

Recommendation of the FCC Disability Advisory Committee
on the Report Prepared by the Emerging Accessible Communications Opportunities
Working Group

Identification of Emerging Technologies and Their Associated Accessibility
Opportunities and Considerations

Adopted by the Disability Advisory Committee September 9, 2021

1. The Emerging Accessible Communications Opportunities Working Group (Working Group) was asked to identify any common accessibility issues for emerging technologies such as autonomous vehicles, Internet of Things, artificial intelligence, virtual and augmented realities, and virtual assistants that would fall within the jurisdiction of the Commission pursuant to the Communications Act of 1934, as amended (Act), and the Twenty-First Communications and Video Accessibility Act (CVAA).
2. Emerging technology is a broad term that encompasses myriad innovations, including those being deployed today or envisioned in the near term across different deployment scenarios.
3. Features and functionalities associated with emerging technologies can be impactful for consumers generally, and consumers with disabilities in particular.
4. Emerging technologies can also present new and unique considerations for consumers with disabilities.

NOW, THEREFORE, IT IS –

1. RECOMMENDED that the FCC consider the following Report highlighting representative emerging technologies and accessibility opportunities and considerations in their development and deployment.

FCC DISABILITY ADVISORY COMMITTEE, EMERGING ACCESSIBLE COMMUNICATIONS OPPORTUNITIES WORKING GROUP

Report on Emerging Technologies and Associated Accessibility Opportunities and Considerations

INTRODUCTION AND BACKGROUND

Emerging technology is a broad term that encompasses myriad innovations. These innovations can be ones that are being deployed today or that are envisioned across different deployment scenarios. Features and functionalities associated with emerging technologies can be impactful for consumers generally, and consumers with disabilities in particular, to facilitate activities across health care, education, careers, and more. The deployment of emerging technologies may also raise new accessibility barriers if not designed with users with disabilities in mind.

As it relates to accessible consumer products and services, the Federal Communications Commission (“FCC”) has jurisdiction as required and described in the 1996 Telecom Act, Communications and Video Accessibility Act (“CVAA”), other federal statutes and FCC implementing regulations. The FCC’s Disability Advisory Committee (“DAC”) offers no opinion about whether or, if so, the extent to which the FCC has jurisdiction over any of the products and services, or component parts thereof, described in this Report. The Report adds to the important work on these issues being done in many other federal and state agencies.

This Report, developed by the DAC Emerging Accessible Communications Opportunities Working Group (“Working Group”), identifies representative emerging technologies and accessibility opportunities and considerations in their development and deployment. The Report is not intended to be exhaustive, but instead provides descriptions of, and accessibility considerations for, a variety of general categories of current and envisioned technologies and services.

OVERVIEW OF CATEGORIES OF EMERGING TECHNOLOGIES

This Report highlights a representative list of categories of emerging technologies that may be especially impactful for persons with disabilities and outlines key accessibility considerations for industries broadly to consider in developing and deploying these innovations. As discussed in this report, each example of emerging technology has accessibility opportunities and accessibility considerations.

Autonomous and Connected Vehicles

Overview. Autonomous Vehicles are those that provide automated driving capability using a combination of cameras, sensors, and automated processing that minimizes the need for a person to operate the vehicle. They may use vehicle-to-vehicle (“V2V”) communications, vehicle-to-infrastructure (“V2X”) wireless technologies, or both. Semi-autonomous vehicles are currently in use and companies are working towards the development and deployment of fully autonomous

vehicles. Autonomous and connected vehicles can have potential privacy, security, and accessibility implications.

Connected Vehicles often involve the integration of mobile technology into automobiles so cars can connect to commercial wireless networks. This integration can allow for voice communications, emergency communications, streaming music, traffic updates, and more.

Accessibility Opportunities. Autonomous and Connected Vehicles hold potential to promote independence, economic opportunities, and social well-being for older Americans and persons with disabilities by offering independent mobility for daily activities. Reducing transportation-related obstacles could enable new employment opportunities for individuals with disabilities and could reduce healthcare expenditures from missed medical appointments. Ensuring that Autonomous and Connected Vehicles will meet the needs of Americans with disabilities will require carefully thought-out inclusive design to ensure widespread usability by persons with all types of disabilities—visual, auditory, cognitive, mobility, and others. A 2017 report the Ruderman Family Foundation estimated two million Americans with disabilities could access new employment options with improved transportation choices.¹

Accessibility Considerations. The features discussed below are illustrative, could apply to autonomous, connected, and traditional vehicles, and could be barriers for people with disabilities that may need to be considered in the development and deployment of these technologies:

- Hailing mechanisms for fleet and taxi services
- Communication of vehicle arrival and location (e.g. so someone who is blind or has low vision can locate the vehicle)
- Interacting with the Autonomous and Connected Vehicles in routine and emergency situations, including the ability to place calls using Relay services if call placement is a feature
- Entering an Autonomous or Connected Vehicle
- Securing passengers, mobility equipment, and service animals
- In-vehicle user interfaces (particularly those with speech or gestural mechanisms)
- In-vehicle video programming and communications functionality
- Optional pre-set accommodation preferences
- Exiting an Autonomous or Connected Vehicle

Artificial Intelligence

Overview. Artificial intelligence (“AI”) refers to machines or algorithms that are capable of performing cognitive tasks usually performed by humans based on the data and programming provided to the computers. This includes different technology solutions that mimic humans and

¹ https://rudermanfoundation.org/white_papers/self-driving-cars-the-impact-on-people-with-disabilities/

use logic from playing chess to solving equations. Machine learning (“ML”) is one type of AI technology that focuses on the use of data and algorithms to imitate the way humans learn as well as analyze and draw inferences from patterns in data. Some industry standards bodies are pursuing solutions to ensure that AI is developed in a way that does not implicate people with disabilities in a discriminatory or disparate way. AI/ML can have potential privacy, security, ethical, and accessibility implications.

Accessibility Opportunities. AI holds potential to improve independence and connectivity and communications for and among persons with a variety of accessibility needs. For instance:

- People who are blind or have low vision can use apps on their smartphones to read text messages, email, and general internet reading.
- People who are blind or who have low vision can access digital content through audio description and adjustments of graphic elements such as fonts, colors, and spacing.
- People who cannot see their visual environment can use audio map apps to navigate and travel.
- People who are deaf or hard of hearing can use instant transcription apps to transcribe conversations with others.
- People with physical disabilities can utilize their voice to navigate their smartphones.
- People with physical disabilities can use keyboard navigation that requires less precise fine motor control than some other interface methods.
- People with speech disabilities can use apps that use their speech to create an output of audio or text so they can be understood.
- People with speech disabilities can use voice and speech recognition to access the internet through sound and gestures.

Accessibility Considerations. A variety of barriers may exist in the application and use of AI by and for people with disabilities. Among other things, disabilities are diverse, nuanced, and dynamic; they may not fit within the formulaic structure of AI, which is programmed to find patterns and form groups. Products that lack accessibility can stop people with disabilities from accessing important aspects of life like quality healthcare, education, and on-demand deliveries. In addition to being a potential solution to overcoming barriers for people with disabilities, as AI solutions are developed, accessibility for people with all types of disabilities must be considered. It is also important to address interoperability with existing assistive technology to ensure that a variety of input and output methods are available and accessible.

Internet of Things (“IoT”)

Overview. The Internet of Things, or IoT, refers to physical devices that are connected to the internet, all collecting and sharing data. Connecting these objects and adding sensors (or actuators) to them adds a level of digital interconnectivity and control to devices that would otherwise function in isolation, thus enabling them to communicate real-time data without involving a human being. IoT has the potential to provide alternative means for people with

disabilities to independently use devices in their physical world that may otherwise have been inaccessible.

Accessibility Opportunities. Examples of IoT devices that may be used by and beneficial to people with disabilities include:

- An online retailer ordering option allows the user to order/re-order products efficiently and can also reduce the time the user spends searching for a product.
- Washing machines, ovens, refrigerators, and other major appliances that do not have tactile operating buttons or visual alerts may be operated from mobile applications, computers, or tablets, creating new opportunities for people with mobility, hearing, or vision limitations.
- Video doorbell cameras can alert individuals when someone is at the door, let them see who it is and communicate with them from a mobile phone or computer. Video doorbells can also be used to help family members offer support and safety for disabled individuals who live on their own.
- Door locks that allow the user to manage their home's exterior doors from any location, with awareness of who is coming and going into/out of the home, alerts if a door is not properly closed, and provides automatic unlocking mechanisms when the user is physically near the door can create new opportunities for people with mobility limitations.
- Light switches can help users manage lights from a wall switch, a mobile phone, or by voice.
- Air quality monitors can measure indoor pollution for improved air quality for the benefit of people with chronic illness.
- Smoke alarms and carbon monoxide devices can alert the user's mobile phone through a variety of audible or sensory alerts about emergencies in the home.
- Programmable thermostats can be controlled through voice or mobile applications, allowing the user to adapt their activities and manage room temperature automatically based on their routine.
- Wearables can monitor gait or other physical information to share with doctors and caregivers as well as remind individuals to perform daily functions such as taking medicine.

IoT devices may operate with a variety of technical considerations, including devices/services that use speech-based or other aural output to provide feedback to the user, and devices/services that embed video/image playback or bidirectional communications functionality. IoT devices may also operate under interoperability protocols to allow homes equipped with connected lighting, heating, and electronic devices to be controlled remotely by a phone or computer. These protocols create standard data models for interconnected home devices so these devices can work with one another without having to figure out which ecosystem "talks" to the particular device a consumer wants to buy.

Accessibility Considerations. A variety of barriers may exist in the application and use of IoT by and for people with disabilities, including users with multiple disabilities and consumers who are deaf-blind. The complexities of connecting and configuring devices to a home network can limit the adoption of these devices. Many IoT devices do not include specific accessibility features and may not have accessibility built into the input, configuration, output, and maintenance functions.

Augmented and Virtual Realities

Overview. Augmented Reality (“AR”) and Virtual Reality (“VR”) devices and platforms are forms of technology that allow for a new way to experience and interact with the world. AR is technology that combines real-world images with overlaid data, such as sound, video, graphics, GPS data, and more. Smartphone AR apps use a smartphone’s camera to generate a real-world image, which the app then overlays with additional information. VR displays these generated images to a user, usually wearing a headset, to create a “virtual world” that the user can move through or interact with. Some smartphones can be combined with headsets and, by using the motion-sensing capabilities of the smartphone, serve as the screen for a virtual reality program.

Accessibility Opportunities. Examples of AR/VR capabilities that may be used by and beneficial to people with disabilities include:

- Devices/services/content with speech- or gesture-based input mechanisms
- Devices/services/content that use speech-based or other aural output to provide feedback to the user
- The ability to provide multi-modal input and output to accommodate persons with vision, hearing, and mobility disabilities to interact and receive feedback from the technology.
- Devices/services/content that embed video programming playback or bidirectional communications functionality
- The ability for devices/services to intake external audio and translate it for the user.

Accessibility Considerations. A variety of barriers may exist in the application and use of AR/VR by and for people with disabilities that may need to be considered in the development and deployment of these technologies. In addition to considering the typical user needs of people with disabilities, AR/VR technologies can present new barriers for those who experience:

- Motion sickness, virtual reality sickness, vestibular issues
- Monocular vision which can affect depth perception
- Monaural hearing which can affect the ability to locate sounds
- Mobility and range of motion issues when navigating virtual space

Additionally, AR/VR technologies may reflect a bias in gesture-based inputs that causes gestures to be filtered—for instance, where a sign language gesture is similar to a gesture that the technology identifies as inappropriate. Industry standards bodies have developed best practices

for diversity in AR/VR, which identify methods for representing a diverse and inclusive set of humans in AR/VR development and related technologies.²

Virtual Assistants

Overview. Virtual assistants are typically cloud-based programs that require internet-connected devices and/or applications to work. They are typically services and/or devices with speech or gesture-based input. There are also devices dedicated to providing virtual assistance by sending notifications and alerts to different devices. Virtual assistants can have potential privacy, security, and accessibility implications.

Accessibility Opportunities. Virtual assistants provide opportunities for people with disabilities to access devices and/or applications, such as the option of voice or text commands for individuals who are deaf or hard of hearing; who are blind or have low vision; or who have mobility disabilities. It is important for virtual assistants to support accessible inputs and outputs for a variety of disabilities.

Accessibility Considerations.

- Virtual Assistants benefits could exclude those with speech disabilities.
- Device features that are available through a virtual assistant should be accessible outside the virtual assistant (for example, an option to push a button to activate the assistant if the user is unable to use voice to do so), including for people with multiple disabilities.
- Notifications from virtual assistants should be able to be sent to mobile devices, and the notification itself should be accessible.

OVERVIEW OF ACCESSIBILITY CONSIDERATIONS

Accessibility should be at the forefront of emerging technologies development and deployment. This can be accomplished when a diverse team is involved in technology development. Certain considerations should be kept in mind in emerging technologies development and deployment, including:

- Involving people with disabilities at all stages in emerging technology standards, research, and development, for instance, by:
 - Hiring people with disabilities.
 - Contracting with organizations with accessibility expertise.
 - Facilitating input or focus groups and considering compensating participants.
 - Testing with people with disabilities as early as possible in the design process and continuing testing throughout the lifecycle of a product or service.

² See, e.g., <https://www.w3.org/TR/xaur/>.

- Considering diverse accessibility needs, including needs associated with consumers with hearing-, vision-, physical-, and cognitive-related accessibility needs, as well as consumers who have multiple accessibility needs and those who are deaf-blind.
- Including users with a range of disabilities in user research exercises.
- Including accessibility in Minimal Viable Products (“MVPs”) to reduce the need for retrofitting products.
- Considering universal design approaches while also recognizing the value of customization in the functionality and the availability and usability of third-party applications and peripheral devices.
- Making accessibility options easy to activate.
- Making input and output functions accessible.
- Captioning in products or services using sound and display, where appropriate.
- Including audio description in products or services using text or video, where appropriate.
- Ensuring compatibility with assistive technology, including screen reader programs and Braille devices, where appropriate.
- Making operating instructions simple and clear.
- Considering multiple options for accessing technology—e.g., voice, text, and gesture interfaces.
- Anticipating how the emerging technology product or service will intersect with other user needs, e.g., operation of AR/VR technologies by those who experience motion sickness.

There are still open questions about accessibility considerations for emerging technology. For example:

- Is there a need for a best practices document or checklist of accessibility considerations that would be available to entities developing products or services using emerging technologies?
 - If so, how should the information be communicated to those who need it?
- Are there any new opportunities for standardization to ensure interoperability of emerging technologies with existing assistive technology? For example, the USB Human Interface Device standard for Braille displays removes the need for Braille devices to have custom software and drivers for specific operating systems or screen readers.

CONCLUSION

Emerging technologies offer benefits and opportunities for consumers of all abilities to access resources to improve their daily lives. These innovations should also be developed with

accessibility in mind. While the DAC offers no opinion about whether or, if so, the extent to which the FCC has jurisdiction over any of the products and services, or component parts thereof, described in this Report, it encourages the FCC, within its purview, and industries to raise awareness about the need for emerging technologies and services with accessible features and encourage the development of products and services that maximize the benefits of these innovations for consumers with disabilities.

APPENDIX: TAKEAWAYS FROM WORKING GROUP PRESENTATIONS

- The Working Group welcomed presentations from a representative from a wireless service provider and an accessible technology expert from the telecom industry to highlight how technology is meeting the needs of consumers with disabilities. Key points raised by presenters are noted below.
 - Accessibility requirements should be as familiar and consistent as possible with existing requirements while being flexible to adapt to new use cases.
 - Current rules offer some of that desired consistency and flexibility, but emerging technologies may present additional considerations.
 - The broadest range of users need to access full functionality of the product or service.
 - Support for technology-agnostic modes of operation is crucial so innovators are not limited just to what has been proven, which may be outdated.
 - Technologies, including the Minimal Viable Product (“MVP”), should be designed with considerations for a variety of different challenges, including:
 - Dexterity/Limbs Control
 - Haptic/Feeling
 - Mobility/Posture
 - Cognitive
 - Hearing
 - Inclusive design principles include:
 - Accessibility should not be an afterthought
 - Technology should be developed by and with, not for, people with disabilities
 - Inclusive design means intentionally designing in an inclusive way, so you do not unintentionally exclude
 - Design with, not for people with disabilities
 - Consider the environment, activities, and content that underpin your user experience
 - Consider intersectionality with other human diversity

- The Working Group welcomed presentations from the Chief Marketing Officer of one of the largest deaf-led social impact organizations and a professor and leading expert in the field of inclusive design to explore the importance of considering accessibility at the beginning of development. Key takeaways are noted below.
 - There have been substantial technology developments that have advanced communications accessibility, and technology can improve quality of life.

However, some technologies have limitations for certain people or lack a human element. For instance, virtual assistants that use automated speech technologies or computerized automobile functionality may not be accessible to individuals who are deaf or hard of hearing; automated speech technologies and artificial intelligence applications may lack the human aspect in that they may be unable to capture appropriate speech with accents or tone inflection; advanced security systems may exclude users who cannot utilize an audio-only channel.

- Tech solutions without meaningful human connection diminish dignity for people with disabilities and can lower service quality if it is implemented before it is ready.
- Retrofitting accessible features as an afterthought creates a sense of exclusion.
- Creating technology without people with disabilities in mind can generate obstacles and potentially expensive “Band-Aid” solutions down the road.
- The rise of systems fueled by data is seen in all aspects of life – work, education, government, health, marketing. This raises issues of AI ethics as AI tools automate, amplify, and accelerate existing patterns.
- Minority groups often do not show up in majority evidence, which impacts data gathering, proxy data, data analysis, determination and guidance, and ethics audits with bias against these groups. Even if there’s proportional representation of people with disabilities in the data set, there can still be bias against these groups.
- Accessibility at the outset is key, as these barriers will morph once the system is adopted. Designing with the edge in mind allows developers to detect risks better and make their products more resilient.
- A potential solution is Inclusive Design – the design and development process should be diverse. Full participants are producers, not just consumers.
- Emerging tech businesses should hire people with disabilities and include them on day one of design/development. It is also good to seek out the people with the greatest difficulty with the current design, as those users will have the most innovative suggestions. Doing so can save costs by addressing the needs of everyone at the beginning.