

## Toward a Wireless Interface for Hearing Instruments

To support the hearing impaired, various wireless technologies for hearing instruments have been available for many years. Products based on such technologies can for instance be used in public venues. With the latest generation of Bluetooth Low Energy Audio, the range of possibilities is expanded considerably. This paper addresses the new developments and the question what people with hearing loss may expect in the near future.

Rob Drullman  
March 2021

Photo: Pixabay.com

### Introduction

Hearing impaired people want to receive the sound of their hearing aids as clearly as possible. It often concerns understanding speech, but it also applies to music, for example. Speech sounds entering via the microphone of the hearing aid can be disturbed by the acoustical environment, in particular by noise and reverberation, which reduces intelligibility.

The best way is to bypass the acoustic environment and present the source directly – and wirelessly – to the hearing aid. There are several options available and in this paper I want to focus on public venues. Well known analogue solutions are inductive hearing loops, FM systems and IR systems (Dillon, 2012). In recent years digital systems based on 2.4 GHz have become available as well.

Hearing aid manufacturers have *streamers* on the market; their application is usually limited to the personal environment, e.g., transmitting TV sound to a hearing aid. To date, these are proprietary solutions, with the receiver in the hearing aid or as a separate accessory.

### Development of the Bluetooth hearing aid standard

Bluetooth® is a worldwide digital standard of the electronics industry for wirelessly inter-connecting devices. Innovations in Bluetooth come in quick succession. This is done in Bluetooth SIG (Special Interest Group), where the most important technology companies in the world drive new developments. Six years ago, the joint hearing aid industry united in EHIMA (European Hearing Industry Manufacturers Association) started a collaboration with Bluetooth SIG to develop a standard for hearing aids (EHIMA, 2014). It aims at realizing a universal solution that allows hearing aid users, including cochlear implant users, to receive high-quality speech and music wirelessly. Without accessories, directly to the hearing aid and regardless of the brand.

In recent years, Bluetooth has continued to penetrate. Connectivity and communication are omnipresent. The use of wireless earphones – the so-called *hearables* – is expected to increase sharply in the coming years (Hunn, 2020). An important innovation for this was the introduction of Bluetooth Low Energy, from which hearing aids will also benefit.

## LE Audio – the next generation streaming

At the end of 2019, Bluetooth announced Low Energy Audio, or LE Audio for short (Bluetooth, 2020). This provides improved audio performance and hearing aid support is explicitly mentioned. Important features of LE Audio are *multi-stream*, *audio sharing* and *broadcast*. Sound from a source (speaker) can then be streamed to an unlimited number of receivers. Hearing aids equipped with a suitable Bluetooth receiver will be able to connect, similar to turning on the T-coil mode to connect to a hearing loop system. Streaming from multiple sources at the same time makes it possible, for example, to broadcast different languages. Very useful in places such as international train stations and airports.



The above all has to do with technology. LE Audio is one of the prerequisites for a successful implementation of optimal support for the hearing impaired. Upon completion of the software development, EHIMA intends to share it as *open source*. That is part of the aim to have a future system used by as many people as possible.

Another equally important prerequisite is accessibility and ease of use. How do we ensure that users of LE compatible hearing aids can benefit from this? For that we need to have a good understanding of the different use cases.

## Wireless Streaming System – what hearing aid users can expect

EHIMA has launched the concept of a wireless streaming system for hearing instruments, with LE Audio as its technology base. The wireless streaming system (interface) intends to ensure a consistent user experience, which is essential for a successful implementation. Various scenarios can be devised in which users are served: the public spaces with a single source, such as places of worship, concert halls, theaters or stadiums. Or locations with multiple sources, such as in multi-screen cinemas.

Regardless of the venue it shall be easy for hearing aid users to connect. This calls for a tight set of user requirement and system specifications. The first wireless interface specification is currently under development and will address the above-mentioned scenarios – focused on *public broadcast* – where it can be regarded as a digital variant of a hearing loop.

The experiences that the streaming system wants to offer to a hearing aid user are in fact very practical. Sound must go directly to the hearing aids, regardless of brand; it must be easy to use, without the need for other devices; any additional services and functions could be accessible through an app on a smartphone.

A streaming system transmitter must announce availability of a source to the users of hearing aids and have the option to limit access to the source to qualified users (exclusivity).

An important issue is whether the streaming system can be accessed directly or if an app on a smartphone is required. The latter could make its use easier, but it is also a limitation. Not every user can or wants to work with a smartphone and is then more likely to be locked out. Basic system functionality should be available directly from the hearing aid. On the other hand, current hearing aids with Bluetooth are often used for connection to a smartphone, with all kinds of other services and support. Despite all the technical possibilities, it is important to keep a permanent eye on the ease of use of the system.

As an illustration, one scenario is described in more detail below. The different steps must be worked out in the final EHIMA streaming system specifications.

## CINEMA USE CASE



### Description

Jim and his wife go to see a movie at the cineplex, which has 8 small theatres. They choose a movie in theatre 6.

### Actors

- Cinema operator who shows the movie.
- Jim, a hearing-impaired customer who wants to listen to the movie sound via streaming.
- Other customers watch the movie without being disturbed by the streaming system.

### Trigger points from receiver's point of view

When going from the lobby to the movie theatre a sign shows the availability of EHIMA's streaming system. Jim passes the narrowcast theatre 6 transmitter and hears a short jingle. Jim accepts the system signal by clicking on a button of his hearing aid. It is set to a mix of microphone and streaming input, so that he can also hear ambient sounds.

### Trigger points from sender's point of view (system operators)

Streaming (broadcast) starts automatically when the movie begins. There may be more movie languages, so more streams available. Hearing aid users can connect even after the movie has started (late comers).

## Pilot research

In order to gain an impression of the opinion of hearing-impaired users, a pilot study was conducted in Denmark at the end of 2019. Existing proprietary 2.4 GHz streamers from two manufacturers were used to simulate EHIMA's wireless system. The experiences in using these systems were compared with those of the traditional hearing loop.



Tests were conducted in a classroom and in a church where hearing loop systems had already been installed. Subjects listened to audio via hearing loop or stream from a live speaker or from a recording of a radio talk show.

The streaming system appeared to have a sufficient range for these areas and was insensitive to interference from other devices. Neither was there a discernible delay on the signal. That is, the sound received from a live speaker was lip-synchronous.

A total of 16 (severely) hearing impaired subjects were questioned about their opinion on sound quality, speech intelligibility and interference. The opinions on streaming were always positive, with scores slightly higher than for the hearing loop. In general, a majority preferred the wireless streaming system.

## Near future for EHIMA's Wireless Streaming

As mentioned before, EHIMA will focus on the common *public broadcast* scenarios when drafting the requirements and specifications of the first version of wireless streaming. In later versions, solutions will also be developed for other use cases, e.g., 1-to-1 private connections.

Smaller and medium-sized areas – places of worship, cinemas, theaters, auditoriums, conference rooms, etc. – with the audience on a fixed place are relatively simple to operate. Perhaps in larger spaces by means of several transmitters to reach all hearing aid users. It will be different for the very large venues – stadiums, train stations, airports – where people are moving around. This will require multiple transmitters, which must be tuned to each other in order to continuously reach the hearing aid users without disruption.

In order to realize the optimal streaming system for end users, it is of great importance to involve international hard-of-hearing organizations in the process. This also applies to organizations and companies with public spaces, installers of communication systems, manufacturers of hearing loop systems, content providers, operators of venues, etc.

Finally, we will have to look at standards, (inter)national guidelines and regulations for supporting the hearing impaired. There is a worldwide call for inclusive societies in which people with disabilities can fully participate. Regulations will require adjustment, expansion, starting with awareness of emerging wireless technologies. It should not be limited to just hearing loops.

## **Conclusion**

EHIMA's Wireless Streaming System will be a highly attractive supplement to existing public broadcast systems. The technology is relatively easy to install, despite a number of technical challenges. It will deliver high quality sound to the hearing impaired, both for speech and music.

There are also challenges in terms of ease of use for the (elderly) hearing impaired. Ease of use is of primary importance for the hearing aid users. When properly implemented, the system will give the hearing aid users better access to information and therefore more independence.

The fact that Bluetooth as an organization cooperates with the hearing aid industry and also explicitly involves hearing aids in the marketing of LE Audio is beneficial for the hearing-impaired community. This also includes people with cochlear implants. And the fact that a fast-growing market for hearables has emerged in a short period of time will also be beneficial. We expect that the major electronics companies will pay more attention to audio in their products and help finding solutions for people with hearing loss.

When can we expect the first EHIMA streaming systems in practice? That is difficult to predict, because we depend on many different players. All in all, the hope of availability in key locations is sometime within the next 2-3 years.

## **Acknowledgements**

For this paper I used different sources of information, particularly from experts in audiology, hearing instruments and usability. I want to express special thanks to Nikolai Bisgaard and Per Kokholm, who have been active in EHIMA's wireless development projects for many years.

## **About the author**

Dr. Rob Drullman works as an independent researcher and consultant and has been Secretary of the Technical Committee of EHIMA since 2016.

## **Literature**

- Bluetooth (2020). "LE Audio",  
<https://www.bluetooth.com/learn-about-bluetooth/bluetooth-technology/le-audio/>
- Dillon, H. (2012). *Hearing Aids* (2<sup>nd</sup> edition). New York, USA: Thieme.
- EHIMA (2014). "Wireless connectivity turns hearing aids into multipurpose devices",  
[https://www.ehima.com/wp-content/uploads/2014/09/PR\\_EHIMA\\_Bluetooth\\_17092014.docx](https://www.ehima.com/wp-content/uploads/2014/09/PR_EHIMA_Bluetooth_17092014.docx)
- Hunn, N. (2020). *The Hearables Report 2020-2025*,  
<https://www.nickhunn.com/hearables-market-to-reach-80-billion-in-2025/>