Amazon. Hardware Basics: Amazon Echo. (Dec

Alexa can keep you company just about anywhere in your home.

Amazon Echo might look like a cylindrical Bluetooth speaker, and it is in part. The device has built-in omnidirectional speakers that play music and other audio. But it does so much more than that. Like smartphones with voice-recognition capabilities, Echo is yet another step toward the voice-controlled computers of science fiction we've been seeing in television and movies for decades.

You can ask the gadget to play music, tell you the weather forecast, add to your to-do list, read you your schedule or the news, and much more. If you have compatible smart-home devices, you can tell Echo to dim the lights or turn appliances on or off. By design, you interact with the device hands-free so that you don't have to stop everything and fumble with your phone or get to a computer (although you do need to access an app or website to configure some of its settings). Want to listen to some Beethoven while you fix your hair, set some mood lighting and heat up the smart oven in the other room? The Echo's for you. It's always on and listening for the magic word to wake it up. Once it hears that, the device gathers the voice commands that follow and sends them to a natural voice recognition service in the cloud called Alexa Voice Service, which interprets them and sends back the appropriate response. The device has an array of microphones that can pick up your voice from across the room, even over music and other environmental noise.

Amazon is adding more services to the Echo all the time and has made the Alexa cloud service available for use by third-party developers, opening it up to lots of future possibilities.

Amazon Echo is a cylindrical device that measures around 9.25 inches (23.5 centimeters) in height and 3.27 inches (8.3 centimeters) in diameter. A microphone off/on button and an action button at the top of the device provide some control options, and they rest on a ring you can rotate to adjust speaker volume. But the main control is the seven-microphone array built into the top, which uses beamforming technology and noise cancellation to "hear" your voice (i.e., record it and send it to the cloud).

A light ring at the top outer edge provides status information, such as the volume level and whether the device is streaming audio or the microphone is turned off, via various light colors and motions. An LED that lets you know the status of the device's WiFi connection sits near the base just above the power cord. Echo comes with a 21-watt power adapter, which is its only power source. Sorry - you can't carry it around with you.5-inch (6.4-centimeter) woofer and a 2-inch (5-centimeter) tweeter. They take up roughly the lower half of the cylinder. They're covered in cloth, and speaker holes let the sound travel to your ears. A reflex port in the air chamber above the speakers reportedly decreases distortion and enhances the woofer's sound.

Teardowns have revealed that the device contains three circuit boards. A small board at the

bottom contains Texas Instruments (TI) power and speaker drivers. A circular board at the top (integrated into the volume control wheel) houses components for the control buttons, volume wheel, status LEDs and microphones. A rectangular, side-mounted board above the speakers contains the brains and communication components, including the following [sources: Cunningham, Detwiler, Ifixit]:

TI DM3725 ARM Cortex-A8 Core Digital Media Processor

A TI power management integrated circuit (IC)

4 gigabytes (GB) of NAND flash memory

256 megabytes (MB) of LPDDR1 random access memory (RAM)

A Qualcomm Atheros QCA6234 dual-band 802.11n WiFi and Bluetooth 4.0 module.

But as you'll find out later in this article, the real brains behind the device rest in the cloud.

An optional remote control is sold separately. The remote includes a microphone, a talk button and a directional track pad (with play/pause, previous, next and volume symbols) for easy audio control.

Amazon Echo Dot
If having a hands-free, voice-activated assistant appeals to you, another device to consider is the Amazon Echo Dot. At 1.3-inches tall by 3.3-inches wide, the Dot takes up less room than the original Amazon Echo, and it's cheaper to boot. The first-generation Echo Dot was released in March 2016 for $89.99, but a second-generation model with a more powerful processor was released in October 2016 for only $49.99. The Dot's small speaker isn't as impressive as the Amazon Echo's woofer and tweeter, but unlike the Echo, the Echo Dot can be paired with external speakers via Bluetooth or its 3.5mm audio jack. You can scatter multiple Dots throughout your house to get information from Alexa, play music, place orders or control your smart home from more than one room without having to carry a remote (although the optional remote will work with Echo or Echo Dot). If you have more than one Echo or Echo Dot within earshot, Alexa will reportedly use something called Echo Spatial Perception (ESP) to respond to you from the nearest device.

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Without a connection to a home WiFi network, it'll be impossible to use your Amazon Echo. The device supports dual-band 802.11 a/b/g/n WiFi network connectivity. It can't be used with ad-hoc, peer-to-peer, or enterprise networks or public networks that require extra authentication steps (like many hotel, coffee shop or airport networks).

The bulk of the work isn't taking place on the device itself. Echo sends your voice commands via your WiFi network to Alexa Voice Service to be interpreted and acted upon. Alexa is a

cloud service, which means it's a software-based service running on a lot of powerful servers in one or more data centers, accessed via the Internet. Alexa then converts the response (whether from an Alexa service or a third-party web app) and sends it back via audio to your Echo, and in many cases via text and graphical cards to the Alexa app home screen.

A social creature, Echo connects to other devices (like your smartphone) via Bluetooth. It supports audio streaming from smartphones and tablets via Advanced Audio Distribution Profile (A2DP) and voice control via Audio/Video Remote Control Profile (AVRCP).

You can manage Echo remotely with the Alexa app, which you can download to devices running Amazon Fire OS 2.0 or higher (with the exception of the second generation Kindle Fire), Android 4.0 or higher, or Apple iOS 7.0 or higher. If you don't want to use the app, you can visit Alexa's Amazon homepage.

You have to set up your Amazon Echo using either the app or the website (including connecting to your WiFi network and pairing it with the optional remote or other devices via Bluetooth). You can also use the app or site to:

Change settings

Consult help

Look at and manage your shopping and to-do lists

See and manage your timers and alarms

Set up news and music services you want to be able to access

See your music queue and what's playing on your device right now

In Settings, you can add an additional household member and switch the device from one user's profile to another with the voice command "switch accounts." Doing this allows you to share some digital content, but it also authorizes the other person to make purchases with the credit card on your account, unless you disable purchasing.

Alexa's voice-recognition algorithms improve with use, learning your speech patterns and word usage. The app or website's home screen will display text and graphics cards showing your recent interactions, descriptions and links to get to more related information. The descriptions show you what Alexa heard you say and give you a chance to provide feedback about whether it heard you correctly. The feedback will help teach your virtual assistant Alexa how you speak (more on that later). You can also delete the cards and the voice commands that invoked them (or delete prior commands under History in Settings), although this will apparently take away from whatever Alexa has learned about your speech.

You can further help it learn how you speak by going through the Alexa "Voice Training"

session, during which you read 25 commands aloud, and by accessing your previous commands and making corrections where it misinterpreted you.

There are also third-party-created features that you can activate via voice or in the Skills section of the Alexa app or website and then use via voice command on Echo. The thousands of available skills that have come out since the Echo was introduced let you do things like order a ride from Uber or Lyft, play Jeopardy, hear tweets from your Twitter timeline, follow a seven-minute workout, get updates from your Fitbit, order a pizza from Dominos, check on your Capital One accounts and hear news from your favorite outlets. Each skill listing should show you what command or commands to use to access it.

Updates download to the device automatically. Many of its features actually reside in the cloud, where Amazon and third-party developers can add to them anytime.

Amazon's Alexa Appkit also lets third-party developers and manufacturers add Alexa Voice Service to their products at no cost. Alexa capabilities have been added to the Nucleus home intercom, the Pebble Core wearable device and Invoxia's Triby kitchen smart speaker.

Amazon.com Inc.

Whether you're next to the device or across the room, once you've woken up your Echo, you can ask it for the time, weather, traffic, sports scores and schedules, news, restaurant and other establishments' info from Yelp, entries from Wikipedia and lots of other information. You just have to learn and use the accepted commands. Your Echo will also send text information to the Alexa app on your phone or tablet, and it can cast further information to a Fire OS tablet.

Echo can play music from your Amazon Music library (containing any digital music purchases from Amazon or music imported from your computer), Amazon Prime Music (accessible by Amazon Prime members), Amazon Music Unlimited (a subscription music service - there is even an Amazon Music Unlimited for Echo subscription available for use on a single Echo), Pandora, iHeartRadio, Spotify and TuneIn, in addition to streaming music from your smartphone or tablet via Bluetooth. You can request specific songs or bands, or say more general things, like, "Alexa, play jazz." And you can create new stations in Pandora. The device can play audiobooks via Audible and take advantage of Whispersync to keep your place, and it has the ability to set sleep timers to stop the audio playback after a set amount of time.

Echo gives users the ability to order digital music, Amazon Choice products and Prime-eligible products, or reorder previously placed Amazon Prime-eligible orders. Since anyone in the vicinity can talk to Echo, for added security, you can set a confirmation code that you have to say to place an order, or you can simply turn off purchasing via Settings in the Alexa app.

Echo can be used as part of your connected home to make compatible lights, appliances and smart-home hubs voice activated. Some Echo-compatible connected home brands include Insteon, Belkin WeMo, Philips Hue, ecobee, Samsung, Nest, SmartThings and Wink.

You can make Echo execute more complex sets of actions by setting up an Alexa channel on the third-party site IFTTT ("If This, Then That"), which sets up triggers for certain actions. This means you can use Echo to turn on appliances when alarms go off, control a Nest thermostat, find your phone or add things to your Evernote to-do list via voice command.

As of early November 2016, the device understands North American and UK English and German.

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The Echo constantly listens for a special wake word to know when to start listening for commands and do your bidding, provided you haven't turned off the device's microphone. The default wake word is "Alexa," but you can change it to "Amazon" or "Echo" using the app. There are plans to add more possible wake commands in the future [source: Davies]. When the Echo's light ring is blue (with a cyan portion toward the person speaking), it is sending audio to the cloud and processing your request.

Echo will understand a certain set of pre-programmed commands, and when you speak the wake word before a command, it does one of three things: performs the task you requested, prompts you for more information or tells you it doesn't understand your request. You can speak into the remote from other rooms and get Echo to respond. The action button can also be used directly to turn off alarms and timers if you don't want to do it via voice. If you want, you can use the app or website to set the device to play, start and end sounds when it wakes up and when it stops sending your audio.

You can turn off the Echo microphones with the microphone button at the top of the device if you want to be sure it's not sending audio. The light ring will glow red when the microphone is off. Your Amazon Echo device won't listen for the wake word or process commands when the microphone is off, but you can still send requests through the remote control (if you have one). When you press the remote's microphone button and speak into the remote, the Echo's light ring will turn blue while it is sending your audio to the cloud, and it will return to red when you're finished.

Examples of Echo voice commands include:

"Alexa, what's the weather in Atlanta, Georgia?"

"Alexa, tell me a joke."

"Alexa, how far is it from here to Austin, Texas?"

"Alexa, sample songs by Elvis Costello."

"Alexa, what is the IMDb rating for 'Star Wars: The Force Awakens'?"

You can obviously ask your Echo quite a few things, and it even has some built-in Easter eggs. For instance, if you say the Princess Bride line, "Alexa, inconceivable!," it will reportedly reply, "You keep using that word. I do not think that word means what you think it means" [source: Pogue].

And as with our actual language, there are multiple ways to say some of the same things. For instance, the following should make Echo play the same audiobook:

"Alexa, read 'A Christmas Carol.'"

"Alexa, play the book 'A Christmas Carol.'"

"Alexa, play the audiobook 'A Christmas Carol.'"

"Alexa, play 'A Christmas Carol' from Audible."

You can consult the Amazon Echo help pages and the Alexa app for more information on working commands.

Rachel Murray/WireImage/Getty Images

Echo was offered to some Amazon Prime members in late 2014, and it became widely available for purchase in June 2015. Its price as of this writing is $179.99, and the optional remote is an additional $29.99.

The company is improving and adding new capabilities to Echo and Alexa all the time, like movie showtimes, text-to-speech for Kindle and Yelp local search. With access to the Alexa service being offered free to third-party gadget and app developers, a great many voice-based services have been made available for Echo since the device's release, and we will no doubt see more in the future, both on Echo and other devices. Reviewers have noted that the device seems to understand natural speech more accurately than a lot of its voice-recognizing counterparts (including Siri and Xbox), even at a distance or over background noise, and that it replies with useful information most of the time, in addition to providing decent sound quality on music playback [sources: Ackerman, Hardawar, Pogue].

As with any service that collects data (in this case vocal recordings) and stores it in the cloud, data breaches are possible. The data stored by Alexa is not entirely anonymous. It has to be connected to your Amazon accounts to remain useful. And the device requires your location information in order to provide services like local weather and traffic, much like your phone does.

Before you buy, you have to weigh whether you're more worried about how Amazon or others might use the information or more wowed by the services and conveniences the info makes possible, just as you must with other data-gathering and sending devices. In the case of Echo, you can at least turn off the microphone array whenever you want, and thanks to its status lights, you can see when it's sending your voice to the cloud.

We've seen voice-activated assistants before, but this is the first one that is mostly untethered from our full-featured computing devices. Amazon Echo is a hands-free step toward the integrated virtual home assistants many of us have assumed would pop up any day now.

Hopefully this means it's only a matter of time before we can issue voice commands for all of our household duties from the moment we wake up to the moment we go to bed, from adjusting our environmental comfort to figuring out what's for dinner. Here's to our future "Star Trek"-like existence. I've been considering finding a way to have my tablet read my mail and schedule and get weather info to me in the morning. I use Siri sometimes, but it requires that I pick up my phone, key in a password and hold down a button, which is hard to do when getting dressed or brushing my hair. Echo could potentially free me from stopping to check the phone, tablet or computer, and let me continue getting ready, a great boon for a perpetually running-late, non-morning person. Once again, my research has added a gadget to my wish list.

How Speech Recognition Works

How Siri Works

How Smart Homes Work

Alexa Voice Service

Amazon Developer

IFTTT

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