



Statement by Ryan McCrate
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before the United States Senate
Committee on the Judiciary
Subcommittee on Competition Policy, Antitrust, and Consumer Rights
June 15, 2021

Thank you, Chairwoman Klobuchar, Ranking Member Lee, and members of the Subcommittee. I am Ryan McCrate, Vice President and Associate General Counsel for Alexa at Amazon.

I joined Amazon in 2007, the same year we launched the Kindle eReader. Since then, I have supported a number of customer offerings including Amazon Video, Music, and Games Studios. In 2016, I took over as the lead lawyer for our newest product, Amazon's Echo and Alexa voice service. Our corporate philosophy is firmly rooted in working backwards from what customers want, and continuously innovating to improve that experience. Fortunately, for me, and the legal team I lead, a strong focus on the customer makes it easier to make good decisions. When you start with the customer and work backwards, the correct answer is often right in front of you. Technology is an important part of modern life, and it offers extraordinary benefits we are just beginning to realize.

I. Amazon's Alexa – Working backwards from the customer

At Amazon, we talk about inventing on behalf of our customers. Nine years ago, we set out with a goal: to bring voice assistants accessed on mobile devices to the home. The foundation of our vision was to build the *Star Trek* computer and create a service that made it possible to walk around your environment, and get information or anything else you needed just by asking.

The result was Amazon Echo and Alexa voice service. Alexa is a cloud-based voice service. Like your mobile device's voice assistant, Alexa lets customers play music; ask questions; and, get news, sports scores, weather, and more. With Alexa, multiple people could interact with their assistant from anywhere in the room. This approach required our teams to overcome substantial technical challenges. Unlike mobile devices, which required users to speak directly into their phones, Echo devices needed to work well in noisy environments and in different locations within homes that had different acoustic characteristics. Further, it needed to understand and work well for people with a diverse range of speech patterns, vocabulary, and accents. This invention opened up many new opportunities for expanding the smart home and customer experience.

Alexa is now available through a wide range of products, including Amazon's Echo family of devices, other Amazon products such as our Fire TV and Fire tablet devices, and devices developed by third-party manufacturers with Alexa Built-in and Works with Alexa. Alexa operates in a similar manner across the range of products on which it is available, although customers access Alexa differently based on the type of Alexa-enabled product they use.

Privacy and security were, and remain, foundational to Alexa's success. From early-stage development, we built privacy and security deeply into the hardware and service by design, and with Alexa and Amazon's Alexa-enabled products, we strive to put the control with our customers.

On our Echo family of devices, customers speak to Alexa by saying the "wake word" (Alexa, Amazon, Echo, or Computer) or, on some devices, by pressing the action button on the top of the device. The wake word is a critical element of the service. It was carefully selected to ensure the service would correctly understand when to "wake up" and start recording a request in order to respond. Alexa, a three-syllable word, is derived from the Library of Alexandria; and Computer, is of course, the AI in *Star Trek*.

Echo devices use "on-device keyword spotting" technology, which is designed to only detect the wake word. The technology analyzes acoustic patterns to detect when the wake word has been spoken using a short, on-device buffer that is continuously overwritten. This on-device buffer exists only in temporary memory (RAM); no audio is ever recorded to any on-device storage. The device does not stream audio to the cloud unless the wake word is detected. The user experience also provides customers with a clear indication of when audio is being streamed. When the wake word is detected, a visual indicator appears on the device to clearly indicate to the customer that it is streaming audio to the Amazon cloud (e.g., a blue light ring on the Echo device or a blue bar on the Echo Show's screen). We also offer a setting where customers can choose to hear an audible tone when their Echo device begins and ends streaming audio to the cloud.

Next, the audio is streamed to the Amazon cloud, where our systems for "automatic speech recognition" (converting audio to text) and "natural language understanding" (interpreting the meaning of text) then determine the meaning of the customer's request so that Alexa can respond appropriately. Amazon encrypts all communication between Echo devices and Amazon's servers, and stores all customer data securely on our servers.

We also give customers control of their voice recordings that are streamed to the cloud. Customers can review, listen to, and delete their voice recordings using the Voice History feature available in the Alexa app and on the Alexa Privacy Settings dashboard, located at www.amazon.com/alexaprivacysettings. They can also delete their voice recordings by voice by saying, "Alexa, delete everything I said today" or "Alexa, delete what I just said." Customers can also choose to not save any voice recordings at all.

Echo devices come with a microphone off button that also enables customers to manually control when their device's microphones are on. When the button is pressed to turn the microphones off, the microphones are electrically disconnected and a dedicated red LED light is illuminated to indicate the microphones are off. As an additional safeguard, we designed the circuitry of Echo devices so that power can only be provided either to this dedicated red LED or to the device microphones, but not to both at the same time. Our multimodal devices (i.e., devices with a screen) also come with a camera shutter as an added layer of customer control and privacy.

II. Developers and device makers – Core to Alexa’s evolution and customer choice

From the beginning, we knew that developers and other device makers were going to be the key to making voice assistants useful for customers, and to Alexa’s success. After Echo’s launch, we immediately turned our attention to opening up Alexa and the smart home to all inventors and developers. Prior to the introduction of Echo and Alexa, controlling connected devices was either limited to a manufacturer’s mobile app or to hubs like Apple Home Kit and Samsung Smart Things. We were the first to announce voice assistant integration into a third-party device, and we developed, without exclusion or licensing, a number of technologies that are now integrated into connected devices. In addition, we democratized access to the voice assistant with the Alexa Skills Kit. In fact, Google, and now Apple, have since embraced this approach.

We continued the journey to a smarter and more helpful home by making sure that Alexa could work with connected devices. We started with the obvious things, like connected lights and thermostats, but quickly added things like appliances—even lawn mowers—and Christmas trees. We’ve seen lots of innovation here: Alexa now works with over 140,000 compatible products from 10,000 brands. Customers use Alexa with their smart devices to simplify their morning routines, take chores off their to-do lists, and keep their homes safe. We love seeing this, but we’ve also always believed that having a smarter and more helpful home is about more than just having lots of connected devices—it’s about the experiences those products come together to create.

Developers and device makers have been core to Alexa’s evolution, and they will be critical to the future of our entire family of devices and services. Unlike an operating system, smart home devices can simultaneously support multiple voice assistants, and connect multiple services, devices, and sensors. Today, customers control their smart home devices through multiple services, interfaces, and commonly, the manufacturer’s mobile app. This is precisely why we do not ask Alexa voice service partners and device partners to be exclusive to Alexa, and why we do not collect licensing royalties for our patents that improve the smart speaker device experience.

We work relentlessly to improve the service so that our partners and developers can build products and capabilities for customers at a rapid pace. Today, there are hundreds of Alexa Built-in devices, including not only speakers, sound bars (e.g., Bose, Polk), and smart displays (e.g., Facebook, Lenovo), but also TVs (e.g., Sony, Samsung), PCs, hearables, wearables, appliances, and more.

Our Alexa “skills” program allows third-party developers to offer the equivalent of apps for Alexa that provide customers additional features and capabilities. We have over 130,000 skills, from well-known brands like *Jeopardy!* and OpenTable, as well as small developers like MyPetDoc and Big Sky. Some of the most popular categories of skills include smart home (e.g., Philips Hue, ADT), music (e.g., Spotify), sleep aids (e.g., Sleep Sounds and Headspace), and food & drink (e.g., Domino’s).

Alexa helps to generate billions of dollars for the developer and device maker community. Partners are successful with Alexa because they see more revenue and customer engagement, and an increase in brand affinity from integrating voice into their products and services. We also make our developer tool, the Alexa Skills Kit, free to use, and provide reference designs for hardware that make incorporating voice into devices extremely easy. This has unlocked new opportunities to both hardware makers and services providers to make their products smarter.

In addition to Alexa Built-in and Works With Alexa, we recently announced Alexa Custom Assistant. Alexa Custom Assistant is a new solution that lets companies create intelligent assistants that are built on Alexa technology, but with their own wake word. The Alexa Custom Assistant can be used to build intelligent assistants into an even broader array of devices, including automobiles and consumer electronics. It provides companies a comprehensive, managed voice solution that reduces the cost and complexity of their having to build their own intelligent assistant from the ground up.

For other enterprises that do not want to build on our Alexa voice service technology, a number of AI technology services are provided by products from Nuance, Microsoft's Azure, and IBM's Watson. At Amazon Web Services, we enable developers and businesses with no prior machine learning expertise to easily build sophisticated, scalable, ML-powered applications like Amazon Lex and Amazon Polly. Lex is a service for building conversation interfaces into any application using voice and text. Polly turns text into lifelike speech for all Amazon Lex languages.

We recognize that innovation does not just come from us. There are many smart people in the world who can innovate if given the right tools. We continue to believe in the promise of the Alexa virtuous cycle, where external developers and partners create a diverse and high-quality selection of skills, and these experiences fuel consumer engagement and choice. Because we've simplified the interfaces, standardized the technological components, and opened up the service to developers, there are now many home products by inventors large and small.

III. Voice Interoperability Initiative – Choice and flexibility for manufacturers and customers

We also fundamentally believe that customers should have the option to select the devices and experiences that best meet their needs, including the choice and flexibility to interact simultaneously with multiple voice agents on a single device.

Over a year ago, we announced the Voice Interoperability Initiative (VII). VII is a program to ensure voice-enabled products provide customers with the choice and flexibility to interact simultaneously with multiple voice agents on a single device. People use multiple voice assistants, and different voice services will have unique proficiencies and utilities. Voice-enabled products should be designed to support multiple, simultaneous wake words, so customers can easily interact with the voice assistant of their choice by saying the corresponding wake word.

We also don't expect companies to only use our services or our software. We believe partners and customers should be able to pick the solutions that work best for them. VII's membership now includes over 80 blue chip brands and small innovators alike, including consumer electronics, automotive manufacturers, telecommunications operators, hardware solutions providers, and systems integrators. In partnership with VII's membership, we have developed a Multi-Agent Design Guide, and work is underway on a developer toolkit to help companies prototype multi-agent products.

We believe interoperability is important, and that customers that purchase smart home devices should have a choice over the many ways they can access and use the device. This is why we've supported initiatives like the Matter/Connectivity Standards Alliance (formally the Zigbee Alliance) to drive more adoption of open protocols for smart home communications. The Alliance works to create and evolve universal open standards for wireless device-to-device communication for IoT to ensure interoperability for all consumer devices to work seamlessly together. Ultimately, success and trust is earned only when customers have the choice and flexibility to bring all of their devices and services into a seamless interaction.

IV. Smart Home – A helpful home that works harder for customers

In order to understand where we are headed, we have to first examine how we got here. The home has evolved substantially over the years, and we increasingly see customer interactions that demonstrate we are actually creating a more helpful home. When electricity was first installed in homes, that was probably considered “smart”—and now it is just standard. Similarly, we’re helping make the home truly smart with technology.

Anyone who has walked the floor of the annual International Consumer Electronics Show since the early 2010s is familiar with the infinite devices, appliances, gadgets, and now cars, equipped with sensors, Wi-Fi capability, robotics, or computing power that are being brought into the home. The smart home has been on an accelerated invention trajectory for well over a decade.

In the last 10 years, the technology has evolved considerably and, today, the smart home space is thriving. Equally important, it is intensely competitive. We are seeing fast follows to voice interface in robotics, ambient computing, and predictive machine learning tools. Customers will always use multiple interfaces depending on the context of their needs—browsers, apps, mobile phones, voice, robotics, and other sensors.

Voice assistance is still a nascent user interface (UI). It is a natural progression from typing, to swiping, to speaking; and, it supplements, rather than replaces, prior UIs. Depending on the application, the location, and utility, customers will access the UI most suited to their need in the moment; such as, typing “weather” into a browser while in the office, opening a weather app on a mobile device while on the go, or asking a voice-enabled device a question while cooking in the kitchen.

Furthermore, the vast majority of voice interactions today still occur on a user’s mobile device, as eMarketer estimates that nearly 90% of voice assistant users use a smartphone voice assistant at least once a month. We invented enabling speakers with a voice assistant; however, we were not the first or even second in voice. In fact, today we are still well behind Google Assistant and Apple’s Siri in customer interactions, despite the growing adoption of Alexa-enabled smart home devices. Apple just announced that 600 million devices monthly are using Siri. When we first dreamed up Alexa, our peers had much more relevant data for the purposes of building a voice assistant. For example, when Apple launched Siri in 2010, it had ample amounts of voice search data given its large base of iPhone users. And, when Google launched a voice directory assistance program in 2008 (“GOOG-411”), in order to evolve and refine their voice technology, they were able to build on a huge volume of voice search queries. In contrast, we had no pre-existing voice data when we set out to build Alexa. The story of Alexa’s development illustrates that success and failure are not pre-ordained. Innovation, intuition, willingness to take risks, and working backwards from the customer determine success in cutting-edge products and services. Sometimes the risk pays off for us, as with Alexa, and sometimes we fail, as happened with the Fire Phone.

Moreover, as we are seeing by the large and growing number of competitors big and small, there is room for many winners, especially given the different specific competencies of various products. We see great promise for a future where people use multiple voice services, and we're committed to making that experience as seamless as possible for our customers. Companies like Spotify have made significant investments in their own voice technologies. The number of voice assistant options is growing and include Google Assistant, Siri, AliGenie, Duer, Bixby, Sherpa, and Lyra, among others. Investments are also growing in many service sectors. Most notably, banking and healthcare have begun integrating bespoke voice technologies in consumer banking features, the pharmaceutical research lab, the hospital, and electronic record systems.

V. Conclusion

The modern home is smarter than it has ever been. Equally important, this space is intensely competitive. The Alexa team and I are motivated by this—we are looking at how we can continue inventing for customers and identifying solutions for challenges we never thought we'd face.

Alexa has proven to be incredibly helpful to our customers, and we've been humbled by how customers are relying on our devices to do everything from staying connected with friends and family through videos and live view check-ins, to asking Alexa to set a timer so baking brownies don't burn, and to dim the lights for movie time.

When we first began working on Alexa, we also didn't fully comprehend the profound impact Alexa would have on people's lives. Customers experiencing arthritis can now easily text grandchildren. A person who is blind or with low vision can hold an object up to Echo Show devices, and Alexa will tell them what it is. Customers with mobility impairments have shared stories about how they use Alexa's voice features with smart home devices to manage their entire household. Young customers who may be dyslexic now have an ability to interact with a computer through the voice interface.

These are just a few examples of what voice services like Alexa can do. It's technology that makes the home more helpful for our customers, and we continue to experiment and learn how customers put this new interface to work.

Thank you for this opportunity to share our vision for a better home experience. I am happy to take your questions.