SoundHound

Discovering the Possibilities of Voice Assistants on the Edge

EXECUTIVE SUMMARY

Even as voice assistants make their way into every aspect of our lives, their true potential is just now being realized by companies in a wide range of industries. Smaller footprint Edge and Edge+Cloud voice assistants are emerging as solutions for smart devices, as well as hearables, wearables, wireless headphones, and a number of devices in the medical and manufacturing industries. Car manufacturers and other OEMs who don't want to rely on cloud connectivity for hands-free operations of their hardware devices are turning to Edge+Cloud solutions to ensure always-on service for their customers.

Voice assistants on the edge are creating possibilities for manufacturers while delivering on the promise of hands-free interactions for consumers and workers.

When the cloud is not available or not required, privacy is important, and processing power and costs are limited, intelligent edge voice AI technology is giving brands across industries a voice.

THE POSSIBILITIES ARE ENDLESS.

Chapter One:

Introduction to Connectivity

As the voice AI industry continues to mature, terms that once had a single meaning have fused and morphed into a collection of interchangeable, albeit confusing, terms. What is an embedded voice assistant? What is an edge solution? Which connectivity solutions are completely cloud independent? In which instances does a voice assistant have some access to the cloud for product and information updates?

What are the differences among edge solutions? How is an edge voice assistant different from an Edge+Cloud voice assistant? Can a cloud-connected voice assistant operate when the internet is down? With so many questions and confusion around the terms for the growing number of voice assistant connectivity choices, we thought we'd start with some definition clarification before embarking on a discussion about voice AI on the edge.

Cloud Connectivity

When we talk about voice assistants in the cloud, we are referring to those voice user interfaces built for the purpose of retrieving up-to-date information and accessing functionality from content domains available through an internet connection.

Voice assistants with cloud connectivity reside in speakers, cars, and anywhere that users may expect to get instant answers to a variety of questions.

Edge Voice Assistants

When voice AI has no connection to the cloud, it is considered to be on the edge. Even without a cloud connection, these voice user interfaces can perform a wide range of functions, provide hands-free access to devices, and deliver a limited set of information to the user.

Edge voice assistants provide the greatest level of privacy as information is always stored on-device and is never accessible from the cloud. A wake phrase or wake-up word is always embedded into the hardware to decrease the chance of false positives and "listening in" for any voice assistant solution.

Depending on the use case and manufacturer needs, edge voice assistants can include as much or as little Natural Language Understanding (NLU) functionality and CPU requirements as their solutions demand.

- ***EdgeLite: Fully-Embedded Edge Voice Assistants with Light NLU***
  The lightest version of Edge voice AI, allows the voice interface to process data locally without the privacy or connectivity concerns of the Internet. Developers using this solution would design their own natural language commands, have the ability to instantly update commands as product functionality changes, and create a customized, branded wake word—while minimizing the CPU impact.

- ***Edge: Fully-Embedded Edge Voice Assistants with Scalable NLU***
  Sometimes called intelligent embedded voice assistants, Edge voice AI with more NLU delivers more functionality than is possible with lighter solutions. Requiring more processing power, Edge voice assistant technology also delivers a higher range of natural language understanding capabilities and more domain knowledge on-device.

  Voice assistants on the edge keep sensitive information local while providing opportunities for personalization with advanced technology, such as biometrics or speaker identification. Edge voice user interfaces save manufacturers from paying recurring costs for cloud services and eliminate the consumer privacy concerns associated with cloud-connected solutions.

Edge+Cloud Voice Solutions

In some instances, manufacturers and service providers want their users to have access to the cloud to ensure a consistent voice experience. Edge+Cloud voice assistants provide the most device control, personalization, and information gathering capabilities of any other solution.

When processing space is not an issue, equipment manufacturers and OEMs, like automotive brands, can deliver everything from device control to stock prices and flight status to their customers through Edge+Cloud connectivity solutions. When less processing space is available, device manufacturers can use limited cloud connectivity to answer some queries or push product updates without gathering usage data—thereby combining the privacy of embedded technology with the benefits of product and voice optimization over time.

Edge+Cloud solutions have the benefit of full Natural Language Processing (NLP) capabilities and unlimited content domain access. The best Edge+Cloud solutions include Active Arbitration software that allows queries and commands to be delivered to both the cloud and the Edge device simultaneously, delivering the fastest, most accurate results possible.

Voice Assistant Platform Choices

Voice-enabled devices are created in two ways. Either companies can design their own voice assistant internally or in combination with tools and technology from outside vendors. The choice of outside vendors often comes down to adopting a voice assistant from one of the big tech providers, such as Alexa and Google, or partnering with an independent voice AI platform provider—such as SoundHound.

When businesses choose to build their voice assistant on Alexa or Google platforms, they are choosing to incorporate those brands into their products. In addition, these same voice assistants can be found in speakers and other products produced and sold by Amazon and Google themselves. As opportunities arise, these major players are expected to continue to offer their voice assistants in more products across industries—possibly pushing out legacy brands or those that have already adopted these established voice experiences into their own offerings.

Conversely, partnering with an independent platform provider allows companies to create custom voice experiences that extend the brand and product functionality. These voice user interfaces can be designed and developed with the unique user in mind and deliver more accurate responses based on targeted and custom content domains. Wholly-owned voice assistants serve as brand ambassadors and allow device manufacturers to control their customer relationships and determine how user data is collected and used.

Independent, Custom Voice Assistants

Developing wholly-owned voice assistants requires either having all the expertise in-house (uncommon) or entering into a technology partnership with an independent voice AI platform provider.

Many businesses are realizing that voice AI is more than a simple voice input to a search engine, it’s the interface between their users and products.They've found that partnering with an independent provider with the right technology and experience to help solve their unique user needs helps them get to market faster and with a more robust voice experiences. That’s because customized, scalable voice AI solutions provide the greatest flexibility for design and implementation of any voice user interface—including the ability to choose between embedded, edge, hybrid, or cloud-only connectivity solutions.

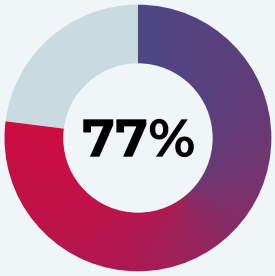
You, as the product owner, are in the best position to decide what voice interface is right for your products, company, and customers. All you need are the right tools and the right partner.

Chapter Two

Beyond Search: Voice Assistants as Product Solutions

Voice assistants on the edge have matured past only being a source of entertainment, music, and fun facts. The options for connectivity—from embedded only to some cloud to cloud only— have opened up a myriad of opportunities for brands across industries. Voice-enabled products solve a variety of user challenges and offer businesses a way to increase productivity, efficiency, and safety.

Even before the pandemic, hygiene and safety have been primary concerns in industries such as healthcare and manufacturing. Now, a multitude of industries have been impacted by the need for hands-free interfaces. Brands that distribute their products through vending machines or kiosks, hoteliers, cruise ship operators, banking and financial services companies, airlines, and many others have joined the search for product solutions that keep people safe and healthy.



A national survey of 1,660 adults in the U.S. found that 77% are changing their routine because of the COVID-19 pandemic. That change includes more use of voice assistants as daily and multiple daily voice commands rose by 1% and 5% respectively. For the first time, more than half of smart device owners are using voice commands at least once a day.

Source: Voicebot.ai

Edge and EdgeLite connectivity solutions provide much-needed, hands-free interfaces while adding a layer of accessibility and efficiency to device operations. A by-product of our newly formed habits around touchless interfaces has been the increased accessibility that voice assistants provide to those for whom touching, typing, and swiping are difficult or not an option.

Advances in voice AI technology and the low cost, lower power consumption, and ease of development for edge voice assistants have opened the door to voice experiences for a variety of smart devices, the hearable and wearable market, and specialized settings such as healthcare and manufacturing—to name a few.

The availability of smart voice interfaces that require minimal processing loads is creating a new role for voice assistants: hands-free product interfaces that will simplify our everyday lives and voice-enable the world around us.

The auto industry is seeing an increase in voice AI adoption across vehicle models as Edge and Edge+Cloud connectivity options are meeting their hardware requirements while delivering seamless voice experiences to drivers and passengers in their cars.

New Possibilities With or Without A Cloud Connection

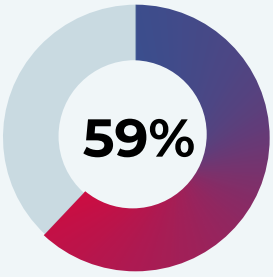
The evolution of voice assistants from solely cloud-connected to those with a range of connectivity options is providing opportunities for voice user interfaces for brands that could not consider the solution before.

When internet connectivity functions are not the only consideration, voice assistants on the edge offer a wide-range of benefits and allow brands to do more with less, including:

- Ease of development for engineering teams
- Lower CPU (Central Processing Unit) requirements
- Always-on reliability without reliance on a cloud connection
- Guarantee of privacy
- Faster response times
- Opportunity for personalization
- Freedom from recurring cloud connection costs
- Faster time to market

Voice assistants on the edge can deliver advanced NLU and complex voice interactions in an embedded environment. Limited cloud connectivity can provide manufacturers with the ability to push product updates and add new content without sacrificing processing power or user privacy. More cloud connectivity allows manufacturers to deliver more natural conversational experiences for device control while allowing users to get up-to-date information from the cloud.

With options for cloud connectivity, brands can choose to collect specific usage data to provide greater personalization or to inform product updates. Any data collection or storage practices, even for the purpose of product or voice experience improvements, should be communicated clearly to users with an option to opt out.



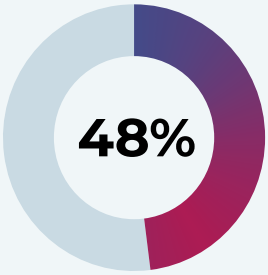
Some 59% of respondents who use voice commands say they believe their privacy concerns regarding voice control are important. That's compared to the 29% who feel that privacy concerns are a consideration but not that important, and the 7% who say such concerns are not important.

Hub Entertainment Research

When data is collected, it can be anonymized and used to inform product updates and improve the voice experience. With Edge voice technology, product manufacturers have choices about their customers, their data, and their products. Regardless of privacy policies, level of connectivity, processing power, or other considerations, brands now have the power to decide how they will pursue a voice-first strategy and how that fits into the company and product roadmap.

Smarter Devices

Home appliances, TVs, hearables, wearables, and other smart devices are prime examples of products that can be quickly and easily upgraded with a voice user interface. Voice assistant providers—such as Amazon and Google—have already recognized the potential for voice interfaces in this market and are aggressively developing products of their own. Manufacturers hoping to remain competitive will need to accelerate their voice assistant strategy roadmap to keep up.



In October 2020, 48.5% of U.S. adults reported having at least one smart home device that was not a smart speaker. About 27% of U.S. adults use voice assistants or voice interfaces to interact with their smart home devices on at least a monthly basis.

Voicebot.ai

With voice interfaces, smart appliances become easier to operate and allow users to do things like turn on the oven while still holding the baby, request the washer door to open while holding an armful of laundry, or set the thermostat from across the room. Depending on the appliance or smart device and the needs of the consumer, there are a multitude of ways to make smart devices more intelligent to decrease friction, increase convenience, and drive user demand.

Home security systems can be made smarter by adding embedded edge voice assistants that allow them to not only detect noises, but then send sound clips to residents to let them know a dog is barking or that glass is breaking. Users can then decide on the next, best steps based on what they hear and get help through the same interface—without the need to find a phone or other mobile device. Other home alerts might include smoke or CO detection, doorbells, and fall detection.

259 Million

smart home devices currently in use worldwide.

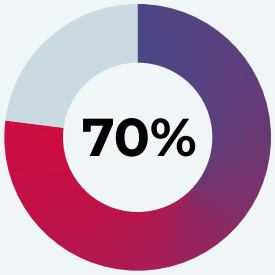
Statista

77 Million

homes are predicted to have smart devices by 2025.

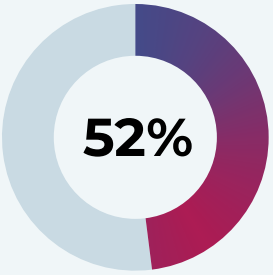
Statista

Already, TV manufacturers are turning to voice-enabled remote operation to help users get the entertainment they want faster and with less searching. As a hub of the home, the TV can easily become a source of shopping and other purchasing opportunities made easier by the combination of voice and visual display that help consumers choose the items they want to buy. Appliances, such as the TV, are natural sources of purchasing opportunities and will soon be at the forefront of voice AI monetization opportunities for the brands that own them.



Smart TVs are now in 70% of TV households

Hub Entertainment research



52% of all TVs are now smart TVs, up from 45% in 2020

Hub Entertainment research

Seamless Driving Experiences

The rapid growth and focus on the in-car experience reflect consumer demands for ease, convenience, and entertainment for everyone in the vehicle—including passengers.

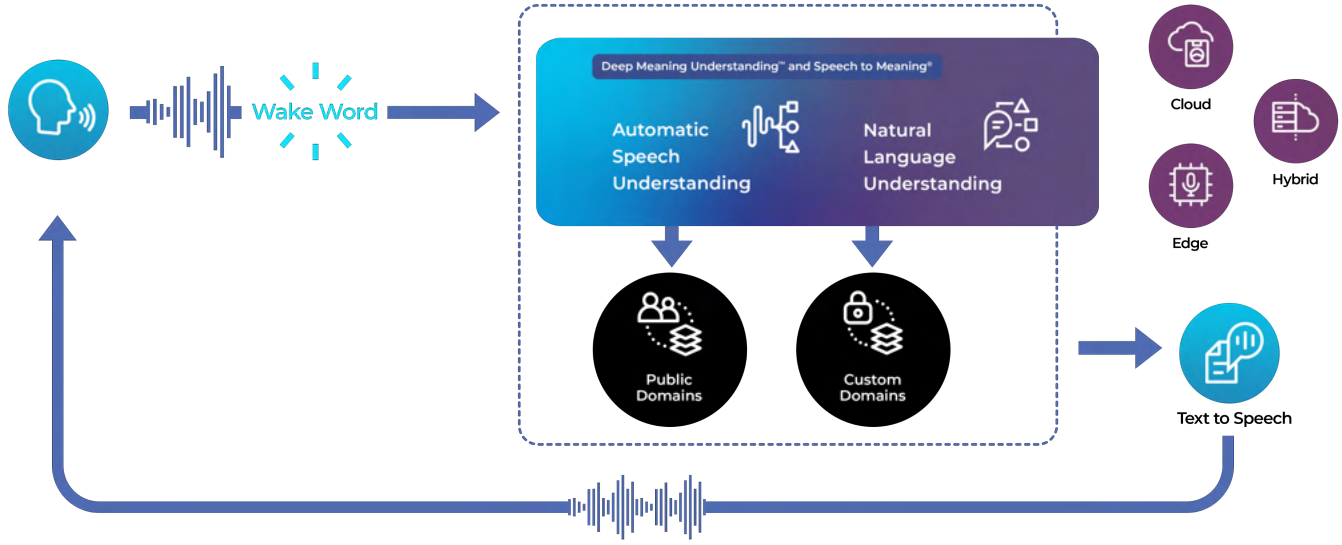
Already, major auto manufacturers are voice-enabling a wide range of vehicles—not just the top-of-the-line models. Rapid innovation in voice AI technology and the availability of embedded and cloud data from a single platform provider, and the availability of multiple language interfaces have been the catalysts for car manufacturers to extend voice experiences to more models in more geographies.

$37,530.4 million **- projected global in-car infotainment market project by 2028.**

Allied Market Research

Previously, auto makers had to find ways to create connections between an embedded voice AI platform and one that had access to content domains in the cloud. Now, Edge+Cloud connectivity with Active Arbitration technology is delivering frictionless voice experiences by eliminating the need to wait for a response from one system before sending it to another.

With Active Arbitration, a user's query is sent to both the cloud voice AI and the edge device simultaneously, returning a faster, more accurate response. Advancements in Natural Language Understanding (NLU) for Edge devices have elevated the interaction between users and the voice assistant from robotic command and control to natural-sounding conversations.



Seamless, conversational voice interactions are paving the way to deliver greater value to consumers through personalization, proactive suggestions, and purchasing opportunities in the car—such as ordering food for delivery or pickup.

Manufacturing and Healthcare on the Edge

While manufacturing and healthcare seem like two very different industries, when it comes to their needs around voice user interfaces, the challenges they face are very similar: efficiency, added safety, hygiene, and focus.

In both environments, workers and professionals are multi-tasking and splitting their attention between the job at hand and recording their progress. Sensitive and complex equipment in both environments makes operation and maintenance a challenge for people working with manually controlled devices. Voice-enabled devices in manufacturing and healthcare give operators and technicians an easier way to operate machinery in a touchless environment that's safer, easier, more efficient, and more hygienic.

Voice User Interfaces On the Manufacturing Floor

In the manufacturing environment, allowing workers to continue with their tasks while recording inventory and other critical information creates a more efficient workflow and eliminates the need to juggle the task at hand and a recording device. Machine operation becomes safer when workers don't need to put their hands in close proximity to heavy equipment and is more efficient when one operator can control machinery and troubleshoot by simply talking to the tools.

The top two reasons that companies implement IoT are operations optimization (56%) and improvement of employee productivity (47%). The next most common use cases are safety and security, which 44% of companies view as top reasons to utilize IoT.

Microsoft

On the voice-enabled manufacturing floor, workers don't have to put down tools to record job status or inventory updates. Workers can simultaneously pull inventory and move it to the next location without the need to stop and enter the information physically.

Voice-enabled machine tools require only one operator to utter voice commands that initiate pre-set tooling programs, run diagnostics, adjust machine settings, and review maintenance history. On-device setup information helps less experienced operators learn their way around the machinery while improving the efficiency of skilled machinists.

The rise of voice assistants in manufacturing will be realized in real-time savings, greater efficiency, and lower accident reports. Already, the projected growth in the smart manufacturing markets is creating business opportunities for the manufacturers of a variety of hardware devices, including sensors, robotics, and controllers.

Patient Care and Hygiene in Healthcare

The healthcare environment is similar to manufacturing in that physicians and healthcare workers must multitask. Instead of attending to machine operations and other tasks, physicians and technicians must tend to a human being while operating machinery or recording notes. Voice-enabled devices bring the focus back to the patient by eliminating manual equipment operation and note-taking tasks.

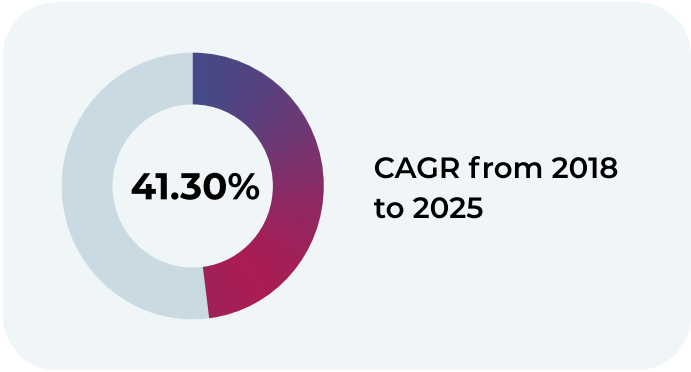
Creating a hands-free environment for healthcare providers solves a multitude of challenges and increases efficiency and speed of care. By adding voice AI to the equipment and environment, surgeons, nurses, and other practitioners can focus on providing care and services hands-free—thereby improving patient experiences and positive outcomes.

In the operating room, a voice assistant can help surgeons keep their hands and eyes on the patient. Since the surgeon is already accustomed to addressing his staff with voice commands during a procedure, adding voice-enabled technical devices into this environment is a logical next step. The hands-free modality of a voice user interface removes a level of mechanical manipulation and the need for familiarity with the buttons and knobs of each device.

Operations as simple as brightening the light, tilting the table, and adjusting suction and irrigation devices can be initiated faster and without the need for attendants to use their hands. To avoid the need to set medical equipment to an individual surgeon's preferences prior to a procedure, devices can be pre-set for a surgeon's preferences through speaker ID technologies.

In other applications, doctors can verbally trigger photos to be taken during procedures, such as colonoscopies, and label them as they continue the exam. Sensitive devices such as X-rays, MRI machines, CT scanners, and other medical equipment can be operated remotely without requiring the presence of a medical professional in the same room. Portable or hand-held devices can be operated with voice technology, keeping one hand free for other tasks and further reducing the transfer of germs from one patient to the next.

Fior Markets



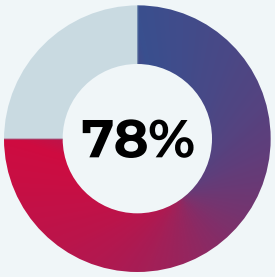
Fior Markets

The need for touchless interfaces and greater protections for healthcare workers has accelerated the rise of voice AI technology in healthcare. Rapid growth in intelligent virtual assistants in every aspect of patient care will soon create a technology gap for medical equipment manufacturers without voice user interfaces.

Hands-Free Hospitality

No industry's revenue has been impacted more by the recent pandemic as the hospitality sector. Cruise ship owners, hoteliers, and restaurateurs continue to face challenges around providing excellent service while maintaining strict hygiene and social distancing standards.

While the hospitality industry has always been a prime candidate for voice AI, concerns over guest privacy, cost, and available hardware have been barriers to entry. Recent technology advances and the availability of reliable, accurate, and conversational voice AI in a range of connectivity options have opened new possibilities for brands in the hospitality industry. Soon, voice-activated in-room controls will be the standard in the majority of hotel rooms and cruise ships.



of hospitality companies are expecting voice-activated devices to become mainstream for room lights and temperature controls.

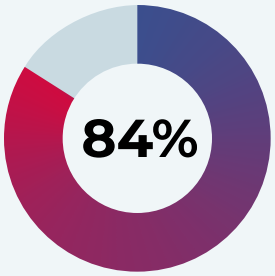
Information and Communication Technologies in Tourism 2021

Edge technology voice assistants that can provide in-room, in-plane, and on-ship control of environmental elements such as lights, curtains, door locks, TVs, and other entertainment devices without connection to the cloud are finding their way into company roadmaps across the industry.

When each device has its own voice control, hoteliers and cruise ship owners will no longer need to worry about buying, replacing, and maintaining voice AI hubs, such as smart speakers—a cost and risk many were not willing to accept in the past. Voice-enabled smart TVs can provide voice assistants that not only control the TV and entertainment selections, but can also answer questions about the weather, local points of interest, reservations, and room service. Meanwhile, in-room devices that are controlled independently of the cloud will provide greater privacy and customer trust.

Edge+Cloud solutions that reside in on-premise devices provide the best of both worlds by storing guest data locally while pushing content from the cloud to deliver more functionality—such as access to local events and restaurant information. Upon departure, guests will have the option of clearing the cache of information on the device before leaving the property.

For guests with loyalty and rewards memberships, certain data can be saved, and future stays personalized to match their preferences for extra towels, blankets, pillows, room temperature, room service, and a variety of other needs.



In a survey by Hotel Technology News, 84% of business travelers stated that they think a personalized guest experience is important.

Hotel Technology News

In places with more processing power, like cruise ships, on-premise servers can house custom content domains to give passengers the ability to find on-ship events and book excursions. Once in port and when the internet is available, passengers will have full access to up-to-date information on things like weather and points of interest in the current location.

Voice-Enabled Quick Service and Fast Casual Dining

QSRs around the country are already piloting voice assistants for their drive-thru and drive-in locations using Edge+Cloud voice AI to take orders—freeing employees to prepare food and perform customer service tasks. The recent shortage of hourly employees is creating a greater need for automated voice ordering services in Quick Service and Fast Casual restaurants around the country.

A study by Hospitality Insights examined a QSR that installed voice recognition systems for taking orders and discovered that they were able to increase drive-thru revenue by 10-20% due to being able to serve cars at a faster rate than before. Voice assistants also increased the accuracy of the orders, even during rush hour.

Hospitality Insights

While it may seem that adding a touchless, self-service option to your drive-thru and phone ordering process reduces customer service, the opposite is actually true. Customers are able to place orders faster without waiting for the availability of an employee and orders are received and delivered with greater accuracy and efficiency.

Advanced Natural Language Understanding (NLU) technology and high-quality text-to-speech functionality provide a voice interface that closely resembles interactions with a human agent and allow customers to speak naturally to place orders.

Whether people are ordering more because they have more time to consider additional options, or whether they're just more comfortable placing a larger order via a device over a human is still unclear. What we know is that installing voice-enabled ordering systems gives guests the freedom to order what they want and consider additional items, while allowing for multiple orders from several customers simultaneously.

A study by Forbes discovered that voice AI technology can reduce staff talk by as much as 95%, which allows employees to concentrate on producing high-quality food and service for their customers. Forbes also discovered that when using voice assistants to place orders, the average ticket increased by 20-40%.

Forbes

Voice-Enabled Devices In the World Around Us

Hearables and wearables enhanced by embedded voice technology have the potential to impact the consumer market as well as manufacturing and other applications. For consumers, the added convenience of voice creates more opportunities for manufacturers to add functionality to their devices. Already designed for busy people on the go, voice-enabled hearables and wearables give consumers access to product functionality while their hands and eyes are busy.

The global hearables market size was valued at $21.20 billion in 2018, and is projected to reach $93.90 billion by 2026, growing at a CAGR of 17.2% from 2019 to 2026.

Research and Markets

Common areas and places that require physical contact to operate—such as elevators, self-service kiosks, and vending machines—benefit from voice technology. Touchless interfaces add a layer of hygiene and convenience for a large portion of the population who are now avoiding touching surfaces and have become acutely aware of the possibility of disease transmission from direct contact with devices and equipment in public spaces.

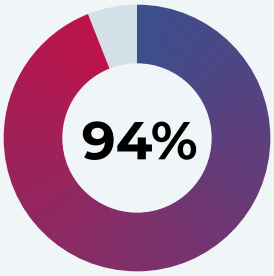
Device manufacturers of all types can begin to imagine the possibilities of product differentiation and added functionality that wasn't possible before with manual operation. They can also begin to reach a larger audience by making their products more accessible and easier to use for people who are unable to perform manual operations.

Chapter Three

Intelligent Choices for Product Success

Why add a voice interface when it's simple to press a button? The answer is that pushing a button or turning a dial is not always as simple, convenient, or safe as it seems. Even without a physical barrier, there are times when reaching out to touch a machine is not the most convenient or the safest way to access the functionality.

Offering more than one way to access your product or device provides solutions for people and situations where the seemingly simplest way isn't always so. Voice assistants on the edge and Edge+Cloud voice AI solutions increase the ease of use, convenience, safety, and hygiene for a variety of devices across industries and use cases.



of consumers believe voice technology does more than save time—it improves the quality of life.

Adobe

Smart devices and products are beginning to proliferate, creating crowded markets and fierce competition. Brands hoping to remain competitive with differentiated products should already have voice AI on their product roadmaps. Those that don't, can quickly catch up with edge voice assistants that are easy to develop and install. For manufacturers, the choice is clear: be a market leader and implement a voice interface now or follow the leader with a voice interface later.

Better Arbitration Software Improves Speed and Accuracy

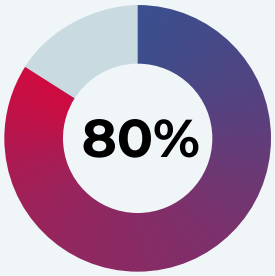
In the past, hybrid voice assistants were slow to respond and difficult to access. In some cases, the technology for the embedded assistant was not the same as the cloud-connected voice AI. In other cases, the arbitration software that allowed the voice assistant to access both the embedded content and domains in the cloud, treated the different content locations as separate entities—waiting for a possible response from the embedded voice assistant before moving the query to the cloud.

Now, parallel arbitration models provide faster and more accurate voice experiences by sending queries and requests to both the edge device and the cloud voice AI simultaneously in an Edge+Cloud solution. Whichever system provides the fastest, most accurate answer is the one that is delivered to the user. Parallel arbitration eliminates the delay in response common in legacy technology solutions and delivers a seamless experience to users who are unaware of the source of the response.

Branded Experiences

The proliferation of smart devices in homes—and in the world at large—has created an opportunity for greater voice technology adoption. While the world is focused on getting information or the answer to a joke, appliance and device manufacturers are looking for ways to add voice-enabled functionality to their products—while creating consumer value through branded experiences.

The ubiquity of voice assistants is already creating fierce competition. Brands who initially partnered with existing voice assistants, such as Alexa or Google, are now finding that the lack of customer relationships has put them at the mercy of bigger brands who are replacing their products with voice-enabled devices of their own.



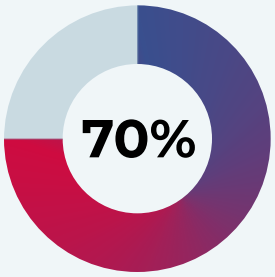
of respondents are more likely to do business with a company if it offers personalized experiences, showing that conversational AI has a direct impact on customer loyalty and revenue.

Single Grain

Voice assistants from Amazon and Google are always hosted in the cloud, and customer data is collected and used to understand the market, current use cases, and future demand for voice-enabled products. Consumers have grown wary of these voice solutions as privacy issues and data collection methods continue to come under scrutiny.

When small device manufacturers build their voice assistants using platforms—like Alexa and Google—they are giving an outside company complete access to their customer base, usage data, and market information. Instead of growing market share and customer loyalty through innovative voice AI solutions, these companies have given potential competitors the ability to test the market and collect user data and experiences that will allow them to market competing products—sometimes at a lower cost.

Brands that choose to work with independent voice assistant platforms maintain control over user data, privacy, and customer relationships. Consumers build trust with known brands that clearly communicate their data collection and data storage to their customers while providing product and service updates that reflect an understanding of the unique needs and desires of their customer base.



of consumers say a company's understanding of their personal needs influences their loyalty.

Salesforce

Faster Response Times

Voice user interfaces that require access to the cloud can slow down simple operations like rolling up the windows in a car, turning on a light, or starting an appliance. Brands that have partnered with big tech voice assistants are dependent on cloud-connected domains to perform product functionality that can more easily and quickly be handled by less expensive, more responsive, and highly accurate edge voice assistants.

With cloud-only solutions, simple commands require multiple steps for set-up, including connecting to personal wifi and enabling apps and skills. When the wifi isn't available, neither is the voice interface. While there are many use cases where a cloud connection is the most desirable solution, turning on the lights isn't one of them.

Due to their limited range of functions, edge voice assistants respond with a high degree of accuracy and speed, even in noisy environments.

Accuracy in Noisy Environments

The availability of edge voice user interfaces from established voice AI platform providers means that manufacturers no longer need to settle for the lower performance of legacy embedded solutions built on older technology. Now, the benefits of advanced voice AI, including better NLU, a library of languages, and high performance in noisy environments, are available regardless of cloud connectivity.

No matter the environment, a combination of custom acoustic models and microphones that know how to handle noisy environments can be applied to ensure the best performance in the environment the voice assistant is designed for. While it's ideal for accuracy to have a noise-free input audio stream, that is usually not the reality for most devices.

Advanced voice AI technology is able to handle a wide range of noisy environments including car, airplane, and cafeteria noise, regardless of the level of connectivity. Independent platform providers with advanced voice AI technology can work with manufacturers to provide the best speech recognition experience possible in any environment.

Lower Manufacturing Costs

Voice assistants built on the edge provide savings by eliminating the high cost of subscription-based cloud access fees and lowering the development time and investment with simpler, easier to implement voice user interfaces.

For edge voice AI solutions, the cost of implementation is low enough that brands no longer need to rely on existing voice assistant solutions and can quickly and easily develop intelligent, custom voice assistants equipped with all the specialized knowledge and product functionality users need.

Recurring cloud connectivity costs can make voice AI technology prohibitive for small devices and appliance manufacturers. When those costs are eliminated, voice interfaces become cost-effective product improvements that transform everyday products into smart devices.

As voice assistants move to more connectivity with Edge+Cloud solutions, the cost to implement increases, and some cloud connectivity will be required, but there are still cost savings with these solutions when compared to cloud-only voice assistants.

Product Independence and Differentiation

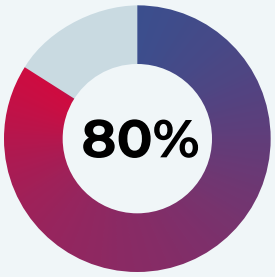
Instead of giving your voice experience and customer relationships over to another company, you can create a customized experience based on your particular needs and the needs and desires of your customers. When you choose to partner with an independent voice AI platform provider, your voice assistant doesn't have to be cloud-only, it can take as little or as much CPU space as your device has and include as much cloud connection as you need to deliver the voice experience that's best for you, your product, and your customer's needs.

What's more, wholly-owned edge voice assistants give manufacturers the flexibility to create their own commands based on unique product features and functionality and deliver voice experiences that respond to the unique phrasing and lexicon of their users. Customizable commands give manufacturers the flexibility to meet their customer’s needs without asking them to rethink how they naturally ask for things.

Knowing your audience and putting them at the center of your voice assistant strategy is a critical first step to finding the right voice technology partner—one who can help you meet your customer’s unique needs for information and product functionality.

Great for Personalization

In parallel with a growing demand for personalized experiences amongst consumers is the desire to keep sensitive data and conversations private. Voice assistants on the edge allow brands to deliver both. Locally stored data that never reaches the cloud allows users to determine personal settings, security passwords, and other personal information without concerns about internet hacking and security breaches.



Nearly 80% of the companies surveyed had experienced at least one cloud data breach in the past 18 months, and nearly half (43%) reported 10 or more breaches.

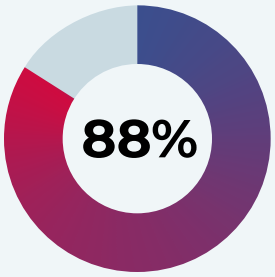
Ermetic

Personalization technologies such as speaker identification and biometrics improve the security level of voice interfaces while allowing for individualized settings and secure data storage.

Product Modernization

Of course, there's the appeal for customers to purchase the latest tech and own devices where they can show off "cool" functions to their friends. Keeping up with consumer trends and desires with product offerings that include the most interesting features is a critical factor in retaining a competitive edge for most brands.

For businesses, digital transformation includes investments in products that are innovative and will continue to help them stay ahead of the technology curve. Technology and devices that include voice AI interfaces are poised to help companies keep pace with the digital age.



of adopters say IoT is critical to the success of their company. We heard from those in IoT adoption that, two years from now, they believe they will see a 30% ROI, inclusive of cost savings and efficiencies.

Microsoft

Simplicity is at the core of edge voice technology: from simple to implement and use to accurate and fast responses to simple requests. As the adoption of smart devices grows, consumers will begin to expect the ease and convenience they've experienced in existing voice-enabled devices to become available in all smart devices.

Chapter Four

Functionality, Accessibility, Privacy, and Security

Voice assistants on the edge have the potential to impact who is able to access technology and devices without assistance from others. Barriers that include the need for physical dexterity, the ability to read, and good eyesight are eliminated when voice is introduced as an interface.

So much can be accomplished with voice AI embedded into the products around us. Without putting a strain on batteries or relying on the cloud, smart home devices take on a new level of functionality with added benefits. Custom wake words allow products to be always-on and ready to respond to a prompt to "wake up" while keeping power consumption low and user privacy high.

Improve Product Functionality

Knobs, controls, tapping, typing, and swiping are natural barriers to added product functionality. Complicated controls and menus can disincentivize users from attempting to use a device, and a wide range of options can be as off-putting as not enough functionality. When faced with choices they don't understand, users will often default to choosing only the most basic functions of a device or appliance.

In most cases, people don't want to take the time to read a product manual and instructions before using a newer version of a device they've used before. Without full understanding of the options available to them, consumers may not experience all the useful functions and fail to recognize the key product differentiators that you've added to beat the competition.

In 2020, there were 4.2 billion digital voice assistants being used in devices around the world. Forecasts suggest that by 2024, the number of digital voice assistants will reach 8.4 billion units – a number higher than the world's population.

Statista

Voice interfaces allow users to ask for the outcomes they desire without knowing exactly which settings it takes to achieve their goals. Manufacturers can offer more functions and build them into sets that deliver the desired outcome—surprising and delighting users with the ease of use and simplicity that voice commands offer.

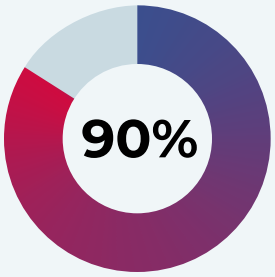
Accessibility for a Diverse Community of Users

The democratization of technology and universal accessibility is dependent upon providing users with more than one way to use any device. The addition of voice technology brings the power of speech to those for whom interfacing with devices that require manual interaction is a problem. For a large percentage of the population, the ability to access technology and a variety of everyday devices is the first step toward inclusion in a society that is becoming more dependent on technology for everyday living.

61 million adults (26%) in the United States live with a disability. 4.6 percent of people with a disability have a vision disability with blindness or serious difficulty seeing even when wearing glasses. 13.7 percent of people with a disability have a mobility disability where they have limited or no use of hands and arms.

CDC

Among those for whom technology is not easily accessible are those with vision and mobility restrictions, including the older generation. Fading eyesight and increasingly difficult dexterity are a source of frustration and loss of independence for the growing number of people entering their later stages of life. For people who could be otherwise independent, access to technology and the ability to operate various devices at home and in the world around them can be a barrier to independence.



Nearly 90% of adults over age 50—across all age, race, income, and health status categories—want to remain at home and "age in place."

Capital Caring Health

Voice-activated TV remote controls allow people without manual dexterity to raise and lower the volume and find the entertainment they want to watch. In the future, people will even be able to order a pizza to be delivered during the movie.

Access to devices that require reading or knowing which button to push or knob to turn limits accessibility to older and younger generations. When voice technology is embedded in children's toys and learning devices, pre-readers have access to more learning and toy functionality without the need to have an adult present to play. Independence and learning can both be achieved with devices children can access with their voice.

The global smart toys market is expected to hit around US $69,932.5 million by 2026, owing to the growing prominence of the concept of the internet of toys. During the forecast period of 2018 to 2026, the market is expected to develop at a growth rate of ~36.4% CAGR.

Transparency Market Research

Conversely, certain appliances and other dangerous devices in the home can be programmed to ignore children's commands—barring them from turning on the oven or operating devices that could be hazardous to them. In some cases, limiting access to certain devices may be as important as eliminating barriers. Brands that identify opportunities to increase safety as well as convenience and accessibility will be the ones that will take the lead as top innovators of the future.

Voice-enabled devices not only position companies as socially-conscious, they also expand opportunities to bring in entire new populations of people as users and evangelistic brand enthusiasts who are sure to share their positive experiences with their friends and networks.

Speaking the Language of Your Customers

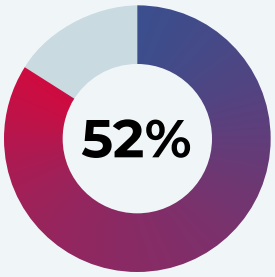
Knowing your users and their spoken language of choice is key to delivering a useful voice experience. Edge voice technology gives brands the freedom to choose from a library of the world's most popular spoken languages.

Manufacturers of internationally distributed devices are able to customize voice experiences for different geographic areas to meet the language needs of users across the globe—a competitive advantage that will take other companies in the market years to catch up to.

On the other hand, if your brand is taking a wait-and-see approach, your competitors could get there sooner and capture the market long before you can implement a voice interface that can compete.

Enhanced Security and Privacy

Your customers want privacy without sacrificing convenience or functionality. Voice AI technology on the edge not only eliminates the worry of personal data sharing it can also increase security levels for many types of devices.



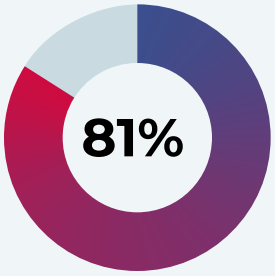
of consumers are worried about their voice assistants listening in the background to their private conversations.

Capgemini

Personalization technology—such as biometrics and speaker ID—can ensure that only authorized users are accessing certain devices. Through a simple process of wake word enrollment, multiple users can gain access to the same device while maintaining user security and personal settings.

Biometric identifiers, including fingerprints, facial or voice recognition, can be elements of security protocols for voice-enabled devices. Safety keywords can be easily programmed into embedded devices by individual users when manufacturers make the technology part of their product offerings.

Smart home products and devices for use in the medical, hospitality, and work environment can be made secure through a voice interface that keeps passwords, settings, and other sensitive operational data local on the device combined with other security technologies—such as biometrics.



of the total number of breaches leveraged stolen or weak passwords.

Verizon

In many instances, privacy concerns are centered around the collection, storage, and use of data by voice assistant providers. Keeping information private or collecting anonymized data for product development or voice experience improvement can be communicated to consumers who can be allowed to opt out of any cloud connectivity or data collection.

Voice assistants on the edge can provide an added level of security when used in home security systems or anytime when an immediate response is required for safety reasons. Voice alert systems in cars allow drivers to get help even when they don't have access to their mobile device or are unable to use their hands to push a call button. In the home, secure wake words and distress keywords can get faster help to people in distress.

Smarter, more accurate, and less expensive voice AI solutions that don't require a cloud connection for operation have the potential to make our everyday lives simpler, more convenient, and more accessible to more people than ever before.

Chapter Five

Choosing the Right Connectivity for Your Needs

Voice assistants that exist on the edge of connectivity can perform with or without a cloud connection. Edge voice interfaces provide the security of always-on connectivity and the convenience of functionality without the cloud. Smaller smart devices—or those with a limited number of specific use cases—benefit from the lower cost, and low processing power requirements of embedded solutions.

When hardware devices become more complex and users expect a larger range of functionality, knowledge, and understanding, edge devices can begin to get too weighty and require more processing power and memory than is reasonable.

To deliver the consistency of embedded voice experiences along with a deeper set of use cases and more content domains, manufacturers and large product OEMs (like car companies) might choose an Edge+Cloud solution.

Match Connectivity to User Expectations

Which connectivity solution you choose for your product will depend on your goals and the needs of your users. Some use cases require a lot of processing power and memory when they aren't connected to the cloud. While some products can support the large processing footprint, others may need to either limit their use cases or opt-in for at least partial cloud connectivity to support the information load.

In an Edge+Cloud connectivity model, a smaller volume of content domains can remain resident on the device—ensuring functionality regardless of the availability of the cloud—while a large library of other domains can be made available in the cloud.

With Edge+Cloud voice assistants, users will be delighted to get responses to all their answers and still be able to control the car or other device with voice commands.

Deliver the Full Voice Experience With Less Cloud Dependence

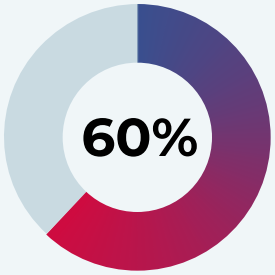
For developers and brands, the choice to adopt either a cloud-only, Edge, or Edge+Cloud voice experience shouldn't require choosing between voice technology providers—since the same system can be used for any type of solution. In cases where a manufacturer has chosen a cloud-only solution, changing to an Edge+Cloud voice interface is merely a matter of changing the URL in the configuration when both interfaces are built by the same voice AI platform provider.

While EdgeLite voice assistants may have limited ASR (automatic speech recognition) and NLU (natural language understanding) capabilities, Edge+Cloud voice interfaces are fully conversational and include the same advanced voice AI understanding as cloud-only technology.

When Connectivity Must Be "Always-On"

Just because your customer is driving in the mountains shouldn't mean they can't control in-car functions, like rolling up or down the windows, changing the lighting, or turning on the radio. Those controls can all be provided through an edge voice assistant.

Cruise ships and airplanes are other examples of situations where the voice assistant may move in and out of internet range. When in range, brands want to provide the greatest functionality and most inclusive experience possible. But, when the internet is not available or not reliable, those brands still want their customers to have the benefit of voice control.



Nearly 60% of car buyers in the U.S. want a voice assistant, and about half say it's a factor in their purchasing decision.

Voicebot.ai

While moving vehicles, planes, trains, and ships are obvious examples of inconsistent internet connectivity, there are others, too. In fact, we all experience poor internet connections—even at home. Relying solely on the cloud for voice assistant operability may not be the best option when voice commands are used to turn on and off the product or determine specific settings.

Edge and Edge+Cloud solutions all have the advantage of allowing users to operate devices and get a pre-set number of answers to questions for things like directions to use the product and maintenance records when the cloud is unavailable, unreliable, or not required.

Voice Assistants In the Cloud

The availability of voice AI solutions that don't include the cloud doesn't mean that cloud solutions are always an undesirable option. In fact, there are many use cases where cloud connectivity is the optimal voice experience for users.

Getting the weather, hearing the recent stock prices, and finding the best restaurant nearby that is open past 9:00 pm are all functions that people have come to expect from their voice assistants in certain environments.

For brands and manufacturers, understanding the end-user, knowing their environments, needs, and desires are critical to deciding on the level of connectivity you'll design into your custom voice assistant solutions.

When getting information from the cloud is paramount to the user experience, brands will want to partner with a voice AI platform provider that gives them access to hundreds of domains and delivers conversational technology that is smarter, faster, and more accurate than any in the market.

41 Billion

IoT devices by 2027.

Business Insider

8 Billion

increase from 2019.

Business Insider

Rapid growth in the IoT and smart devices will continue to drive consumer demand for voice interfaces that make their smart devices smarter and easier to operate. Getting it right means that brands and manufacturers either accelerate their voice experience roadmaps or find more ways to innovate on and customize the solutions they already have—extending them to more products with connectivity to match their most common use cases and customer expectations.

Chapter Six:

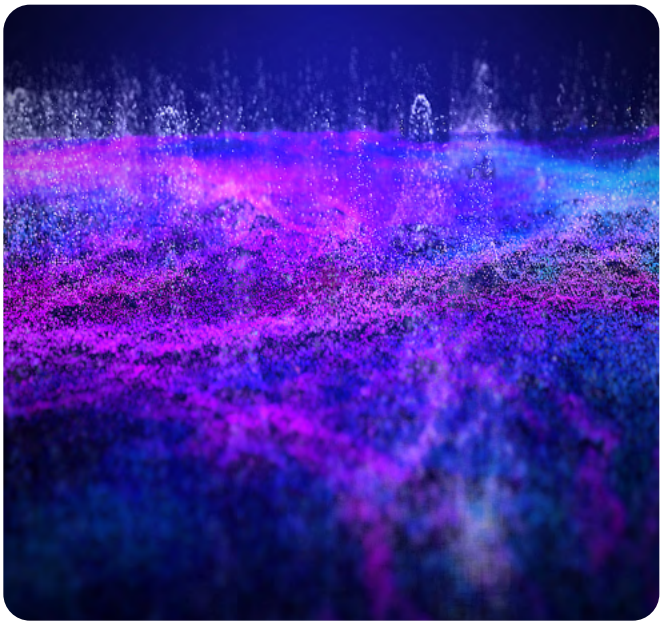
Conclusion

Although voice AI has been around for nearly a decade, it's just starting to unlock opportunities for manufacturers across industries. A broader range of connectivity choices is at the forefront of removing the barriers to entry—including cost, privacy, processing power, and time to market. Brands that have identified their business challenges and recognize voice AI as a solution can now begin to add voice user interfaces to their near-term and long-term product roadmaps. Edge speech technology is giving companies the ability to enhance the core capabilities of their products with a voice solution that's always-on, seamless, and efficient.

Conversational voice assistant technology is already available, and its implementation by brands is limited only by the imaginations of developers and designers who must look past the constraints of the past and rethink the way users interact with their products. Improvements in arbitration software and the availability of a range of solutions from one voice AI platform provider means that brands can simply switch from a cloud-only solution to an Edge+Cloud solution that delivers the fastest and most accurate responses possible.

Imagining the possibilities of voice assistants on the edge is just now entering the minds of manufacturers across industries. The potential of improved product functionality, deeper customer connections, and the ability to iterate based on real market knowledge is driving leading organizations to rethink their notions of voice AI. If you haven't started the conversation in your company, now is the time to act.

At SoundHound Inc., we have all the tools and expertise needed to develop a voice assistant ranging from the always-on voice control and maximum privacy of edge voice interfaces to a cloud-only option for the broadest capability with minimum hardware impact to an Edge+Cloud solution that combines the control of embedded with the capabilities of the cloud.



Explore our independent voice AI platform or register for a free account. Want to learn more? Talk to us about how we can help you bring your voice strategy to life.

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