

ARTILLERY INTELLIGENCE BRIEFING

HEARABLES: BROADENING THE DEFINITION OF AR
SEPTEMBER 2019



Table of Contents

EXECUTIVE SUMMARY	3
KEY TAKEAWAYS.....	4
INTRODUCTION: BROADENING AR	5
AR'S UNSUNG MODALITY: SOUND.....	6
DRILLING DOWN: USE CASES.....	7
INDICATORS & ACCELERANTS.....	8
APPLE	9
IWEAR	9
GOOGLE	11
HIGHLY MOTIVATED.....	12
BOSE.....	13
HARDWARE BLITZ.....	13
ALL ABOUT CONTENT	14
LEADING INDICATORS	15
LEARNING CURVE.....	19
MONETIZING AUDIO	20
BY THE NUMBERS	21
THE REAL WORLD IS THE CONTENT	23
LOOKING FORWARD: A NEW LANE FOR AR.....	24
KEY TAKEAWAYS (REDUX)	25
ABOUT ARTILLERY INTELLIGENCE	25
METHODOLOGY.....	28
DISCLOSURE AND ETHICS POLICY.....	28
CONTACT.....	28
REFERENCES.....	29

Executive Summary

Augmented reality's (AR) definition continues to evolve. Though considered by most to be a graphical format that overlays imagery on the physical world, there's an emerging sentiment that AR's definition is too narrow. As the technology grows into its own skin, it's expanding into alternate forms of "augmentation."

Chief among them is the emerging area that [ARtillery Intelligence](#) calls "audio AR." It involves AR's signature overlays... but audible rather than graphical. It can inform users and augment their experiences through audio cues, which are advantaged by subtlety and reduced hardware friction.

In fact, the foundation for this opportunity happens through already-pervasive "hearables" such as [Apple AirPods](#). The popular device sold [25 million units](#) in 2018, which ARtillery Intelligence projects to grow to just over [100 million](#) by 2023. This is the first step to an audio AR future.

The second step is content and apps that developers build on that hardware base. [Apple](#) is motivated to make this happen, as audio AR is one component – along with Watch and glasses – of a prospective wearables suite that ARtillery Intelligence believes will be central to the succession plan a maturing iPhone.

Meanwhile, the [BoseAR](#) platform already provides developers a place to build audio AR apps and experiences. This should accelerate audio AR as developers are incentivized by distribution scale from [Bose](#)' hardware base. It's on pace for one million audio-AR enabled devices by year-end.

Developers are already jumping on this opportunity with audio AR apps that feature guided audio tours, espionage games or fitness management. Going beyond just audio cues, these apps tap into the IMU sensor bundle in BoseAR hardware to sense precise head movement as inputs.

AR's expansion into new modalities and definitions doesn't end with audible content. Other key signals and inputs are developing, such as location. In fact, one of the most popular forms of AR to date utilizes device location as a key input to inform and influence user experience: [Pokemon Go](#).

[Niantic](#) AR lead [Ross Finman](#) likes to say "the real world *is* the content." Rather than taking a secondary role to graphical overlays, the real world should be a primary component in AR experience creation, similar to how location is a key input that dynamically alters [Pokémon Go](#) play.

In what other ways is AR expanding into new modalities and definitions? We unpack this concept in the following pages, including examples, case studies, exclusive interviews, and original data. The goal, as always, is to inform and empower you with a greater knowledge position.



Key Takeaways

-  The common connotation with augmented reality (AR) is graphical overlays on the physical world.
 -  There's growing realization among industry insiders that this definition limits AR's potential.
 -  Other forms of sensory augmentation will continue to broaden AR's definition.
 -  Chief among these is sound, also known as "Audio AR," delivered through "hearables"
-  Audio AR's advantages over its graphical cousin include discreetness and reduced hardware friction.
 -  A subtle whisper in one's ears can happen with less stylistic barriers than AR glasses.
 -  The opportunity also builds on an existing base of increasingly pervasive hearables like AirPods.
 -  AirPods popularity will drive commodity players to meet demand for lower cost hearables.
 -  This common progression (e.g. smartphones) will democratize and further penetrate hearables.
-  Hardware penetration and comfort levels are the first steps to Audio AR, and are well underway
 -  Apple is motivated towards Audio AR as part of a wearables suite that offsets slowing iPhone sales.
 -  Google has a vested interest in an always-on touch point for Google Assistant and voice search.
 -  Bose has shown the most activity and interest in Audio AR to drive its audio hardware sales.
-  After hardware penetration, the next step is software development and killer apps.
 -  Apple will likely open up its platform as a component of ARkit and in the manner of iOS.
 -  Google will do the same, and differentiate through the superior voice assistant (Assistant vs. Siri)
 -  Bose has already developed an open platform (BoseAR) and a \$50 million fund for developers.
-  Use cases will develop over time (just like smartphone apps) but are already showing strong signs.
 -  Audio AR will shine in social and professional networking use cases to identify people.
 -  It will also shine in local discovery and navigation use cases to identify surroundings.
 -  Commerce will also be a big category for consumer information while retail shopping.
 -  Audio AR's killer apps could require visual inputs, likely in concert with mobile and face-worn AR.
-  The revenue opportunity – just like the above order of operations – will start with hardware.
 -  Hearables hardware will grow from \$6.6 billion in 2018 to \$27 billion in 2023.
 -  This will be led by Apple, followed by Bose, Google, Samsung and a long tail of commodity players.
 -  Though these revenues are tracked for perspective, they aren't yet counted as "AR revenue."
-  Software revenue will then build on that hardware base and be housed within audio AR apps.
 -  AR software revenue will grow from \$174 million this year to \$3.46 billion by 2023.
 -  This includes in-app purchases, commerce enablement, advertising and premium app revenues.
 -  Unlike hearables hardware sales, these software revenue sources are counted as "AR revenue."
-  The concept of broadening AR's definition won't end with sound, as AR should involve all senses.
 -  Other areas will include haptics, including more textured versions of watch-based haptics.
 -  Location as an input for digital experiences (a la Pokémon Go) will be a key area of "augmentation."
 -  Broadened use cases will engender broadened business cases and a more robust AR sector.

Introduction: Broadening AR

There's an ongoing industry debate over whether or not [Pokémon Go](#) is truly AR. Though the debate is inconsequential, it raises a larger issue about broadening the definition of AR. Is the common connotation of graphical overlays on the physical world too narrow? And does it do AR a disservice?

Digging deeper, detractors point to [Pokémon Go's](#) lack of scene awareness and spatial positioning for overlaid graphics. They argue these graphics are more floating stickers than "true AR." Others argue that most players turn off AR mode or only activate it 2-3 minutes per session on average.ⁱ

But an important counterargument is that [Pokémon Go](#) melds the digital and physical worlds in a broader sense. Even if it isn't AR on a *pixel* level, it is on an *experiential* level. For example, gameplay is dynamically altered to encounter grass Pokémon around parks, and water Pokémon around beaches.

The lesson here is that for AR to grow and have wider appeal, it may require broadened definitions. Just like [Pokémon Go's](#) more general cohesion of the digital and physical, there are other AR-adjacent technologies and developing flavors of non-graphical "augmentation," most notably audio content.

Informational sound overlays could piggyback on hearables like [Apple AirPods](#) or [Bose Frames](#). Like [Pokémon Go](#), these don't carry AR's traditional and graphically-oriented definitions. But does that matter, as long as they're compelling and opportune ways to augment human experiences?

In practical terms, broadening AR's definition means broadening its use cases and, in turn, broadening its business cases. This means potentially more revenue for the early and unproven AR sector that's still in the process of defining itself.

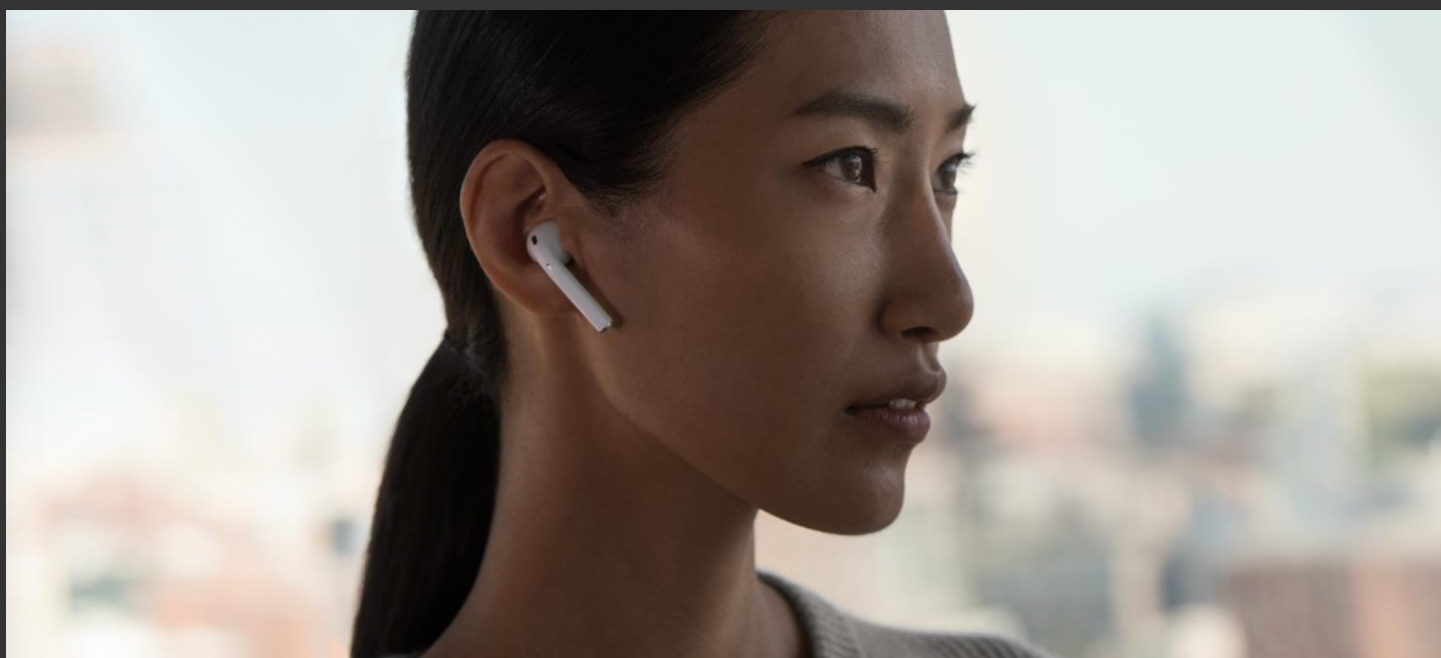


Image Credit: Apple

AR's Unsung Modality: Sound

In terms of penetration and impact, it could be argued that one of the most successful AR products to date is [Apple's AirPods](#). That statement sounds strange because the audio device isn't often classified as AR. But it could represent and lay the foundation for AR's unsung modality: sound.

With that in mind, we often joke that the original form of AR was radio. It augments your perception of the world while driving, jogging, or zoning out. While meant in jest, this raises an important point about expanding our conceptual understanding of augmentation. It should include all human senses.

Sound in particular could be a more viable near-term AR modality. "Audio AR" as we call it could come sooner than — and eventually coexist with — its graphical cousin. One advantage is subtlety: It's less cumbersome than pulling out your phone and it sidesteps AR glasses' style crimes.

That discreetness could in fact be audible AR's greatest strength. Because AR glasses are held back by cultural and stylistic factors, the subtlety of ambient audio could fill an important gap. And the potential all-day use creates a massive addressable market (in the form of time) for content.

Unpacking that a bit, [AirPods'](#) sleekness and portability have already begun to condition a use case to leave them in your ears all day. That then engenders a new channel for ambient audio. And the foundation is already

building with [25 million](#) AirPods sold last year according to [ARtillery Intelligence](#).ⁱⁱ

As always, [Apple's](#) lead will be followed by hardware commoditization by third parties, and falling hardware component costs that engender ubiquitous penetration. Then it's all about the apps and use cases that develop. [Apple](#) will likely open up its platform in the manner of [iOS](#), and [tvOS](#).

In fact, audio leader [Bose](#) has already beaten it to the punch. The [BoseAR](#) platform gives developers a place to build audio AR apps. It will accelerate audio AR by incentivizing developers with distribution scale from [Bose'](#) hardware base, including one million audio-AR enabled devices by the end of 2019.



Drilling Down: Use Cases

So what will developers build on these platforms?* One use case could be getting details about an upcoming business meeting or someone you're shaking hands with at an event. [LinkedIn](#) could develop an app that delivers such audible stats on the fly.

The interplay of a glasses-mounted camera and an audio whisper could make such an app possible. The camera – also potentially housed in a lapel pin or other discreet location – could sense faces in view, while machine learning identifies them and audio AR delivers the info subtly to your ears.

There are also societal and altruistic use cases such as helping the visually impaired. Pervasive audible intelligence could enable such individuals to operate with greater independence. Like the above business networking example, cameras can sense and translate surroundings to audio.

A less technologically involved use case involves foreign language translation. Audio AR devices can hear and translate foreign languages on the fly, lessening friction in international travel. [Google](#) in fact has already



developed this, using its [Pixel Buds](#) in tandem with [Google Assistant](#), as explored later.

Of course, graphical AR will still develop in parallel, and will be better suited for several use cases. But audio could take over a certain share of real-world interactions like getting informed about people or surroundings. It will be conducive to local discovery, news, shopping and social pings.

There are lots of directions this could go. But the foundational principle is that we'll all become empowered through audio cues, thus augmenting our realities. And just as graphical AR will get more textured and personalized with advancements like the AR Cloud, audio AR will follow a similar evolutionary path.

"What we started to realize was that there's this whole world of audio content that you can pin to the real world," said [Bose's](#) John Gordon at January's ARiA conference. "So what's the architectural tour of the city? what's the blues tour? There can be layers and layers and layers tied to the same physical space."

**Audio AR apps being developed today are profiled later in this report, including discussions with developers.*



Indicators & Accelerants

One factor that will accelerate audio AR is investments by tech giants to bring it to market. As we examined in *The Top of the Food Chain: Tech Giants Tackle ARⁱⁱⁱ*, tech giants' self-serving motivations to boost core business often involve market-accelerating investments in emerging tech.

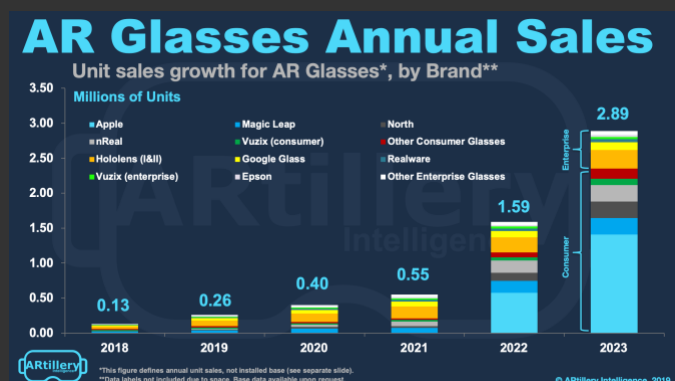
That principle applies to audio AR, including players listed above and those that will join them. To characterize activity so far and to extrapolate market directions, we'll take a closer look at three examples: [Apple](#), [Google](#) and [Bose](#). They're each investing in audio AR, but in very different ways.



Apple

To examine Apple's hearables ambitions requires first looking at its rumored AR glasses. Given Apple's track record in mainstreaming emerging tech, AR proponents are hoping for some of that signature halo effect. Long-running rumors point to a 2020 release date.

But recent signals indicate that the program may be on hold due to personnel reasons and readiness of the underlying technology. The latter is one reason ARtillery Intelligence has been skeptical for a while about 2020, basing its market forecasts instead on a 2022 arrival for Apple glasses.



Regardless of timing, we remain confident that Apple AR glasses are coming. As examined in the report cited on the previous page, financial motivations can reveal directional signals for tech giants' AR moves. That's especially true for AR's role at Apple to both prop up and succeed an aging iPhone.

As background, the iPhone is maturing, along with the rest of the smartphone market. But as iPhone sales continue to decelerate, wearables are a beacon of hope in Cupertino. That was once the position where the iPhone sat in being the rising star to offset maturing Mac sales.

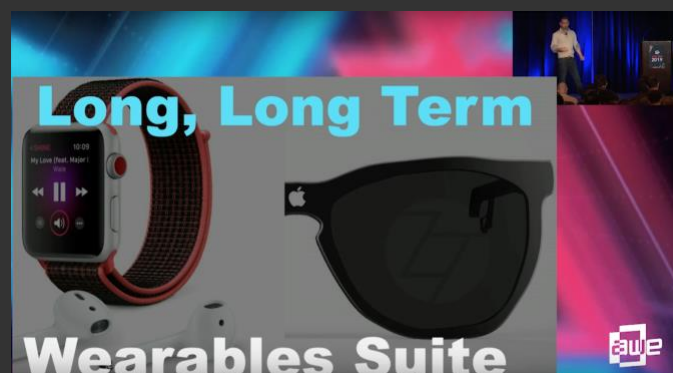
Specifically, iPhone sales are down \$3.5 billion year-over-year in Q3 2019, while wearables reached \$5.5 billion for the first time.^{iv} The growth in the latter isn't enough yet to offset the former, but it's still a young product line growing from a small base, compared to the saturated smartphone market.

Add it all up and there's too much on the line for Apple to walk away from AR glasses. A supporting role to the iPhone could make AR glasses' overall revenue impact in the tens of billions. Equally important, they could also prop up Apple's next big play: a wearables suite.

iWear

That brings us back to AR audio. Glasses could be a key component in a wearables line that succeeds the iPhone as Apple's cash cow. In concert with AirPods, Watch and others, it could augment several senses and comprise the ultimate personal computing touchpoint to our lives.

This is classic Apple playbook and will manifest in a holistic suite of wearables that includes line-of-sight AR through glasses; biometric tracking and info delivered to your wrist; and textured/intelligent audio delivered to your ears through AirPods. Altogether, it's a suite of sensory augmentation.



This scenario would also align with [Apple's](#) affinity for platform lock-in as a means to ARPU metrics. A wearables suite could incentivize multi-device ownership through functional advantages, just like [Apple](#) has done for years with interlocking devices like [iPhone](#), [iPad](#), [AppleTV](#) and [Mac](#) products.

And the first steps are underway. [Apple Watch](#) has been one of the most successful [Apple](#) products in years, as have [AirPods](#). As mentioned earlier, the latter sold [25 million](#) units last year. This conditions user behavior around an all-day hearable device – the first step to an audio AR future.

For those who wear [AirPods](#) frequently, they tend to wear them for long stretches of the day, which is a positive sign. However they remain idle most of that time and are activated occasionally for phone calls or other basic functions. The eventual vision is for audio AR cues on a more perpetual basis.

To get there requires apps. That will happen by [Apple](#) internally, just like it has default iOS apps (Mail, Maps, Calendar, etc.). Then just like the [iPhone](#), we believe it will open up audio AR development to third parties. The historical analogy is that we're now at the [iPhone 1](#), before the App Store launched.



click to play

Google

Apple's positioning with AirPods could soon find a challenger: Google. Though Apple has a big head start, Google appears to have its eyes on a hearables future given its less-popular and more clunky Pixel Buds. Though not as sleek, they're a vessel for a superior voice/AI engine: Google Assistant.

In fact, Apple's Achilles heel for AR audio is the famously inept Siri. Google Assistant will win the voice search and "general knowledge" AI game, based on the extensiveness of Google's knowledge graph. It can process voice queries and answer questions with greater reliability.

And this could be a winning factor. Hardware sleekness can be improved much easier than a quality AI engine can be built. So Apple will have to counterbalance Siri's detriments by creating more killer apps for AirPods, or by opening up the innovation to developers as suggested on the previous page.

Google meanwhile wins on sheer scale. Apple's AirPods have a total addressable market of about 865 million global iPhones. Android however has a much larger global base of devices that is closer to 2.5 billion.^v Most of those aren't yet compatible with Pixel Buds but it's a larger shell to grow into.



Highly Motivated

In the previous section, we examined [Apple's](#) motivating factors for AR audio as a way of predicting its future. Performing that same exercise for [Google](#) reveals significant vested interest in hearables. For [Google](#) it's all about increasing direct touch points with consumers.

As background, [Google's](#) position at the front door to the web was displaced to a certain degree in the app-heavy paradigm of the smartphone era. So, many of its moves are to counterbalance resulting search volume attrition through AI-fueled mobile tools like [Assistant](#), voice search and [Google Lens](#).^{vi}

Hearables help it accomplish that through an always-on audible channel for personalized messaging. This can happen through traditional google searches (pull) in the case of voice queries. It can also happen through predictive alerts (push) which [Google](#) is already developing through [Assistant](#).

This vision would also align with [Google's](#) smartphone-era construct of “micro moments.” These are the content snacking moments in the grocery line or subway — pulling out your phone for a quick fix of email, [Facebook](#) or [Snapchat](#). It created lots of opportunity for media (and ad) delivery.

But as stated earlier, audio's advantage is discreetness. It's less cumbersome than pulling out your phone. And because AR glasses are held back by cultural and stylistic factors, the subtlety of ambient audio could fill an important gap. All-day use also creates a massive opening for content.

So far, [Google's](#) experimental use case for [Pixel Buds](#) is real-time language translation through [Assistant](#), as mentioned earlier. This is a good example of the directions [Google's](#) audio AR could go, but [ARtillery Intelligence](#) believes retail commerce and local discovery will be its real endgame.^{vii}



Image Credit: Bose

Bose

As examined earlier, [Apple's](#) path to audio AR could follow its early [iPhone](#) progression in launching a developer platform and app store. This will engender more scalable creation of audio AR experiences thereby making [Airpods](#) – and its wearables suite – more attractive

But audio tech leader [Bose](#) is already there. The [BoseAR](#) platform provides a developer kit for building AR experiences. Like [iPhone](#) apps use the iOS SDK to tap into sensors like GPS, [BoseAR](#) apps do the same with inertial measurement (IMU) sensors increasingly built into its audio devices.

This IMU bundle includes an accelerometer (to register head movement pace), gyroscope (to register directional head turns) and magnetometer (to sense direction vis-a-vis magnetic north). Developers can build apps that tap into these sensors for audio AR inputs that are processed into app actions.

“So as a developer, you [can] say ‘when head nod does this, then X happens,’” said [Bose's Michael Ludden](#) at the AWE conference. “Right now it's limited to head nod and head shake but you can imagine voice integrations in the future... you can also access the raw data to do things like custom gestures.”



Image Credit: Bose



Image Credit: Bose

Hardware Blitz

[Bose](#) also knows that hardware penetration is the first step to audio AR, and it's blitzing the market from a few angles. First are its [Bose Frames](#) — sunglasses with speakers and sensors. Next out of the gate are its recently-announced [Series 700](#) headphones that are purpose built for [BoseAR](#) apps.

Third in the [BoseAR](#) hardware blitz is a sneak attack. [Bose](#) shipped the last few production runs of its popular [QC-35](#) headphones with the sensor bundle. Then in March, it activated [BoseAR](#) on all of them via firmware update. Altogether, it has almost one million AR devices in market, and more to come.

That last part is key, as the hardware base fuels incentive for developers to build experiences on [BoseAR](#). As we've examined,^{viii} platform wars are often won through early hardware penetration that attracts developers. Resulting apps then attract more users... and the flywheel spins.

“Those are the first three products that we are shipping with [BoseAR](#) but every wearable that we make going forward will have [BoseAR](#),” said Ludden. “So if you're a developer, you know that's part of our commitment to making it hopefully an attractive target platform.”

All About Content

So what have developers built so far? Apps built on the [BoseAR](#) platform span lots of use cases with clever spins on audio AR. These are leading indicators of core use cases as logical and unexpected categories take form — everything from gaming to navigation.

These include [Radar](#) — an app that features volumetric soundscapes such as a beach where the ocean is in front of you and seagulls are above you. [Comrade](#) is a spy-novel game where you follow audio instructions, tracked through the sensor bundle.

There are also utilities like [Otocast](#) — a travel app that lets you discover and experience audio tours serendipitously. [Naviguide](#) pulls data from [Yelp](#) which you can access by looking at a given restaurant and tapping the glasses to activate spoken ratings & reviews.

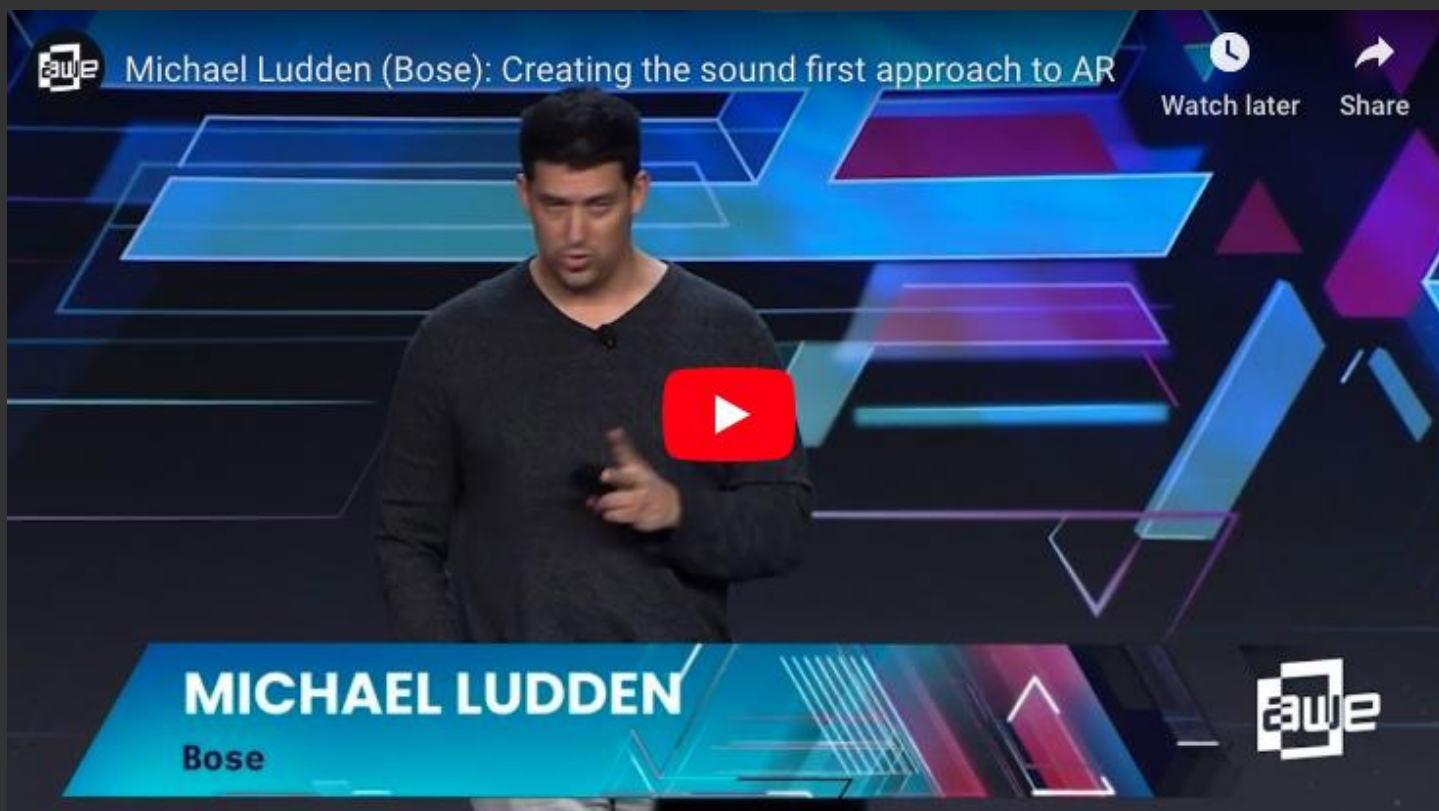
Then there's [Golfshot](#) which provides strategic information to approach the green on a given Golf course. [New Balance's](#) app senses exercise (think: lunges) while counting reps and providing verbal encouragement. [Headspace](#) does similar, building on an already-popular meditation app.

These early apps (and ones further profiled in the next section) are just a glimpse of what we'll end up with. Think of it like primitive [iPhone](#) apps circa 2008, before we got [Waze](#), [Foursquare](#) and [Uber](#). But here, the developer community could have an even greater creative range due to variable hardware.

"You're going to see more and more use cases enabled by different form factors that have [BoseAR](#)," said [Ludden](#). "Now it's really all about content... having apps that are useful, that people want to use on a daily or habitual basis. That's the new promise we're making."



Image Credit: Bose, AWE



click to play

Leading Indicators

In addition to the above examples, there are signs all around us that indicate audio AR activity. In fact, a leading indicator for product development in AR can often be the demos shown at top meetups. This happened last month at the mother of all AR meetups: [AWE Nite SF](#).^{ix}

During the progression of demos – emceed and seen firsthand by [ARtillery Intelligence](#) analysts and the author of this report – something unexpected happened. Though the

explicit theme for the evening was AR in gaming, audio AR serendipitously emerged as an unplanned sub-theme.

Of the four companies that demoed AR products, three were audio AR experiences built on the [BoseAR](#) platform. To further document and analyze this moment of significance in the AR ecosystem, we circled back to those developers to dig a little deeper. Each is profiled in the following pages.

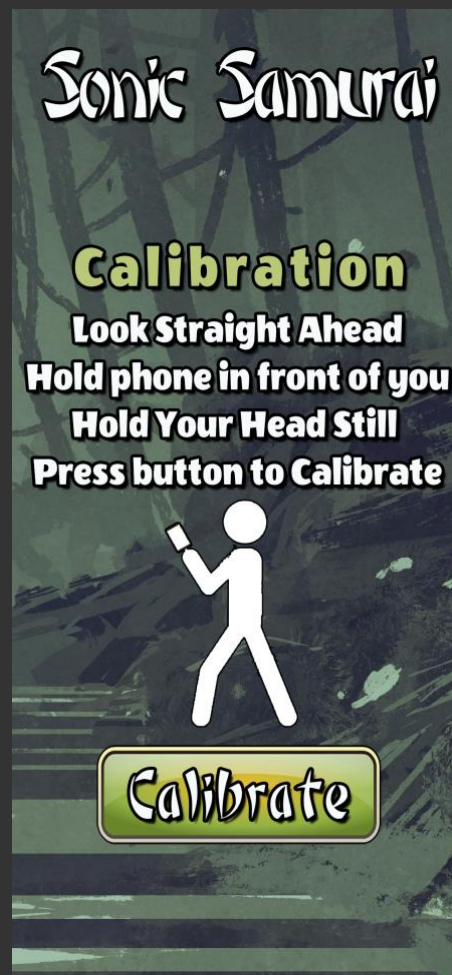
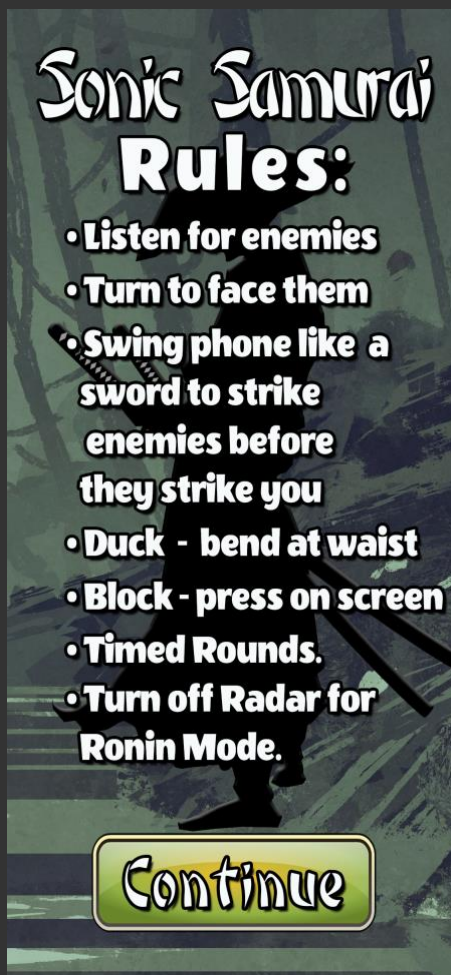
Sonic Samurai

Developed by prolific AR game studio [Happy Giant](#), *Sonic Samurai* positions the user at the center of a battlescape in which enemies approach from all angles. Wearing a [BoseAR](#) device such as [Bose Frames](#), volumetric audio informs players of approaching enemies (along with a radar-screen on their phone), which they can strike or block using the phone as a virtual Samurai sword.

“As a highly visual company, ‘Audio AR’ was something very new for us. It challenged us to think in new ways,” CEO [Mike Levine](#) told ARtillery Intelligence. “The more we got into the [Bose](#) SDK and products, we realized there are so many possibilities for ‘wearable audio AR’. We are excited by what we created, and the possibilities that lie ahead.”



Image Credit: Happy Giant



Unscramble the Oracle

Developed by [XEO Design](#) and led by game-design and UX maven [Nicole Lazzaro](#), *Unscramble the Oracle* is an interactive audiobook. It lets players walk, dance, and tap their way through a fairytale world, helping the Fairy Chicken Godmother find her chicks. Like *Sonic Samurai*, gameplay is guided through audible signals from a [BoseAR](#) device such as Frames, while physical inputs are tracked through the device's IMU sensor bundle.

"Thinking back to my experience designing the first iPhone game, what attracted me to [BoseAR](#) was the opportunity to create an interactive audio world dynamically laid over our own," [Lazzaro](#) told [ARtillery Intelligence](#). "With audio AR, I immediately saw the opportunity to design an original audio-first experience that adapted to wherever the person was, blending a hidden fantasy world with their real one."

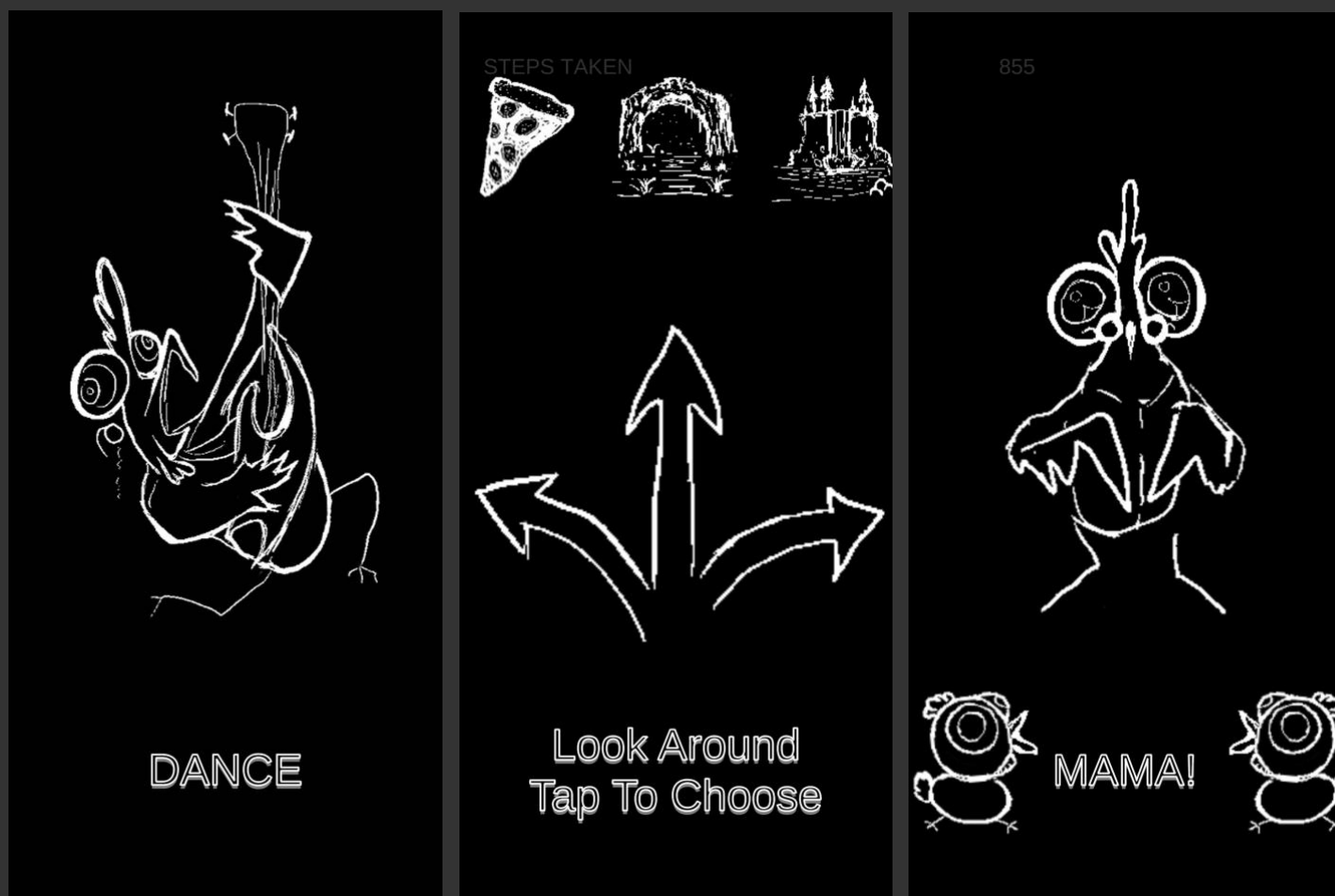


Image Credit: XEO Design

War of the Worlds: Invasion

Developed by [Quirkeley](#) and led by executive producer [Siciliana Trevino](#), *War of the Worlds: Invasion* is part podcast and part game, leading users through an escape from alien invasion. Like the above examples, it uses audio signals to prompt users for certain physical actions which are in turn tracked through the IMU sensor bundle in [BoseAR](#) devices. The theme is also fitting to an audible experience, given the radio-centric origins of the game's namesake.

"What excites me about developing audio-first AR experiences is that I have to rethink space, time and storytelling in a way that doesn't rely on visuals, which is just beyond my comfort zone, where innovation happens," Trevino told ARtillery Intelligence. "War of the Worlds for [BoseAR](#) allowed our team to create an immersive action-adventure in sound that's available on a wearable just under \$200."



Image Credit: Quirkeley

Learning Curve

One common thread in these experiences and their creative development is the process of learning and growing with an inherently new form of user interactions. The playbook for these experiences is being written as we speak and by the above developers, among others. It will be an ongoing process.

“We invented new AR audio-first game mechanics and audio interactions that open up exciting new areas of AR design,” said [Lazzaro](#). “Imagine the player’s head as the joystick. We saw this as an opportunity to explore how audio increases immersion, especially interactive audio.”

This learning curve could apply to monetization too. Beyond UX, what monetization models will integrate best? Given that it’s a form of mobile

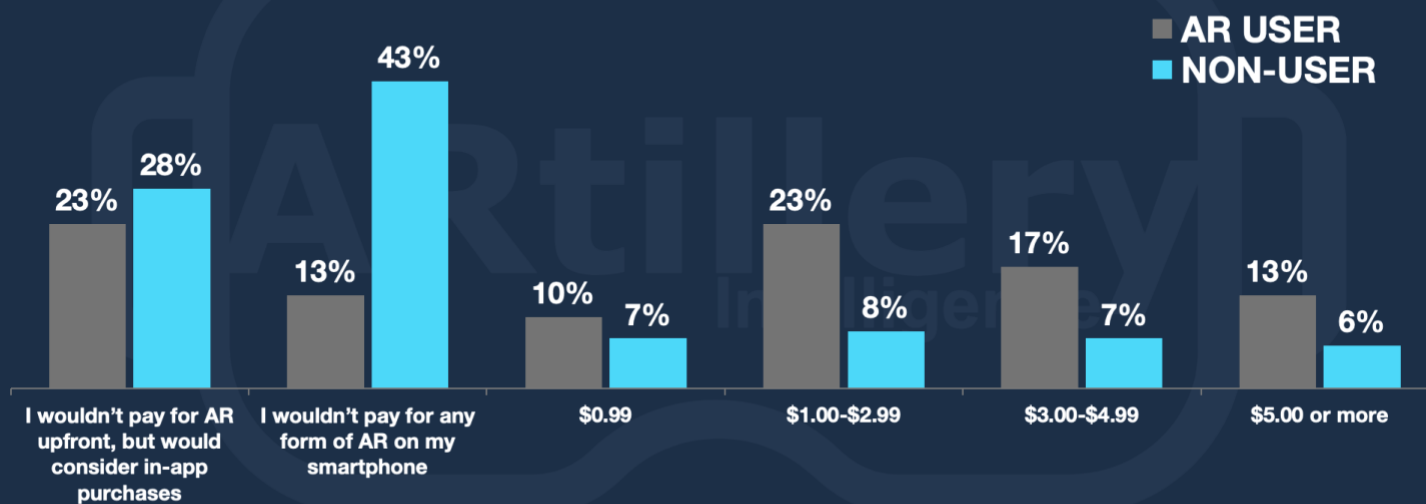
gaming, in-app purchases or sponsorship could develop. These are models supported by [ARtillery Intelligence’s](#) consumer AR survey^x (see below).

[Trevino](#) likewise believes the experience could be monetized through in-game placement of local business fare. That includes food, after working up a hunger from the game’s physical activity; or real-life lattes to go along with the virtual lattes that are part of the gameplay.

Either way, audio AR is a new modality within an already-new AR medium. So just as these developers are embarking on a creative process and growing with audio AR, business models could likewise be experimental. Like [Sonic Samurai’s](#) approaching enemies, it will be a moving target.

Mobile AR Price Sensitivity

What’s the most you’d pay for a mobile AR experience?



Monetizing Audio

Sticking with the theme of monetization, what's the business case for audio AR? Like any nascent industry, that will develop in lots of directions. Some of those directions will be expected, while some will be surprises. Local discovery models outlined above are logical, and in-app purchases are a leading AR revenue model, per the above slide.

Like any other emerging technology – including graphical AR – a value chain will develop. That includes software for experience creation “building blocks,” as we like to call them. The ecosystem will include big players like [Bose](#), as well as smaller toolset providers.

But as mentioned earlier, the hardware always comes first. That process is underway as [Apple](#), [Google](#), [Bose](#) and others are seeding the audio AR opportunity by conditioning the hardware use case. The poster child here is [Apple](#) which sold [25 million AirPods](#) last year as noted earlier.

So it's no surprise that the majority of revenues in the near term hearables market will be the sale of that hardware. Over time, software and other revenue sources will build on that installed base. But the lion's share in early years will go to players like [Apple](#) and [Bose](#) who sell hearables.



Image Credit: Quirkeley

But one key distinction is that they aren't necessarily "hearables" yet to consumers. The user intent behind these hardware purchases isn't largely AR-driven. To plant the seeds for audio AR by establishing a hardware base, devices must be marketed towards consumers' current comfort levels.

According to [Bose's John Gordon](#) at January's ARiA conference, this starts with familiar territory — music — before evolving into audio AR. So [Bose](#) is essentially fighting two battles: conditioning consumers to the hardware while stimulating developers to build Audio AR apps.

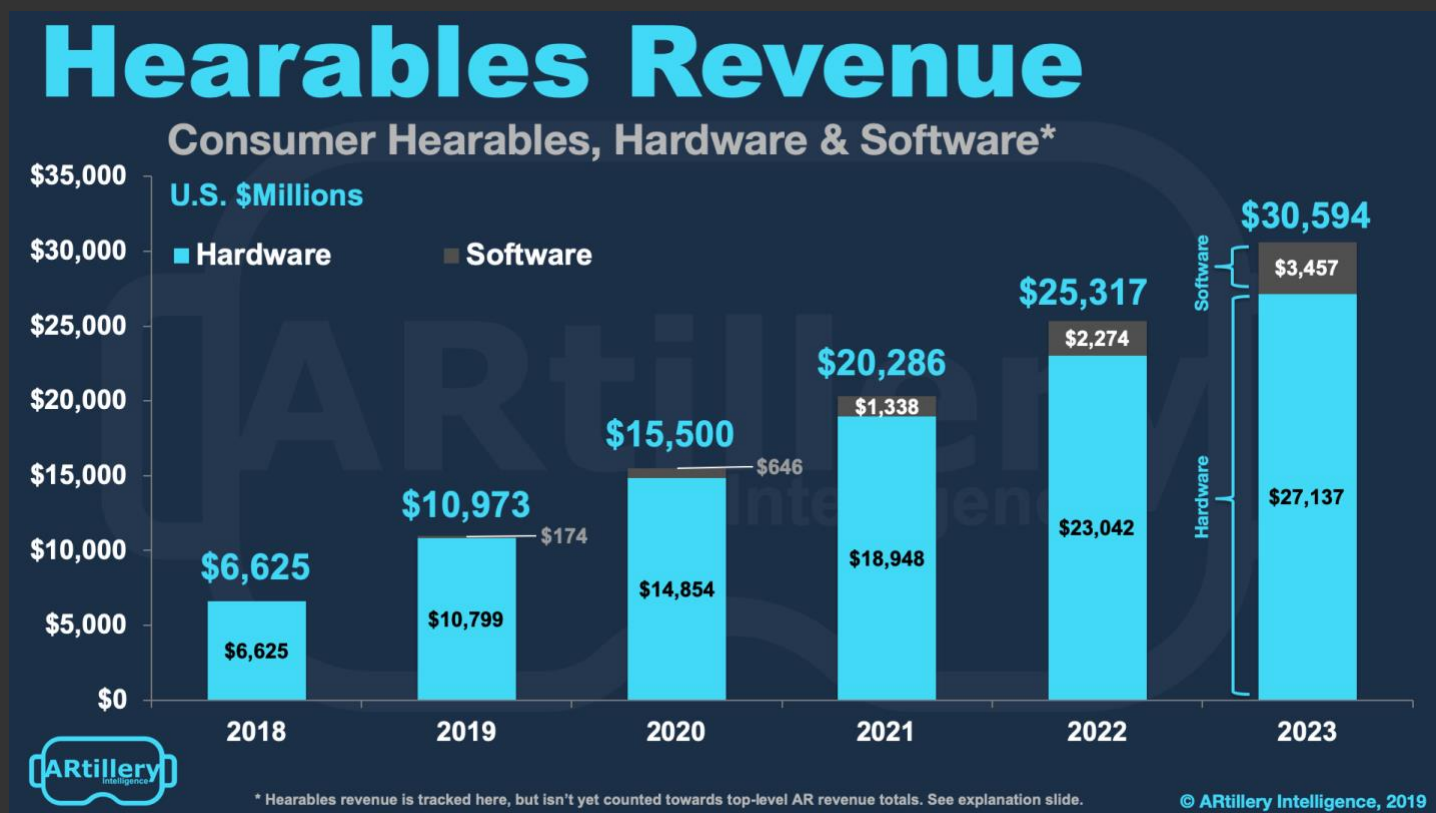
"Start with something people want," said [Gordon](#). "People want to bring music into their lives. They want to bring sound in, and they'll put something on their head to do it. But we wanted to go beyond that. We figured now that we've got something on people's heads, what's next?"

The reason this distinction is important is that hearables hardware revenue isn't classified as "AR revenue" in ARtillery's market sizing. It's tracked for perspective, but doesn't yet contribute to AR revenue totals. But software, such AR apps and their associated business models, are classified as AR revenue.

By The Numbers

With those caveats and definitions, what does the hearables revenue picture look like. [ARtillery Intelligence](#) projects hardware revenues to grow from [\\$6.6 billion](#) in 2018 to

[\\$27.1 billion](#) in 2023 (not counted as AR revenue). Software will meanwhile grow from [\\$174 million](#) this year to [\\$3.46 billion](#) by 2023 (counted as AR revenue).



Further segmenting hardware revenue, **Apple AirPods** will maintain a commanding market share lead, growing from **\$4.5 billion** last year to **\$17.9 billion** in 2023. **Bose** will have a small but influential share of the hearables market, growing from almost **\$200 million** this year to **\$8.6 billion** in 2023.

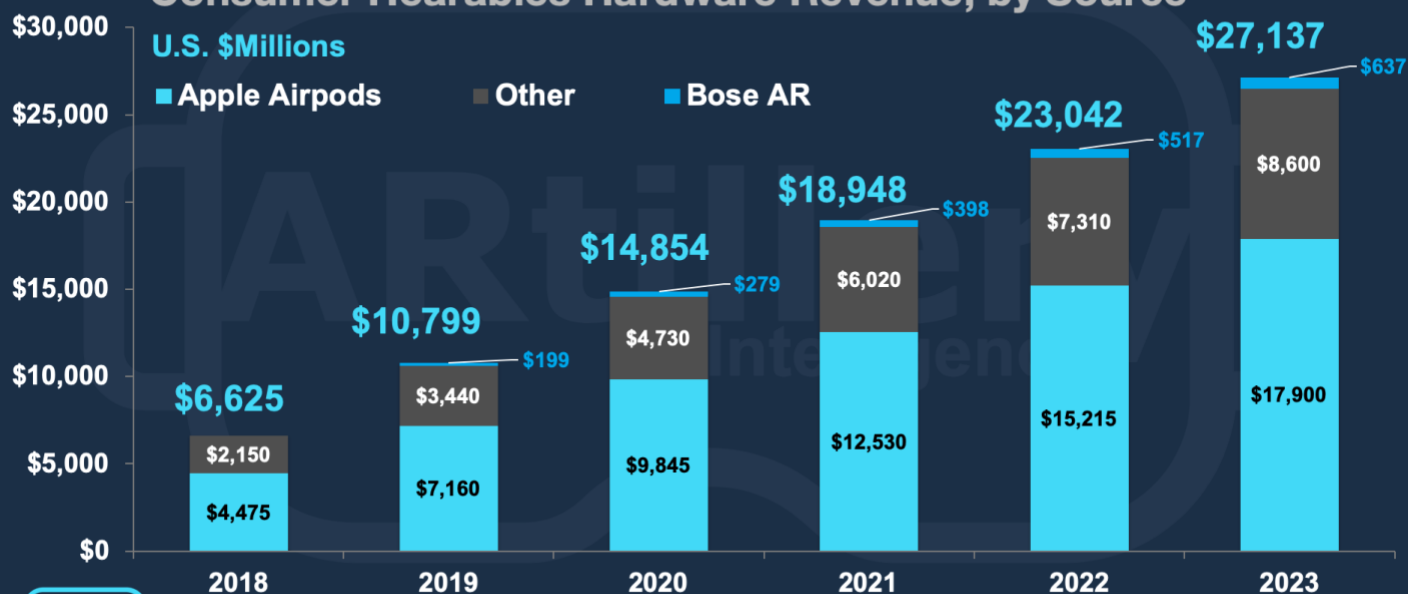
There will be others in this premium tier such as **Google Pixel Buds**, **Samsung's** competitive entrance and others. Following these players, the remainder of the market will be a

fragmented mix of commodity players that emerge globally, especially in China, to fulfil demand for lower-priced hearables.

These commodity players will make hearables accessible to a larger mainstream market and in lots of developing markets. But innovation and market leadership will sit with **Apple**, **Google** and **Bose**, thus mirroring the typical dynamics and market tiers of consumer electronics, most notably smartphones.

Hearables Hardware

Consumer Hearables Hardware Revenue, by Source*



* Hearables revenue is tracked here, but isn't yet counted towards top-level AR revenue totals. See explanation slide.

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The Real World *is* the Content

Most of this report focuses on sound as an alternate AR modality. But it won't stop there. If AR is to truly augment our lives, it should include several factors that constitute human experience. One mentioned earlier is location. And the poster child there is [Pokémon Go](#).

In the ongoing debate over whether or not the game is or isn't AR, the main point is being missed. AR shouldn't be evaluated by what's happening on a *pixel level* but rather an *experiential level*. [Pokemon Go's](#) dynamic play – informed and altered based on location – represents physical/digital cohesion.

[Niantic](#) is also evolving and refining that cohesion on more granular levels. In [Pokémon Go](#), [Harry Potter Wizards Unite](#) and its [Real](#)

[World Platform](#), the company wants gameplay to shift dynamically based on things like the terrain you're standing on or variables like weather.

Going even further, AR lead [Ross Finmann](#) wants to flip the script: instead of digital content (primary) inhabiting the physical world (secondary), the latter should take a leading role. This involves experiences that pull in real world variables as game elements.

"The world is full of colors, so you can make experiences where you mine colors out of the world," he said at the DICE conference. "So the resources of your games can be just the color makeup of your room... The strategies you use change based off of the colors of the environment."



click to play

Looking Forward: A New Lane for AR

What are the other factors and human senses on which AR innovation will focus? Haptics is one that could develop in textured ways – building on the relatively simple haptic signals in wearables like [Fitbit](#) and [Apple Watch](#). And we'll see other categories emerge with the spirit of developer innovation.

The bottom line is that broadening AR's definition in these ways is good for everyone. In AR's nascent (and arguably disappointing) stages, the industry shouldn't further saddle itself with narrow definitions. Broadening AR in the above ways will increase its addressable market, and thus its revenue opportunity.

But if there will be an extension from visual-only AR connotations, it will start with sound: the counterpart to sight in our primary senses. In fact, hearables may not only join the AR mix but beat AR glasses to market due to lower adoption barriers and that all-important hardware base.

"Really, we're just creating an entirely new lane for augmented reality that gives you back your eyeballs and focuses on another sense," said [Bose's Ludden](#) at AWE. "I think there's definitely room in the market, and the world, for that method of thinking about augmentation."



Key Takeaways (redux)

-  The common connotation with augmented reality (AR) is graphical overlays on the physical world.
 -  There's growing realization among industry insiders that this definition limits AR's potential.
 -  Other forms of sensory augmentation will continue to broaden AR's definition.
 -  Chief among these is sound, also known as "Audio AR," delivered through "hearables"
-  Audio AR's advantages over its graphical cousin include discreetness and reduced hardware friction.
 -  A subtle whisper in one's ears can happen with less stylistic barriers than AR glasses.
 -  The opportunity also builds on an existing base of increasingly pervasive hearables like AirPods.
 -  AirPods popularity will drive commodity players to meet demand for lower cost hearables.
 -  This common progression (e.g. smartphones) will democratize and further penetrate hearables.
-  Hardware penetration and comfort levels are the first steps to Audio AR, and are well underway
 -  Apple is motivated towards Audio AR as part of a wearables suite that offsets slowing iPhone sales.
 -  Google has a vested interest in an always-on touch point for Google Assistant and voice search.
 -  Bose has shown the most activity and interest in Audio AR to drive its audio hardware sales.
-  After hardware penetration, the next step is software development and killer apps.
 -  Apple will likely open up its platform as a component of ARkit and in the manner of iOS.
 -  Google will do the same, and differentiate through the superior voice assistant (Assistant vs. Siri)
 -  Bose has already developed an open platform (BoseAR) and a \$50 million fund for developers.
-  Use cases will develop over time (just like smartphone apps) but are already showing strong signs.
 -  Audio AR will shine in social and professional networking use cases to identify people.
 -  It will also shine in local discovery and navigation use cases to identify surroundings.
 -  Commerce will also be a big category for consumer information while retail shopping.
 -  Audio AR's killer apps could require visual inputs, likely in concert with mobile and face-worn AR.
-  The revenue opportunity – just like the above order of operations – will start with hardware.
 -  Hearables hardware will grow from \$6.6 billion in 2018 to \$27 billion in 2023.
 -  This will be led by Apple, followed by Bose, Google, Samsung and a long tail of commodity players.
 -  Though these revenues are tracked for perspective, they aren't yet counted as "AR revenue."
-  Software revenue will then build on that hardware base and be housed within audio AR apps.
 -  AR software revenue will grow from \$174 million this year to \$3.46 billion by 2023.
 -  This includes in-app purchases, commerce enablement, advertising and premium app revenues.
 -  Unlike hearables hardware sales, these software revenue sources are counted as "AR revenue."
-  The concept of broadening AR's definition won't end with sound, as AR should involve all senses.
 -  Other areas will include haptics, including more textured versions of watch-based haptics.
 -  Location as an input for digital experiences (a la Pokémon Go) will be a key area of "augmentation."
 -  Broadened use cases will engender broadened business cases and a more robust AR sector.

About ARtillery Intelligence



ARtillery Intelligence chronicles the evolution of spatial computing. Through writings and multimedia, it provides deep and analytical views into the industry's biggest players, opportunities and strategies.

Run by analysts and former journalists, coverage is grounded in a disciplined and journalistic approach. It also maintains a business angle: Though there are lots of fun and games in spatial computing, cultural, technological and financial implications are the primary focus.

Products include the *AR Insider* publication and the *ARtillery PRO* research subscription, which together engender a circular flow of knowledge. Research includes monthly narrative reports, market-sizing forecasts consumer survey data and multi-media, all housed in a robust intelligence vault.

Learn more [here](#).



About Intelligence Briefings

ARtillery Intelligence Briefings are monthly installments of VR/AR data and analysis. They synthesize original and third-party data to reveal opportunities and dynamics of VR and AR sectors. In addition to data, a layer of insights is applied to translate market events and raw figures into prescriptive advice.

More information, past reports and editorial calendar can be seen [here](#).

About the Author

Mike Boland was one of Silicon Valley's first tech reporters of the Internet age, as a staff reporter for *Forbes* (print) starting in 2000. He has been an industry analyst covering mobile and social media since 2005, and is now Chief Analyst of *ARtillery Intelligence* and Editor-in-Chief of *AR Insider*.

Mike is a frequent speaker at industry conferences such as AWE, VRLA and XRDC. He has authored more than 120 reports and market-sizing forecasts on the tech & media landscape. He contributes regularly to news sources such as *TechCrunch*, *Business Insider* and the *Huffington Post*.

A trusted source for tech journalists, his comments have appeared in A-list publications, including *The New Yorker*, *The Wall Street Journal* and *The New York Times*.

Further background, history and credentials can be read [here](#).



Methodology

This report highlights *ARtillery Intelligence* viewpoints, gathered from its daily in-depth coverage of spatial computing. To support narratives, data are cited throughout the report. These include *ARtillery Intelligence* original data, as well as that of third parties. Data sources are attributed in each case.

For market sizing and forecasting, *ARtillery Intelligence* follows disciplined best practices, developed and reinforced through its principles' 15 years in tech-sector research and intelligence. This includes the past 3 years covering AR & VR exclusively, as seen in research reports and daily reporting.

Furthermore, devising these figures involves the “bottom-up” market-sizing methodology, which involves granular revenue dynamics such as unit penetration, pricing and growth patterns. More on *ARtillery Intelligence* market-sizing research and methodologies can be read [here](#).

Disclosure and Ethics Policy

ARtillery Intelligence has no financial stake in the companies mentioned in this report, nor was it commissioned to produce it. With respect to market sizing, *ARtillery Intelligence* remains independent of players and practitioners in the sectors it covers, thus mitigating bias in industry revenue calculations and projections.

ARtillery Intelligence's disclosure and ethics policy can be seen in full [here](#).

Contact

Questions and requests for deeper analysis can be submitted [here](#).



References

- ⁱ AR Insider: [AR's 3-Minute Sweet Spot in Pokémon Go](#)
- ⁱⁱ ARtillery Intelligence: [Global AR Revenue Forecast, 2018-2023](#)
- ⁱⁱⁱ ARtillery Intelligence: [AR Business Models: The Top of the Food Chain](#)
- ^{iv} AR Insider: [Triangulating the Latest Evidence of Apple AR Glasses](#)
- ^v ARtillery Intelligence: [Global AR Revenue Forecast, 2018-2023](#)
- ^{vi} AR Insider: [Test Driving Google Lens, The Strategic Take](#)
- ^{vii} ARtillery Intelligence: [AR Business Models: The Top of the Food Chain](#)
- ^{viii} ARtillery Intelligence: [VR Usage & Consumer Attitudes](#)
- ^{ix} AWE Nite SF, August 2019: [AR in Gaming](#)
- ^x ARtillery Intelligence: [AR Usage & Consumer Attitudes](#)