines, appliances, or facilities."

The Pew Internet and American Life Project (2010) notes that 72 percent of Americans are now connected to the Internet, and nearly 60 percent are connected wirelessly using a laptop or cell phone. Older Americans are not immune to the connectivity explosion. Indeed, 41 percent of those older than age 65 have access to the Internet. Although the information superhighway provides us with 24/7 access to news, entertainment, sports, and business—in

the final analysis, being "on the grid" translates into connecting with other people.

Connectivity is a shared internal experience, and "the key benefit of technology-driven communication

enhancement is additional human connectivity" (Beck and Harvey, 2009). "Connectivity describes products and

processes that connect people, including all protocols (Bluetooth, FM, near field magnetic induction, t-coils, DAI

etc.), which connect humans" (Beck, 2010). Therefore, with due respect for the technical components, and advances

and accomplishments, in the final analysis, connectivity is about connecting humans to humans.

Of course, there's more to connectivity than hearing and hearing loss. Communication (the transfer of information)

among humans can be accomplished through multiple channels (i.e., audition, vision, touch, smell, and

taste) and across a multitude of venues (television, radio,Internet, texting, instant messaging, etc.). As long as we communicate, we can experience connectivity. However, in the absence of communication, there is no connectivity, no shared internal experiences, no human interaction, and no enablement or growth (Beck and Harvey, 2009). In this article, we'll briefly address and describe five connectivity systems designed for hearing impaired people, to be used in tandem with advanced hearing aids and related products. The importance of connectivity systems was further underlined by Kochkin (2007), who stated improvements in connectivity, with specific regard to multiple environmental listening utility (MELU), will improve hearing aid satisfaction and market penetration. Specifically, greater functionality facilitates increased connectivity as well as increased engagement between the hearing-impaired person and others, reducing the isolation that often accompanies untreated

hearing loss. Of note, there are multiple factors that affect the acceptance of the connectivity system by the

end user, including cost, portability, performance, ease-of-use, cosmetics, and more.

The "Best" System Naturally, because the MELU concept makes a priori and intuitive sense, many consumers and professionals quickly inquire so as to maximize communication across multiple listening environments. Often, they ask, "Which is the best system?" The answer varies and is founded on the needs, desires, and abilities of the individual. The best

system is simply “the one that is used.” Despite widespread availability of connectivity technologies in the United States, market penetration is lower than hearing aid market penetration (hearing aid market penetration hovers consistently between 20 and 25 percent). Undoubtedly, the two penetration rates are closely related to the concept of transitioning hearing aids and assistive devices to “personal communication

devices,” which permit hearing-impaired individuals to effectively listen to and enjoy (Kochkin, 2007) live performances, such as theater, opera, concerts, as well as movies,

Dedicated FM systems provide benefits and security, using a number of different frequency bandwidths.

loop for an enclosed space is rather low (starting at approximately $300 for a complete system).

The primary requirement for loop-to-telecoil communication is the installation (temporary or permanent) of

a simple wire loop around a designated closed area, such as a living room, theater, or auditorium.

Any telecoil user within the loop may hear sound delivered through the system.

Importantly, even some of the smallest custom hearing aid styles (e.g., in-the-canal) are compatible with

land-line and cellular telephones, recorded music (MP3, CD, DVDs, and more), television,

precise and effective communication in places of worship, lectures in auditoriums and other public forums, and

seamless communication in restaurants, automobiles, and other noisy listening situations.

In her recent Audiology Today article (“Looping America”), Patricia Kricos (2010) provided an excellent summary of

telecoils and induction loop technology. These technologies have been available for decades, and provide low-cost,

easy-to-use functionality for use with hearing aids, cochlear implants, and assistive technology. Induction

loops and telecoils work in tandem as the transmitter and receiver, respectively, for wireless communication

between two devices. To engage “loop-to-telecoil” communication, the telecoil (within the hearing aid) must be located within the induction loop’s electromagnetic field, within which it converts electromagnetic energy to

audible sound (Beck and Brunved, 2007). Historically, the most popular application of this technology has been for

communication between hearing aids and telephones. Fortunately, several initiatives have been recently

developed and promoted to increase the use of loops and telecoils in public places, including theatres, lecture halls, and places of worship.

The primary rationale is that telecoils are already used in the majority of hearing aids (Johnson, 2008, reported

an increase from 2001 to 2007 from 37 to 65 percent, respectively) and the monetary cost of a wired induction

with telecoil use. Unfortunately, despite the low cost, induction loops are not widely

used in the United States (outside of a few communities, including Holland, Michigan, which has been a leading

influence with the Looping America initiative), thus limiting connectivity, despite the relatively low cost and

ease-of-use. Of note, loop-to-telecoil limitations include relatively limited bandwidth (as compared with modern

hearing aids and other connectivity systems), possible distortion from nearby electromagnetic sources, and

limited portability.

Infrared (IR) systems have been available for many years. IR systems use an infrared light-emitting array transmitter (similar to a television remote control) in tandem with an IR receiver (often a head-set device) to facilitate one-way, secure transmission from a single-

sound source IR transmitter to one or more IR receivers. These systems have been popular for home use (e.g., television, music

stereo systems) and in public places (e.g., movie or live theatre). The cost of these systems is relatively inexpensive, depending on how many transmitters are required to ensure “line-of-sight” communication to the body- or head-worn receivers. IR systems are very easy to use and require minimal installation or maintenance. The core limitation is that IR systems are primarily designed for indoor use within an enclosed area. That is, the IR system light beam can be interrupted through sunlight, thus limiting benefits for portable applications, and limiting integration into existing hearing aids or cochlear implant devices.

Dedicated FM systems provide benefits and security, using a number of different frequency bandwidths (e.g.,

72–76, 169–175, 216–217 MHz) designed to be independent from other radio frequency sources, including AM/

FM radio, broadcast and satellite television, etc. In the United States, the bandwidth 216–217 MHz has been

established for use with assistive listening devices by the Federal Communications Commission (FCC). In the

United States, some public places have installed FM transmitters broadcasting in the 72–76 MHz frequency

range. To receive this signal, people must wear a hearing aid (or other device) with a specially equipped receiver

tuned to the transmission frequency.

FM systems have enjoyed widespread popularity for educational use with hearing-impaired children, as they

provide excellent portability, ease-of-use, and performance. When used properly in the classroom, FM systems

provide significant signal-to-noise advantages over traditional hearing aids alone (Hawkins and Yacullo, 1984)

and in some cases provide hearing-impaired persons with superior performance to normal-hearing persons in

the same noisy listening environment (Lewis et al, 2004). Due to vast improvements in durability, portability, and

ease-of-use, FM systems have become a cornerstone with respect to educational audiology and hearing-impaired

children. Beyond maintaining an excellent signal-to-noise ratio (SNR), FM systems help to reduce or eliminate background noise and reverberation (Beck et al, 2006).

The primary limitations of dedicated FM systems are cost and size. Importantly, the cost issue is due to the

relatively small number of devices sold each year. In the United States, dedicated FM systems are used predominantly by children rather than hearing-impaired adults. The reasons that FM systems have not dominated the

adult hearing aid market include concerns over ease-of-use (Jerger et al, 1996), cost (Ermann, 2003), and lack of

a “best practices” protocol for use by clinicians (Ermann, 2003). Despite significant advantages over earlier technology, these perceived limitations have prevented dedicated FM systems from significantly improving connectivity for the majority of the 34.25 million people with hearing loss

in the United States (Kochkin, 2010).

Bluetooth (BT) is a proprietary open wireless technology standard for exchanging data using short wavelength

radio transmissions using the 2.4 GHz frequency range. Created in 1994, it was first conceived as a wireless

method for eliminating cables between electronic devices. However, BT quickly gained widespread popularity with

multiple applications and technologies, including cell phones, televisions, and other audio signals from multimedia devices. Indeed, BT has successfully been applied to numerous hearing aid applications, specifically to

address the connectivity problem. BT permits secure, simultaneous connectivity among up to eight devices

within a local network, called a piconet.

The many advantages of BT include communication with multiple and varied electronic devices, as well as

low cost, secondary-to-widespread (and still increasing) adaptation, and use.

Unfortunately, the disadvantages of BT as it relates to hearing technologies include:

Increased power consumption, Larger physical size, Diminished transmission range,

Limited bandwidth (relative to dedicated FM systems),

and a little bit of “technophobia.”

Although significant progress has been made with respect to BT’s audio delay, previous BT systems introduced

a delay in the audio transmission, which was quite distracting (up to 50 msec in some cases). BT devices

require the two (or more) devices within a piconet be paired so they can recognize each other, thus facilitating

device-to-device communication. Despite the relatively simple pairing protocol that is easily accomplished by the

end user (and is increasingly performed prior to the end user acquiring BT devices), the necessity for pairing may

present a significant limitation for many potential older users of this technology.

Although BT provides the potential for vastly improved connectivity, for some users, BT

the hearing aid industry has recently pioneered a “wireless” revolution by building digital signal processing

devices that comprise an on-board “radio,” thus permitting hearing aids to communicate directly with a

programming device, television, cell phone, or a second hearing aid worn on the opposite ear. Currently, some

applications use a Bluetooth relay, while others use “onboard” 900 MHz or 2.4 GHz frequency transmission. These

new dedicated wireless technologies potentially offer improved portability, improved ease-of-use, improved

performance, and improved cosmetics. However, disadvantages at this time include increased expense and

relatively shorter battery life.

Conclusion

This article has provided a brief overview of the technology available to improve connectivity for hearing-

impaired persons using dedicated or shared electronic technology. Each application has advantages and

disadvantages.

(there are missing and jumbled words which are hard to decipher…)

Further, “cross pollination” with other consumer electronic devices, including iPods, iPads, smart phones, GPS systems, FM systems, CDs, DVDs, and other personal communication devices, provide the potential for “app” developments— including the capability to use an integrated microphone on a particular consumer device as a “remote” microphone for BT-enabled hearing devices.

The connectivity potential realized by “piggy backing” hearing aid applications onto general consumer electronics is staggering and offers the opportunity for wider and deeper acceptance (and desire) of these devices than previous technologies.

To overcome some of the obstacles related to BT, for example, pairing, size, power consumption (see above),

Harald Bluetooth attempted to reduce multiple belief systems (across Scandinavia) into one, the goal of improved connectivity is to provide a universal standard for communication that is low cost, easy

to use, acceptable, seamless, and effective. We are not there yet, but the future appears bright!

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