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INDEPENDENT REVIEWS OF THE THINGS WE USE

Low Energy Audio and the Future of ASHA

by Chris Bidmead February 3, 2021

Two important things have happened. Firstly, the much anticipated arrival of Goggle's ASHA (audio streaming for hearing aids). Secondly, the announcement of the new Bluetooth 5.2 standard. This adds Low Energy Audio streaming (LE Audio), a significant development that includes… audio streaming for hearing aids. It is a big mistake to assume that the former was a subset of the latter. ASHA and LE Audio are only very distant cousins.

Google's new version of Bluetooth audio, ASHA, requires Android 10, the newest available version of the Android operating system and in February of this year Google very kindly sent Tested Technology a Pixel 3a phone running this version. We'll report on this in a later review.

ASHA and LE Audio

The Bluetooth SIG development came as a total surprise. At a meeting in early March 2020 organized by the Bluetooth Hearing Aid Working Group I learned that the new standard they had been developing for Bluetooth 5.2 included a radical update to the Low Energy (LE) implementation.

Bluetooth Low Energy (BLE) was incorporated into Bluetooth version 4.0 ten years ago. As its name implies, it was designed primarily to save power. Without sacrificing range, the standard uses lower bandwidth and omits some of the functions of the "Classic" full implementation. One of these omitted functions was audio streaming.

The Inside Story

EHIMA is the European Hearing Instrument Manufacturers Association, responsible for around 90% of all such devices sold worldwide. An effort towards Bluetooth low energy for hearing aid streaming originated with the EHIMA sometime in 2013. The laudable aim was to develop an open standard. But sources suggest that individual members of the group, used to working on closed, proprietary projects, had little previous experience of the cross-company cooperation this would require.

Because of this, the EHIMA seriously underestimated the time it would take, believing that a new standard could be completed in around 18 months. Seasoned open standards developers know that a project of this size will more likely need five to seven years.

Inside Story (continued)

Tested Technology understands that around three years into the project, GN (the Danish holding company responsible for the LiNX Quattro) grew restless and turned to Google for help. GN sources confirm that while the EHIMA's Bluetooth work continued, in 2018 Google and GN began the ASHA project as a safety net.

Google at the time was a member of the Bluetooth SIG. So at least some of the Google engineers were contributing to ASHA and had also been working on the new official Bluetooth SIG LE Audio standards. They will have realized that the EHIMA's original timescale was absurd but must also have felt the pressure ASHA was now under to catch up from a standing start.

This is probably why, measured against the very much wider goals of LE Audio, ASHA offers only a subset of functions, limited even within the domain of hearing aid applications. Sources suggest, however, that the existence of Google's ASHA endeavor lent wings to the official Bluetooth SIG development, speeding finalization of the LE Audio specifications.

LE Audio's current "Mission Accomplished" was probably a little premature—you will always hear the march of the marketing music before the parade actually arrives on the street. But (SARS-CoV-2 permitting) we can expect it to appear in strength this year.

Once LE Audio is ubiquitous in smartphones, wireless speakers, headphones and hearables in general it seems reasonable to suggest that ASHA will go the way of many other brave Google ventures (Google Glass, Google Plus, Google Hangouts spring immediately to mind, but there are many more…).

Wireless audio streaming wasn't a big thing back then. But times have changed and when Bluetooth audio streaming (using Classic Bluetooth) began to burgeon there was a scramble to re-engineer BLE to make it fit for this purpose. Battery life was becoming an issue, particularly as the Bluetooth receiving devices became smaller and smaller.

As it turns out, it was a double-barreled scramble between two factions: the **Bluetooth Hearing Aid Working Group** on the one hand and **Google's Android Accessibility Group** on the other.

Meanwhile…

ASHA works. ReSound's holding company, GN, backed this Google/Android venture from the start, promising "the world's first streaming Android hearing aids" with the launch of the LiNX Quattro in 2018. The promise of Android streaming has finally come true, although the LiNX Quattro was pipped at the post by Phonak's Audéo Marvel, which jumped the gun by using Classic Bluetooth.

With the firmware update of December 2020 and with the right smartphones, currently limited to Google's own Pixel range and one or two Samsung phones, all updated to Android 10, the ReSound LiNX Quattro can be paired directly to the Bluetooth output to receive the phone's audio output over BLE.

Android thus achieves what Apple was able to offer to its own users six years ago. The very wide range of "Made for iPhone" compatible hearing devices actually includes the LiNX Quattro, one of the first hearing aids to offer this capability. Android has a lot of catching up to do on this front.

LE Audio will be rolling out this year in Bluetooth 5.2. Will it be compatible with today's Bluetooth hardware, designed for Bluetooth 5.0? Bluetooth SIG members tell me the answer is "yes", with an appropriate firmware update. The caveat is that Bluetooth 5.2 will come with its own new generation of hardware, designed to handle LE Audio more efficiently.

The crunch point will be in the hearing aids. When you stream to your hearing aids using an intermediate streaming device, as you can with the LiNX Quattro, standard Classic Bluetooth is handling the first leg of the journey. The connection between the streaming device and your hearing aids will use a proprietary (read "kluged by the hearing aid manufacturer") adaptation of BLE. Whether the hardware handling this connection can be firmware updated to LE Audio is the big question. And the answer may well be No.

All the above applies equally in the case of the LiNX Quattro's proven ASHA connection. With one difference that might be significant: Google's ASHA implementation isn't a proprietary kluge. It's an open source kluge. This suggests that if the hearing aid manufacturer has based its ASHA on Bluetooth 5.0 hardware it may be firmware updatable to handle LE Audio.

Hats off to Google (and the Bluetooth SIG)

Effectively, what Google has done is to provide an open source, free for all workaround in answer to Apple's proprietary adaptation of BLE. Apple is famous for designing its own software and hardware standards and hugging them tightly to itself.

In fairness, though, this un-sharing ethos has largely existed in the hearing aid industry too. This seems very likely to change over the next few years as hearables in general mature into commodity items in much the same way as the personal computer industry in the late '70s and early '80s.

Of course, nobody should expect the huge amount of human labor and ingenuity put into development like this to go unrewarded. But there are industry-standard ways of opening up a new resource like power-saving audio streaming to the whole world while still retaining an income stream in return.

That appears to be how the Bluetooth SIG is proceeding. The firmware upgrade to existing Bluetooth 5.0 hardware, as well as the subsequent Bluetooth 5.2 hardware, will be covered by a **RAND-Z** license and therefore will be offered free to all manufacturers.

However, as with all existing Bluetooth products, components and end-user devices will have to be qualified against the Bluetooth SIG's specifications before they can carry the branding. Currently, this will cost manufacturers $4,000 for each product range.

Obviously, vendors of popular consumer products will do rather better out of this deal than specialists like hearing aid manufacturers selling into a much smaller market. But even so, for them this should amount to only a few cents for each individual product. It's the end user, of course, who ultimately foots the bill. But the incremental cost of what in this case is a huge benefit will very likely be invisibly small.

> RAND stands for "reasonable and non-discriminatory", which prohibits the parties who contribute patentable material to the standard from price-gouging and/or selective licensing. The Z suffix takes this a step further, indicating that any license fee will be zero.

No Conferring

Not only are ASHA and LE Audio completely different ways of adding audio streaming to Bluetooth Low Energy, they have each been developed with no relation at all one to the other. The two development teams haven't even been in discussions over the past years it's taken to develop these standards.

Why did these two development strands fail to coordinate their efforts?

One thought is that as Android's contribution was to be open source and the Bluetooth SIG's development (although RAND-Z, see above) largely comprised proprietary intellectual property, this "Chinese Wall" was something Google would have to insist on. It would be crucial to ensure the resulting code was "untainted".*

On the other side of the divide, Nick Hunn of the Bluetooth SIG points out that the LE Audio project, like any Bluetooth venture, also needed a Chinese wall "to protect anyone who contributes IP to the standard. If it were to get into the public domain, patent trolls could try and file similar ideas and then sue anyone implementing the standard. That's a specific problem with RAND-Z, as some of what is developed during the process isn't necessarily patented by any member, as it can evolve from group discussion."

Nick Hunn is Chair of the Bluetooth SIG Hearing Aid Working Group and a passionate industry evangelist. He coined the term "**hearables**" to describe the ongoing fusion of hearing aids and consumer audio

*We haven't been able to persuade Google to confirm or deny this guess. In fact, Google's response to all our enquiries about ASHA has been a series of dull thud "no comments".

This is very unusual for any open source development and seems to lend strength to the view that ASHA, at best, is only a stepping stone to the future of wireless audio.

NFMI versus Bluetooth LE

Tested Technology has been something of an evangelist for NFMI (near field magnetic induction) as a means of communication between two associated hearing aids but also as a technique to support body area networks (BAN) in general. The advantages over Bluetooth in these contexts seemed compelling. There was a suggestion at the Bluetooth SIG meeting that in the light of what LE Audio has been able to achieve, NFMI may be approaching the end of its short but very secure rope. NFMI operates in the low megahertz range using a form of wireless transmission very similar to the familiar telecoil. This gives it the key advantage of being able to travel from ear to ear across the brain without being significantly obstructed by the living tissue or risking harm to it.

Couldn't low energy Bluetooth do the same job? Operating at a much higher gigahertz frequency, Bluetooth transmissions can't pass through the brain (unless powered to dangerous levels). It has been suggested specifically, by Evert Dijkstra, VP Phonak Communications, that at low power they can travel safely from ear to ear circumnavigating the skull.

Personally, at Tested Technology we remain to be convinced about this. The higher the frequency, the less able the signal is to travel through material and the more direct the path needs to be.

True, Bluetooth uses WiFi's 2.4GHz band which is less directional and more penetrative than WiFi's other 5GHz band. And it may be that in the lab, with specially designed (and probably obtrusive) aerials, BLE 2.4GHz could be shown to allow enough "bend" to travel round the outside of the skull. Reflections of the signal off exterior objects like walls and ceilings could help here. But the system would have to work in the open as well.

In any case, low energy Bluetooth transmission between a pair of hearing aids will be rather less power efficient than NFMI, which requires impressively little juice. But as hearable devices become smaller and smaller, manufacturers would be happy to save space and complexity by omitting NFMI and using only a single hardware radio system. Of course the gotcha is that skull-circumnavigating Bluetooth would probably need bigger aerials.

So will this happen?

Devices that are purely sinks for audio streaming will certainly be able to get along without NFMI. Bluetooth LE Audio transmission embeds synchronization signals. This scheme allows two separate streams, one to each earpiece, to be synced to within 20 microseconds. Using this system, there's no need for the individual receiving devices to intercommunicate.

But hearing aids do more than receive streaming radio. Microphones to pick up atmospheric sound waves are obviously crucial. And they've become very sophisticated. Typically there will be a pair of microphones in each hearing aid, each microphone receiving similar information at very slightly different times.

Tiny time intervals like this are the clues the brain needs to pin-point the various sounds in the surroundings and, if necessary, to distinguish between useful information (like speech) and background noise. Instead of several microphones, the unaugmented human ear uses the multiple reflections off the convolutions of the pinnae to derive this information.

For the hearing impaired, the four microphones in the twin hearing aids seek to emulate this. But to do so, all four microphones need to pool their data and will therefore have to intercommunicate.

With a fast and reliable wireless connection between the hearing aids and a sufficiently speedy processor it's possible to derive up to eight virtual microphones—four stereo pairs— from these data. An NFMI interconnection remains the best way to do this.

For this reason, it seems unlikely that LE Audio will see off NFMI as the standard for hearing aid intercommunication any time soon.

Summing Up

Much of what is written here is speculation, based on research, marketing material and discussions with experts in the field. On balance, the conclusion is that the next wave of hearing aids from the major manufacturers will be built around Bluetooth 5.2. The GN/Google ASHA enterprise will become a historical footnote.

But, to borrow Bertrand Russell's summary of young Wittgenstein's philosophy of the future: "That the sun will rise tomorrow is a hypothesis." Bill Gates may have seen the present coronavirus crisis coming. But did you? Did I?

In truth, all we have is the present. ASHA is here now and it works. How well, and with what limitations will be discussed in a future article.

Post Publication Comments

Ian Murdoch 11-FEB-21 AT 1:15 PM

This is a great article but it left out to my mind the one thing that stops ASHA from audio streaming my phone to my Cochlear Nucleus 7 processors.

My phones Bluetooth chip set manufacturer has not implemented ASHA in the Bluetooth chip of their Android 10 phones and have issued no confirmation if they will support ASHA in future Android versions. That's from a phone manufacturer that is one of the big 4 of North America and the UK.

It has to be down to money payable to Google as the only phones that will ASHA work are Google Pixels, some Samsung S models and the IPhones. Min prices for the phones start at £600 UK.

Cochlear as you point out are one of the developers of ASHA. I do not know if they will ever move to Bluetooth 5.2 LSE or even if Cochlear Firmware will be made available to change the method of receiving audio streaming. I cannot take the implants out of my head, only upgrade the processors if and only if, Cochlear allow it.

REPLY by Chris Bidmead 12-FEB-21 AT 2:04 PM

ASHA streaming is an all too rare feature, I fear, Ian. Of the many phones here at Tested Technology, only one—the Google Pixel 3—supports the protocol.

I don't believe this has anything to do with charges for the technology by Google; it's more likely to be because of the imminent prospect of Bluetooth 5.2 which will cover the functionality of ASHA and more.

I understand that devices like the implants you have may possibly be firmware upgradable to Bluetooth 5.2 but Cochlear should be able to give you a definitive answer on this.

– Chris