

Chapter 9

Making the World Accessible for Children Who Are Deaf or Hard of Hearing through Technology

Jim House & Barbara Raimondo

Fortunately, today's society offers many devices and systems to make sure that individuals who are D/HH have access to sound-based information in their environment. What's more, today's gizmos and gadgets make it easier than ever to communicate—both auditorially and visually.

Most parents of children who are deaf or hard of hearing (D/HH) are themselves hearing, and their day is full of sound. They listen to the radio, talk on their cell phone, and hear the smoke detector go off. They obtain a lot of information through listening. When they find out their child can't hear, naturally they are concerned. "How will my child be able to keep up?" "How will he (or she) stay safe?" Most importantly, "Will my child be able to succeed in life?"

According to the [National Institute on Deafness and Other Communication Disorders](#), more than 90% of children who are D/HH are born to hearing parents. Many of these parents may not have had previous encounters with children or adults who are D/HH and therefore

may not be familiar with the resources available today in many areas of life. Also people born hearing can be deafened through sickness or accidents while they are in school, as teenagers or adults after they have developed a language, and may be classified as late-deafened. Sometimes there is an additional sensory or mobility disability in addition to the hearing disability that may require further adaptations or accommodations. For the remainder of this article, the term D/HH encompasses all people who are deaf or hard of hearing regardless of the age of onset or the presence of other disabilities.

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environment. What's more, today's gizmos and gadgets make it easier than ever to communicate—both auditorially and visually. Even children who use hearing aids or cochlear implants benefit from visual technology. There is no reason for children who are D/HH to miss out on access to information. Having access to that information with the help of technology will help children who are D/HH grow up to live independently.

Parents and professionals can become aware of the many tools around and help ensure they are made available to their children and the children with whom they work. Children who are D/HH need access to information that hearing people take for granted. Every experience of information access becomes an experience of language and learning. With access to information provided by technology, children who are D/HH can learn to function independently and make informed decisions.

Many of the technologies shown here will evolve over the years. By becoming aware of what is available now, parents and professionals can use this guide as a starting point to research new alerting devices, telephones, captioned information, and computer applications (apps). While this guide is not all-inclusive, we hope that by following some of these links, you will find other resources and technologies. If you share your findings with us, we will consider them for inclusion in future updates of this chapter.

Technology for the Home

All-in-One Alerting Systems

Many devices in our homes alert us through sound. These sounds can be made visual or tactile through "all-in-one" alerting devices, which combine a receiver with several transmitters. Different receivers and transmitters serve a specific purpose. They may let you know when:



- The telephone or doorbell is ringing.
- The food in the microwave is cooked.
- The clothes in the washing machine are ready.

Receivers can be connected to lamps or vibrating bed shakers, and different flashing or buzzing patterns can help the user discern the source of the signal. Additional lamp receivers can be installed around the home to alert the user in different rooms.



You may be thinking, "Wait a minute—my 2-year-old isn't using the washing machine yet!" But seeing a light flash when the machine is finished can help make the child aware of what is happening in his environment. Similarly, the child may not be answering the door yet either. But the child may see Dad jump up in the middle of reading the child a story to answer the door, and lo and behold, the UPS driver is standing there with a package from Grandma. Being able to connect the flashing of a light with the fact that someone is at the door also helps the child learn about his world.

Later, the child will (we hope!) be doing his own laundry. As he gets older and starts to value his privacy, he may request that his parents let him know when they want to come into his room. For many children are who D/HH, knocking won't work, but parents want to be respectful. One remedy is to install a flashing doorbell at the child's door. A simple flashing doorbell mechanism can be purchased online and attached to a lamp that flashes as the doorbell button is pressed.

Smoke & Carbon Monoxide Detectors

It is a difficult fact to face. According to the [U.S. Fire Administration](#), 57% of all child fire deaths occur among those 4 or younger. Yet it is well established that smoke detectors save lives. Visual smoke and carbon monoxide detectors



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should be installed in the child’s bedroom and in any other room used by the child. Detectors with strobe lights are the most common types. There are also devices that detect the sound of a regular smoke detector and flash a lamp. These devices can be connected to a bed shaker, a strong fan as a substitute, or to complement a flashing strobe light. Starting from a very young age, children should be taught about fire safety and what to do if they see or feel a fire alarm go off.

Many jurisdictions have laws that require apartment managers and other landlords to install visual smoke detectors upon request by the tenant. If you are a homeowner, check with your local fire department or American Red Cross to see if it is able to provide and install free visual smoke detectors in your home.

Home Security Systems

A growing category of mobile phone apps are those that monitor your home. Systems include doorbell notification systems where if any visitor comes to your home and rings the doorbell, a picture of the visitor is sent to your mobile device. If there are pets in the household, some systems allow you to have a “video chat” with them. At the top end, whole house monitoring systems allow you to do several things remotely, such as:

- Programming the house thermostat to heat or cool the house several minutes before you arrive home.
- Monitor children and pets.
- Respond to motion detector alerts.
- Send alerts to police if someone breaks into your home.

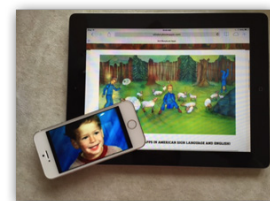
Such systems can be found at an electronics store or through your cable TV providers. Depending on the features you use, a monthly monitoring fee may be charged to your account.

Telecommunications Access

Advancement of the Internet has provided communication opportunities that we could only read about in science fiction

novels a decade or so ago. People who are D/HH and hearing have adopted new ways of communicating, such as email, instant messaging (texting), and video communications. Families can introduce these to their children to help them stay in touch with others. While in the “old days,” Grandma or Grandpa may have written a letter to Grandkid, today they can send an email or text. Mom or Dad can read the message to Grandkid and type the response dictated by the child. As she gets older, she can learn to send messages herself. She can also use video apps, which support sign language. For example, the FaceTime app allows anyone to have a real-time visual and auditory conversation. Another app called Glide allows users to record a video message and send it to another. That individual can record a video message in response and send it back. Each party can read the message and respond at a convenient time.

The availability of high-quality video also means that children and families have access to American Sign Language (ASL) stories and lessons. Gallaudet University’s [Visual Language and Visual Learning Center](#) has produced interactive storybook apps in ASL and English that are aimed at young children. Families learning to sign may want to use [ASLNook](#), which highlights videos of a real-life family signing in natural situations. There are many, many other ASL and sign language apps available. Families can explore them and use their favorites.



Telephones



Andrew Saks and Dr. James Marsters watch Robert Weitbrecht type on one of the first text telephones in the mid-’60s.



A more recent model of a TTY from Ultratec.

The first device that allowed people who are D/HH to use the telephone was the **TTY**—

also known as the text telephone. Both parties typed to each other using abbreviations, such as GA to let the other party “go ahead” and type back and SK—“stop keying”—when it was time to hang up. The TTY was slow and cumbersome by today’s standards but revolutionary in its time. Although most people have moved on to digital technology, the TTY is still used where there is no Internet connection.

Hearing Aid Compatibility for Digital Phones

Although the Internet has opened up a world of opportunities for visual communication, the telephone is still a basic communication tool. Telephone services are more accessible than ever. Many digital phones are designed to be used with hearing aids and cochlear implants. Although you probably won’t be buying your very young child a cell phone, he may be able to have that chat with Grandma on a digital phone you already own.



Phones are rated based on their [compatibility with certain hearing aids](#) that contain a switch that puts the hearing aid in “microphone” mode or in “telecoil” mode. Microphone mode is used most of the time. When on the phone or using an assistive listening device (ALD), the user switches to the telecoil mode. While in telecoil mode, signals from the phone go directly to the hearing aid—eliminating any background noise. M-ratings on digital phones identify phones with radio frequency levels that are less likely to interfere with a digital hearing aid in the microphone mode. An M4 rating is considered best. T-ratings designate the capability of the phone to link with hearing aids set to telecoil and avoid electronic noise and feedback. Phones with a T4 rating are considered best when using a cell phone with hearing aids on

the telecoil setting. Choosing a cell phone with a M4/T4 rating may ensure that your child will hear better with that phone than with a phone that has lower ratings or no ratings at all.

However, the M- and T-ratings only tell part of the story. Each person hears voice transmission differently on the same phone, even if they have identical audiograms and are trying the same phone. Additionally, there are a number of ALDs—like powered neckloops or Bluetooth wireless neckloops—to assist in hearing on a cell phone.

Telecommunications Relay Services (TRSs)

People who cannot hear well on the phone but still need to use the phone rather than text or email can use a TRS. Title IV of the Americans with Disabilities Act (ADA) establishes access to the telephone network through the use of relay services in a manner that is “functionally equivalent.” This means that the experience of a person with a hearing or speech disability in making phone calls should be as close as possible to that of a hearing person making the same call. The Federal Communications Commission (FCC) is the agency responsible for administering the TRS. TRS links a caller with a hearing or speech disability with another person with or without a disability using English or Spanish.

There are two categories of TRS—each having its own advantages and disadvantages (see *Table 1*).

The FCC recently released an open source call center platform called [Accessible Communications for Everyone](#) (ACE) Direct. ACE Direct offers direct video calling along with text and high-quality voice communications. This platform is targeted to corporate and government call centers where large numbers of people can have the option to use sign language or text to do business with these entities. Americans who are D/HH, deaf-blind,

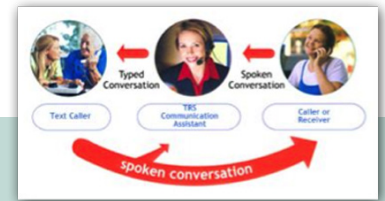
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Table 1

Two Categories of TRSs

Category 1: State TRS

Every state in the U.S. provides its own TRS service through a provider for people using landline phones. The easiest way to reach the relay service in your own state is by dialing 7-1-1, whether you use a TTY or a voice telephone. Captioned telephone services are available in all states for those using landline-captioned telephones.



From USPS

Category 2: Internet Protocol-Based TRS

There are several options available: Captioned Telephone Service (CTS & IP-CTS), Video Relay Service (VRS), and Internet Protocol Relay (IP Relay). All IP-based relay services can be accessed by going to designated websites on the computer or downloading apps on a smartphone. Users are required to register with the service provider to obtain a 10-digit telephone number. The FCC has more information about [Internet protocol-based TRS providers](#).



From NTID

Captioned Telephone Service (CTS)



From NVRC

CTS permits both parties to speak directly with each other, and the person who is D/HH can read a transcript of the other person's words. CTS works with specially designed phones with a readout screen that allows the caller to speak directly to the other party. The phones come in a variety of configurations for landline users, Web browser users, and mobile users. In addition to landline phones, a captioned telephone user may use a Web browser with a nearby phone or a mobile phone. The caller can hear the other party and read responses that are transcribed by an operator—mostly with speech recognition software—or a remote stenographer. Applications for smartphones, such as Android, Windows, and iPhone, provide captioned calls while on the road. Using phones with high M- and T-ratings, being able to read captions is likely to increase comprehension during telephone calls, so this combination may work well.

Video Relay Service (VRS)



From TAP at Gallaudet

VRS allows people who know sign language to call anyone who can hear but does not know sign language with the assistance of a sign language interpreter. VRS is a telephone service through which callers can see and hear each other. Many in the deaf community have a videophone, so they can communicate directly with another deaf individual who has a videophone. Some VRS providers install a device in the home that connects to a television set and serves as a videophone. Families can contact a VRS provider to obtain this equipment for their child. A new FCC ruling now allows hearing people who can sign fluently to obtain a videophone number of their own to call directly with deaf signers without having to use VRS.

Internet Protocol Relay (IP Relay)



From Sprint

IP Relay allows a deaf caller to type on a computer or mobile device to a communications assistant (CA), who then reads the typed message from the caller to the other party. The CA types the other party's spoken responses back to the deaf caller.

or who have a speech disability will be able to communicate directly with federal agencies, local governments, and businesses, such as Verizon or Microsoft, in ASL. Call centers are currently located at the FCC, the U.S. Small Business Administration, and the U.S. Equal Employment Opportunity Commission.

With ACE Direct, users will be connected directly to a customer service center staffed by, most commonly, people who are D/HH and fluent in ASL. Over the next few years, more businesses and government agencies in your area will offer video calls as well. By the time your child grows up, he or she may have a customer service job with a business that uses ACE Direct!

Useful Mobile Apps

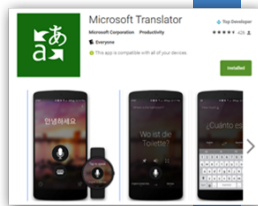
Many mobile apps can provide functional equivalency in communication without using the relay service.



FaceTime – From Apple

For example, some mobile apps function as a videophone and allow hearing family members and friends to communicate directly to the deaf child without using an actual videophone. This is useful, because it allows hearing family members and friends to communicate directly with the child in sign language without using the VRS.

There are various built-in mobile apps available for Apple, Android, and Windows devices that can translate speech to text. For example, an app, such as the Microsoft Translator, can provide more functionality useful for group situations, such as family dinners, meetings at the workplace, and other small-group discussions around a table. Everyone in the group downloads the same app on their phones before the event and then use their own phones as microphones. Once connected, the captions from the discussion will appear on the D/HH person's phone. Dictation apps, such as Speechnotes, can be useful for speeches



Did you know that nearly all television programming must be captioned?

and other presentations where the user aims the phone at a sound source, so text can be generated as the words are spoken. It is not TV quality, but it could be useful in situations where a professional interpreter or live event captioner is not available.

Real-Time Text (RTT)

RTT, which is being developed and rolled out over the next few years on



desktop and mobile devices, will allow text messages to be displayed letter by letter as the individual is typing the message without having to hit SEND or GA, like TTY calls from many years ago. Today's current SMS messages do not allow the other person to see what you typed until you press SEND. This would be a critical improvement. For example, if you text, "HELP I AM HAVING A HEAR..." and fail to hit send, the call taker will not see your message at all. With RTT, when you text, "HELP, I AM HAVING A HEAR..." the call taker will immediately see what you have typed. Even if the message is incomplete, whoever is reading your text can guess that you are having a heart attack, and for some reason, you could not finish the message. An ambulance would be sent to you much quicker with less guesswork.

Media Access

Television Captioning

As your child gets older, from time to time, he may watch a television program. Did you know that nearly all television programming must be captioned? Your child may not be able to read today, but over time, he will. Captions mean that he will be able to follow what is being said. FCC rules mandate that television captions be:



(From PBS)

- **Accurate.** Captions must match the spoken words in the dialogue and convey background noises and other sounds to the fullest extent possible.
- **Synchronous.** Captions must coincide with their corresponding spoken words and sounds to the greatest extent possible and must be displayed on the screen at a speed that can be read by viewers.
- **Complete.** Captions must run from the beginning to the end of the program to the fullest extent possible.
- **Properly placed.** Captions should not block other important visual content on the screen, overlap one another, or run off the edge of the video screen.

The FCC has a Webpage where you can find out more about the [regulations governing closed captioning on television](#).

The FCC also requires that emergency information broadcast on television must be visually and aurally accessible. Emergency information about a current emergency is information intended to help protect life, health, safety, or property. Examples include, but are not limited to:

- **Immediate weather situations:** Tornadoes, hurricanes, floods, tidal waves, earthquakes, icing conditions, heavy snows, widespread fires, warnings and watches of impending weather changes
- **Community situations:** Discharge of toxic gases, widespread power failures, industrial explosions, civil disorders, school closings, and changes in school bus schedules resulting from such conditions.

The information provided visually and aurally must include critical details regarding the emergency and how to respond. Examples of critical details include:

- Specific details regarding the areas that may be affected by the emergency.
- Evacuation orders, detailed descriptions of areas to be evacuated, and specific evacuation routes.

- A list of approved shelters or how to take shelter in one's home (shelter in place).
- Instructions on how to secure personal property.
- Locations of road closures.
- How to obtain relief assistance.

There are different ways to make this information visually accessible, but captioning is used most of the time. The FCC has more information about [emergency video programming accessibility for viewers with hearing and visual disabilities](#).



Internet Captioning of Television Programming

At the time television captioning came along, no one could have predicted the expansion of the Internet and the proliferation of Internet video programming that came with it. For example, some do not “watch television” on the TV set. They watch a program that once was shown on television on the Internet.

At first, there were no requirements that Internet programming display captions. So a program shown on television would be captioned, and when it moved to the Internet, it would not always be captioned! Today, [FCC rules](#) require captioned programs that have been shown on TV to be captioned when reshowed on the Internet. This covers full-length video programming, including programming shown in segments that include substantial portions of the programming and video clips.

Consumer-generated homemade video and movies shown on the Internet are exempt from the FCC requirements, unless they have been shown on TV with captions.

Captioning is not just for people who are D/HH. Many hearing individuals use captioning either to supplement the spoken words, to see the words when in a noisy place, or to keep the volume down when the viewer needs a quiet

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environment. Captioning has also proven to be an excellent literacy tool—allowing children and adults who are learning to read follow the text that is displayed as the person speaks. Cities like San Francisco; Portland, Oregon; Ann Arbor, Michigan; and Rochester, New York, now require public TV sets to display captioning during business hours. The states of Maryland and New York require captions to be activated upon request by a customer. Other places that require captioning display include major U.S. airports and medical facilities in Minnesota. More information can be found at [CaptionsOnNow](#).

Movie Captioning

The FCC does not regulate captioning of theatrical movies, DVDs, or video games. However, more and more of these technologies are including captions. The U.S. Department of Justice recently released its [Movie Captioning and Audio Description Final Rules](#) under Title III of the ADA. The final rules require all movie theaters showing digital films to offer captioning and audio description. Generally, you may see one of these two common technologies:

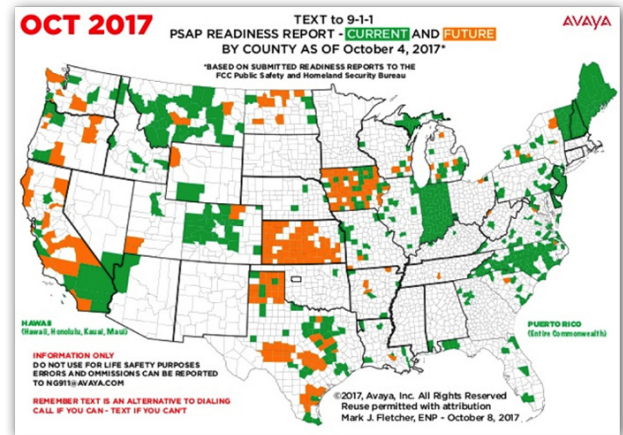
- **Sony Entertainment Access Glasses** (commonly used in Regal Cinemas) allow for captions to be seen “in the air” by providing a large pair of glasses that the viewer wears during the movie.
- **CaptiView** (used in Century Theaters) is a system that shows captions on a rectangular display held in place by a flexible gooseneck stand attached to a base that fits into the cup holder.

Sometimes movies are shown with open captions, which mean that the captions are displayed on the screen for everyone in the audience to see. Most D/HH organizations and advocates on captioning issues prefer this method.

Other devices may be in use as well, and emerging technologies may be working their way through the pipeline. So you and your child someday may watch captions on a device that has not yet been invented!

While we hope they never have to, it is important for even very young children to know how to call 9-1-1.

Access to 9-1-1 Services & Emergency Notification



While we hope they never have to, it is important for even very young children to know how to call 9-1-1. Preschoolers should be taught when and how to call for help in an emergency. Although today many consumers rely on cell phones, and many do not even maintain a landline phone, if you have a young child in your home, it is important to keep a landline. A call from a landline phone is routed to the nearest appropriate public safety answering point (PSAP). Your landline is associated with a fixed address—your home—so emergency responders see your address right away on their computer when someone from your home calls. Further, landlines do not depend on household electricity to function, as do Internet-based phones (although the phone will need a charged battery if the electricity goes out). A child can be taught to call 9-1-1, and even if the child is too afraid or confused to say anything, the emergency dispatcher will send an emergency responder. At this time, landlines are the most reliable technology for calling 9-1-1.

As your child gets older, he may be able to call for help through “Next Generation 911,” which is currently being developed. When it is completed, it will allow individuals to call the nearest center on the Internet with voice, video, and/or data. If your child uses sign language,

the dispatcher that answers the call will be able to summon a sign language interpreter to help with the call in real time. The same interpreter will function as a video remote interpreter after the call to assist with emergency responders once they arrive on the scene.

This future of 9-1-1 services is about 5 to 10 years from becoming a reality. In the interim, some states are developing a system that will allow texting to 9-1-1. This service has already been implemented statewide in New Hampshire, Vermont, and Maine, with partial coverage in other states. Many areas in the U.S. still remain without direct access via texting. *In most cases, there is no direct text or videophone access to emergency assistance. A landline phone or TTY is the best device for calling 9-1-1 directly.*

Text-to-911 continues to proliferate. Around the country, more and more **public safety answering points** (PSAPs) are being certified as ready to receive text messages. Please note that just because a PSAP is listed on the map, it may be some time before it actually starts providing Text-to-911 services. Generally, the overall message from those 9-1-1 centers is to “Call if You Can, Text if You Can’t” because of the current state of texting technology, which will improve over time. Please check with your local PSAP management to verify if the service is in operation, and that text calls are being accepted.

The world is becoming more accessible every day. As technologies continue to improve, your child’s access to information will continue to expand. The future is certainly bright!

Wireless Emergency Alerts

There are several types of emergency notification systems available in your community. One is the **Wireless Emergency Alert** (WEA), which is a service jointly operated by the FCC and Federal Emergency Management Agency (FEMA). Wireless devices made within the past few years have cell broadcast capabilities built in that will warn the user of local weather emergencies and natural or manmade disasters, as well as Amber Alerts and presidential emergency declarations. These messages are broadcast automatically to mobile devices.



Another type of emergency notification service may be available from your local PSAP or 911 call centers. These services also warn you about local emergencies through email or text. Check with your local emergency management organization at home, work, or school to sign up for local notifications.

Conclusion

There are many practices, devices, and materials that provide information visually. Regardless of your child’s hearing levels, the world is becoming more accessible every day. As technologies continue to improve, your child’s access to information will continue to expand. Take a look at what is available and use any and all systems to make sure your child has as many opportunities as possible. The future is certainly bright!

Resources

Major Wireless Carriers & Other Industry Resources

The four major U.S. wireless service providers have staff trained to maximize the accessibility of the phones you purchase from them. For more information about the vendors, their services for customers with disabilities, and other resources on wireless phones, go to the [TDI website](#).



CTIA—a wireless industry trade association—offers a [website](#) that includes an interactive guide on selecting a phone that meets your needs.



The [Wireless Rehabilitation Engineering and Research Center](#) (RERC) does research and development on wireless phones with funding from the U.S. Department of Education.



The [Technology Access Program](#) at Gallaudet University administers several projects with the goal of improving access to technology for consumers who are D/HH.

Where to Obtain Equipment

For more information about these devices and other products for the household, visit these online retailers. Other options can be found by searching for “Visual Alerting Devices.”



[Harris Communications](#)



[HearMore.com](#)



[RehabMart.com](#)



Telecommunications equipment, alerting devices, and other types of products may also be available to qualified individuals and households through the local telecommunications equipment distribution program (TEDP), if there is one in your state. For no charge or a nominal fee, these devices offered may vary depending on the state where you reside. To locate your nearest TEDP, go to the [Telecommunications Equipment Distribution Program Association](#) (TEDPA) website directory of state programs.



The FCC’s National Deaf-Blind Equipment Distribution Program addresses the availability and affordability of specialized telecommunications equipment for deaf-blind people through its [I Can Connect](#) program. There is a directory of state agencies where you can get more information.

Advocacy Resources for Parents

Access to technology for individuals who are D/HH did not happen on its own. In the past, when new technologies were being developed, people who are D/HH were left out. For example, when movies were silent, D/HH and hearing people could enjoy them. When sound was added, no provisions were made for people who are D/HH to access the auditory information. Over the years, many consumers who are D/HH and their hearing allies worked to pass laws that require the kind of access we see today. The following organizations have advocated for this access. You may wish to consider joining and supporting one or more of these organizations. Further, they can provide technical assistance when you or your child experience barriers to technology in areas of telecommunications, captioning, and other issues. Some of these organizations may have state and local chapters in your community.



[Alexander Graham Bell Association for the Deaf and Hard of Hearing \(AGBell\)](#)



[American Association of the Deaf-Blind \(AADB\)](#)



[American Society for Deaf Children \(ASDC\)](#)



[Association for Late-Deafened Adults \(ALDA\)](#)



[Cerebral Palsy and Deaf Organization \(CPADO\)](#)



[Hearing Loss Association of America \(HLAA\)](#)



[National Association of the Deaf \(NAD\)](#)



[Telecommunications for the Deaf and Hard of Hearing, Inc. \(TDI\)](#)



[Filing Complaints with the Federal Communications Commission \(FCC\)](#) on TRS, Advanced Communications, Hearing Aid Compatibility, Mobile Phone Internet Browsers, Telephone Services and Equipment, Access to Emergency Information, Video Description and Closed Captioning (for television and other video display equipment), and other disability issues using Form 2000C.

