VIA ECFS

April 14, 2020

Marlene H. Dortch, Secretary
Office of the Secretary
Federal Communications Commission
445 12th Street, S.W.
TW-A325
Washington D.C. 20554

Re: The Accessibility of Communications Technologies for the 2020 Biennial Report Required by the Twenty-First Century Communications and Video Accessibility Act [CG Docket No. 10-213]

Dear Ms. Dortch:

Enclosed for filing in the above referenced Public Notice are comments of the Rehabilitation Engineering Research Center for Wireless Inclusive Technologies (Wireless RERC).

Should you have any questions concerning this filing, please do not hesitate to contact me via email at helena.mitchell@cacp.gatech.edu.

Respectfully submitted,

Helena Mitchell
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Center for Advanced Communications Policy
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Enclosure

COMMENTS OF
GEORGIA INSTITUTE OF TECHNOLOGY (GEORGIA TECH), CENTER FOR ADVANCED COMMUNICATIONS POLICY (CACP)
AND THE REHABILITATION ENGINEERING RESEARCH CENTER FOR WIRELESS INCLUSIVE TECHNOLOGIES (WIRELESS RERC)

INTRODUCTION

The Georgia Institute of Technology's Center for Advanced Communications Policy (CACP), in collaboration with the Rehabilitation Engineering Research Center for Wireless Inclusive Technologies[1] (Wireless RERC), hereby submits comments to the above-referenced Public Notice seeking comment on the 2020 CVAA Biennial Report, released on March 2, 2020. CACP is the home the Wireless RERC, funded since 2001 by the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR), a Center within the Administration for Community Living (ACL), U.S. Department of Health and Human Services (HHS). The Wireless RERC mission is *to integrate established wireless technologies with emerging wirelessly connected devices and services for a transformative future where individuals with disabilities achieve independence, improved quality of life, and enhanced community participation.*

In anticipation of this Public Notice, the Wireless RERC conducted a 2019/20[2] Mobile Phone Accessibility Review (Accessibility Review/Review). The Review included mobile phone models available up to February 2020 from the top four wireless carriers, one prepaid carrier, and five Lifeline Carriers.[3] Data analysis for the Review is still underway and will inform future comments in response to the FCC's Preliminary Findings Report. **For this filing, however, we are providing input based on the analysis of the subsample of Lifeline-provided mobile phones.** Researchers, using the providers' web pages as a reference, identified 92 Lifeline-

[1] The Rehabilitation Engineering Research Center for Wireless Inclusive Technologies (Wireless RERC) is sponsored by the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR grant number 90RE5025-01). NIDILRR is within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). The contents of this filing do not necessarily represent the policy of NIDILRR, ACL, HHS, and you should not assume endorsement by the Federal Government.

[2] Phone models were identified in October 2019, and again in February 2020, at which time, additional phone models were available.

[3] A random number generator was used to select five Lifeline carriers for inclusion in the review.

provided mobile phones for evaluation. Data was collected on the presence of 35 features that impact accessibility and/or were designed to provide access to people with vision, hearing, cognitive, and mobility disabilities in each phone model. Sources of accessibility feature data included the Mobile Manufacturers Forum Global Accessibility Reporting Initiative (GARI) database,[4] user manuals, and phonescoop.com. With the exception of hearing aid compatibility (HAC) ratings, accessibility features were coded as either 1 = "yes," 0 = "no," or 2 = "information not available." A summary and comparative analyses were produced using Microsoft Excel.

The Wireless RERC's cornerstone survey on wireless technology use by people with disabilities, the Survey of User Needs (SUN), has been completed by over 8,000 consumers with disabilities since it was first launched in 2001. The latest version has been updated in response to changes in technology. In addition to questions about cell phone and tablet use, this version of the SUN collects information about wearables, "smart" home technologies, and other next-generation wirelessly connected devices. Since the 2018 CVAA Biennial Report to Congress, the Wireless RERC collected and analyzed 2018-2019 SUN data. The SUN's data collection period aligns with the FCC's interest in assessing *current* mobile device accessibility. Unless otherwise noted, the comments made herein share the results of the SUN and the ***preliminary*** results of the Accessibility Review.

Study Limitations

A limitation of the results of this Accessibility Review is that the 35 features included in the review are not an exhaustive list. Consumers use device features in novel ways to improve access. For example, the cameras on smartphones can be used as QR code readers to access print materials in an electronic format, which can improve information access by people with vision and print disabilities. However, that feature was not assessed in the study. Except for FM Radio and Wireless Emergency Alerts (WEA) capability,[5] the features identified for the study included

[4] GARI is a project of the Mobile & Wireless Forum (MWF). Some of the data referred to in this paper was sourced from the information available from the GARI website www.gari.info and used with permission of the MWF, although all views and conclusions are the authors' alone.

[5] Data were collected on the presence of an FM Radio feature and WEA capability to inform ongoing mobile emergency communications research initiatives.

those that are used to access the phone, content displayed on the phone, or to connect to external assistive technology (AT) or other smart devices that can be controlled via the phone.

Another limitation of the results that has persisted across all years (2015, 2017, and 2019) covered by this research, is that for many of the features, information about whether these were included in a given phone could not be found using the three consumer-facing sources. Thus, we cannot conclusively state that the features are or are not present. However, the difficulty in locating information about specific features is in itself an important result, as consumers with disabilities may experience a similar problem when comparing and purchasing phone models. While people without disabilities can compare phone models based on preferences alone, people with disabilities may have functional limitations that necessitate certain accessibility features for the phone to be usable by them (e.g., video calling capabilities, HAC, screen reader, AT connection). If a user with a disability is not easily able to find the features he or she needs, then the consumer might purchase a phone that is not fully accessible to them, or not purchase a phone model that would have been accessible to them. Notwithstanding the limitations of this study, the **results provide a snapshot of the accessibility of Lifeline provided mobile phone models** that were commercially available in 2019/20.

SECTION III: COMPLIANCE WITH SECTIONS 255, 716, AND 718

Paragraph 7 - Accessible mobile phones with low-end features, functions, and prices (collectively, non-smartphones).

Eight-nine percent (89%) of the Lifeline-provided phones in the sample were smartphones, and 11% were non-smartphones. The data shows that Lifeline-provided smartphones not only have a greater variety of accessibility features, but they outperform Lifeline-provided non-smartphones in many categories of accessibility. Ten features, including 2-way video, biometric log-in, braille access, dark theme, digital assistants, mirror link, NFC, real-time-text, simple display, and touch input, were only available in the smartphone models sampled. Of the features that were present in both phone types, the ones with the steepest differentials are shown in Table 1 (below). These data indicate that consumers with disabilities seeking to purchase smartphones via the Lifeline program have more device options with a greater variety of accessibility features. Of concern, however, is that some users prefer non-

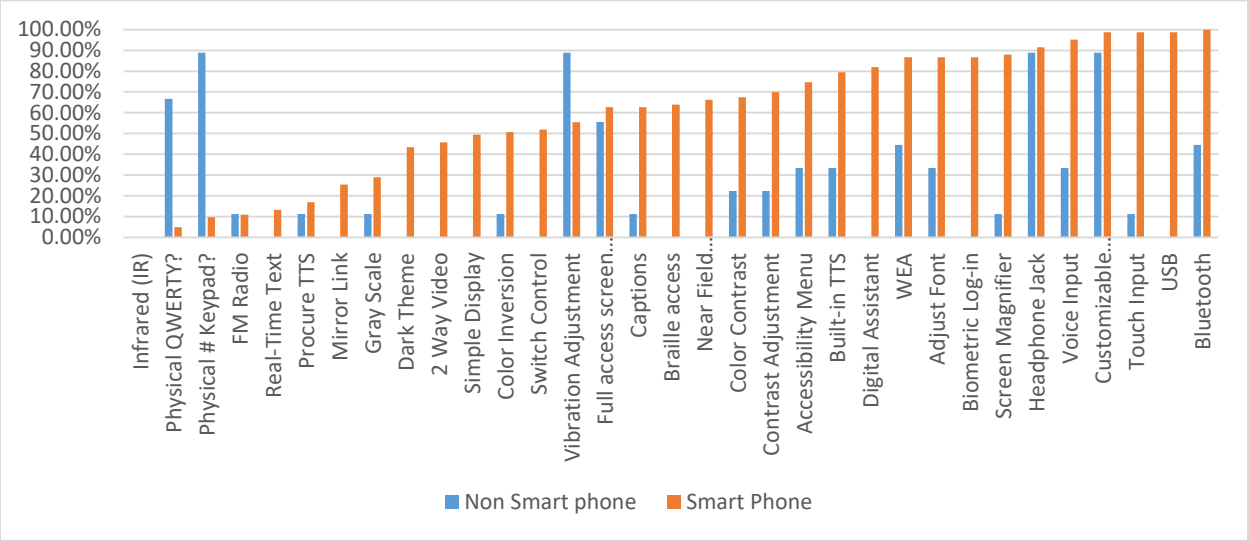
smartphones for their perceived durability,[6] and this preference would (a) limit their device options, as only 11% of the devices in the sample were non-smartphones and (b) inhibit access to WEAs since only 44% of non-smartphones in the sample were WEA-capable compared to 87% of smartphones.

Table 1: Comparison of Non-smartphones to Smartphones - Top 10 Steepest Percentage Point Differentials

Feature	**Non %**	**Smart %**	**Difference**
Physical Number Keypad	100%	10%	90 points
QWERTY Keypad	78%	5%	73 points
Screen Magnification	11%	88%	77 points
Adjust Font	33%	87%	54 points
Captions	11%	63%	52 points
Voice Input	44%	95%	51 points
Contrast Adjustment	22%	70%	48 points
Built-in TTS	33%	80%	47 points
Bluetooth	56%	100%	44 points
WEA-capable	44%	87%	43 points

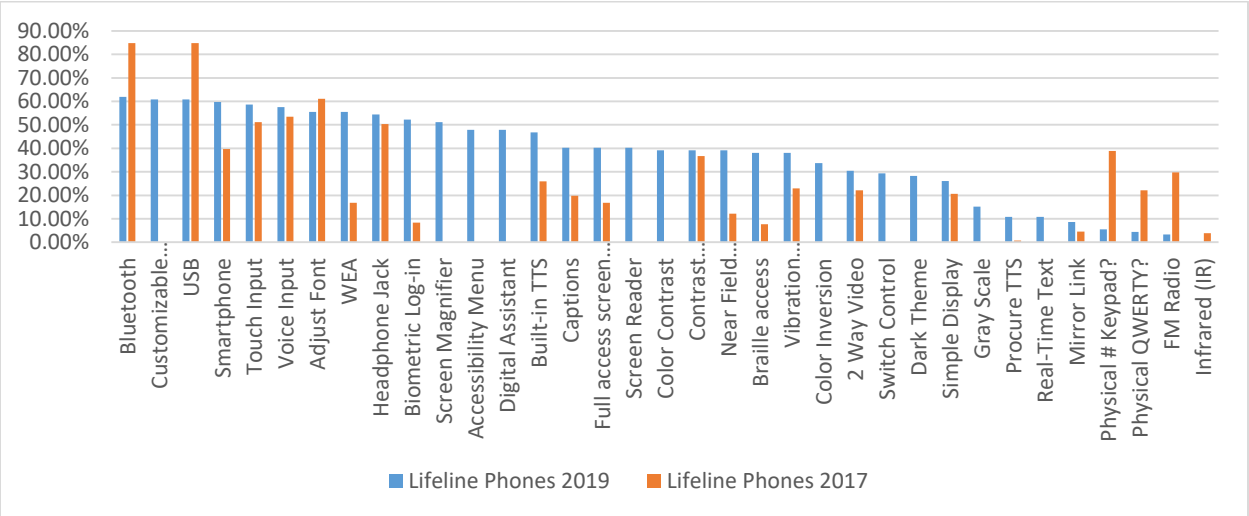
[6] Mitchell, H., LaForce, S., Moon, N., Baker, P.M.A., Garcia, A., & Jacobs, B. (2018, May 3). Comments submitted in response to the Public Notice in the Matter of The Accessibility of Communications Technologies for the 2018 Biennial Report Required by the Twenty-First Century Communications and Video Accessibility Act [CG Docket No. 10-213, Consumer and Governmental Affairs Bureau]. Federal Communications Commission: Washington, D.C.

Figure 1: Comparison Between Non-Smartphones and Smartphones



Notwithstanding Lifeline-provided smartphones grossly outperforming Lifeline-provided non-smartphones on the richness of features, there is a more encouraging finding that shows devices obtained from Lifeline manufacturers have improved accessibility levels compared to 2017 data. The Lifeline program was designed to close the gap in access to technology between low-income populations and higher-income populations. Figure 2 illustrates the increase in accessibility features present in Lifeline phone models in the 2019 sample compared to the 2017 sample.

Figure 2: Comparison of Lifeline Phone Features Between 2019 and 2017



Paragraph 10 - Usability: Information, Documentation, and Training.

Regarding overall ease of use for wireless devices: The 2017-2018 Survey of User Needs (SUN) found that a majority of users of both basic cell phones and smartphones indicated that their devices were easy to use (Figure 3). Regarding basic cell phones, 29% indicated that they were very easy to use, and 33% indicated they were easy to use, for a total of 64% (rounded up). Of remaining basic cell phone users, 25% indicated they were somewhat hard to use, 4% indicated they were hard to use, and 8% indicated they could not use them without help.

Regarding smartphones, 37% indicated them as very easy to use, and 39% indicated them as easy to use, for a total of 77% (rounded up). Of remaining users, 20% indicated they were somewhat hard to use, 3% indicated they were hard to use, and only one user (0.3%) indicated not being able to use it without help.

The increased percentage of those who found both types of phones easier to use, is a promising statistic. To improve access, manufacturers might consider training modulars which offer video or audio guides offering lessons on making the devices more accessible and therefore easier to operate (see Wireless RERC remedy under paragraph 14).

Figure 3: Perceived Ease of Use

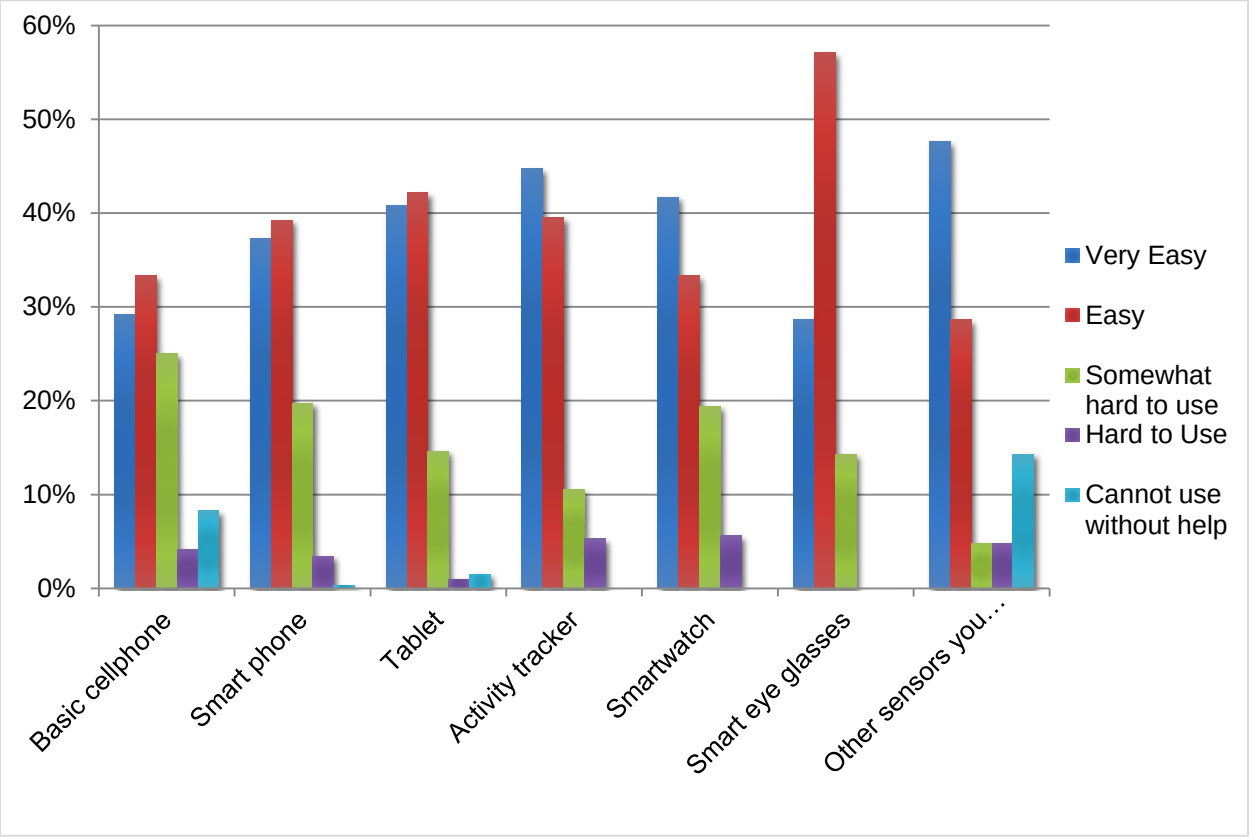
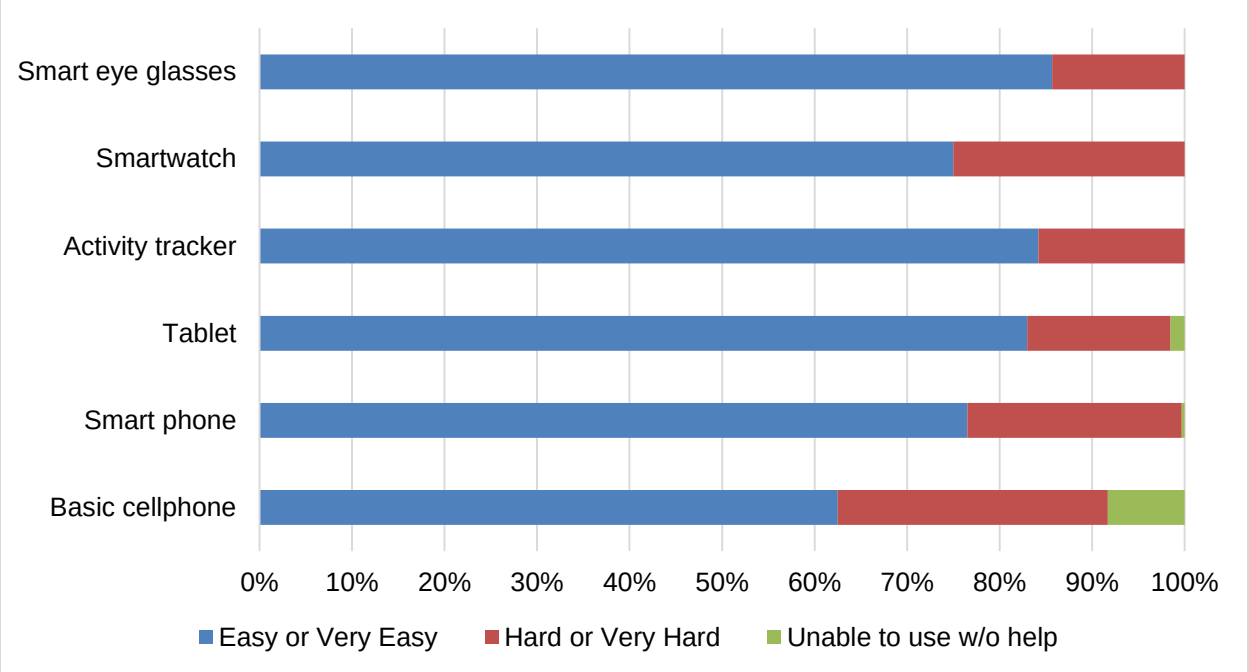


Figure 4: Perceived Ease of Use (Simplified Variable)



SECTION IV: ACCESSIBILITY BARRIERS TO NEW COMMUNICATIONS TECHNOLOGIES

Paragraph 13 - New Communications Technologies

The SUN also queried on the use of interactive voice assistants (i.e., Apple Siri, Amazon Alexa, Google Assistant) for wireless devices. A total of 90 respondents, or 21% of the SUN sample, indicated their use of intelligent personal assistants. Users indicated a diverse range of functional abilities, with cognition difficulty and mobility difficulty tied as the top two difficulties (N=28, or 31% of users), followed by vision difficulties and hearing difficulties, tied for second place (N=23, or 26% of users). Thirty-eight percent (38%) of the sample reported only one difficulty; 30% reported three or more difficulties; and 18% reported four or more. Given the rate of people with disabilities reporting more than one disability, it is exceedingly important to ensure that a variety of accessibility features on devices can seamlessly be integrated with digital assistants to maximize effectiveness.

Paragraph 14 - Accessibility Barriers to Smart Speakers

Currently available smart speakers such as Amazon Echo, Google Home, and Apple HomePod offer usability for certain disability groups, and the programming of "skills" can offer device programing for control, sensing, and display.[7] With the advancements made in artificial intelligence (AI) technology, major companies are working to develop new features that are responsive to the experiences of those with disabilities. In 2019, Amazon revealed a new feature, Show and Tell, on the 'Alexa' device that would allow customers who are blind or have low vision to have home goods identified.[8] To access the feature, a verbal command is given, which will then prompt Alexa to send verbal and audio cues to place the item to be identified in front of the camera.

Smart speakers have been adopted by, among others, people who are blind. A usability issue for people who are blind may include the reliance of smart speaker design on the "ideal human conversation speed" as users who are blind tend to increase the rate of speech of voice

[7] Moon, N. W., Baker, P. M. A., & Goughnour, K. (2019). Designing wearable technologies for users with disabilities: Accessibility, usability, and connectivity factors. Journal of Rehabilitation and Assistive Technologies Engineering, 6, 1–12. https://doi.org/10.1177/2055668319862137

[8] Wiggers, K. (2019). Echo Show camera can identify items thanks to Alexa's Show and Tell. Available at https://venturebeat.com/2019/09/23/echo-show-camera-can-identify-items-thanks-to-alexas-show-and-tell/

output features.[9] Also, as reported in our 2018 comments,[10] the ability to set up the device independently remains a barrier for people who are blind. To address the issue of independent set-up, the Wireless RERC produced a step-by-step video guide for people with vision disabilities that they can reference to set up their devices without sighted assistance. This three-part series provides a thorough tutorial on the set-up and overall operation of the Amazon Echo.[11] These videos, and additional audio guide on the Echo Dot, were produced in response to data we received from focus groups we conducted regarding smart home virtual intelligent assistants. Participants who are blind or have low-vision particularly pointed out their need for sighted assistance in the initial set-up of these smart home devices.

Finally, the ability of smart speakers to understand atypical speech patterns presents an accessibility barrier. Automatic Speech Recognition (ASR) programs are traditionally developed from 'typical' speech, which excludes those with speech impairments or heavy accents. Even the most recent renditions of ASR programs, which are often state of the art, still yield high word error rates (WER) for speakers with only a moderate speech impairment from ALS. Google's Project Euphonia seeks to bridge the accessibility gap of speech recognition systems to be more inclusive of non-standard speakers by performing speech-to-text transcription that improves ASR for people who have significantly slurred speech. To accomplish this, Project Euphonia utilized a two-step training program that started with a "baseline standard" and then fine-tuned the training with a personalized speech dataset. The specific dataset used by the project was drawn from 36 hours of audio, from 67 speakers with ALS and non-standard speech. When developing the

[9] Branham, S. M., & Mukkath Roy, A. R. (2019, October). Reading between the guidelines: How commercial voice assistant guidelines hinder accessibility for blind users. In *The 21st International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 446-458).

[10] Mitchell, H., LaForce, S., Moon, N., Baker, P.M.A., Garcia, A., & Jacobs, B. (2018, May 3). Comments submitted in response to the Public Notice in the Matter of The Accessibility of Communications Technologies for the 2018 Biennial Report Required by the Twenty-First Century Communications and Video Accessibility Act [CG Docket No. 10-213, Consumer and Governmental Affairs Bureau]. Federal Communications Commission: Washington, D.C.

[11] Part 1 - **Out of the Box and Onto the Table**-A Step-By-Step Guide to Unboxing and Powering On your Amazon Echo for People with Vision Disabilities. [https://youtu.be/6IzUPH6T3gk]

Part 2 - **Buttons at 12, 3, 6, and 9 O'clock**-A Tutorial on the Location and Operation of Buttons on the Amazon Echo for People with Vision Disabilities. [https://youtu.be/5UsbI6PvAcU]

Part 3 - **Part 3: Synching your Echo to the Alexa App**-A Tutorial on how to Set Up your Echo for People with Vision Disabilities. [https://youtu.be/NSdOoOoqQJo]

models, the training data went through two different machine learning process. The first is the RNN-Transducer (RNN-T). This encoder is bidirectional, which means it looks at the entire sentence at once to provide context. As a result of its platform sequencing, it requires the entire audio sample for speech recognition. The research engineers employed a second machine learning process called Listen, Attend, and Spell (LAS). This encoder is an attention-based, sequence-to-sequence model that maps sequences of acoustic properties to sequences of languages. The network produces "word pieces," which are linguistic representations between graphemes and words. Project Euphonia also tested accented speech. As a result, the project improved upon the RNN-T model, achieving 91% of the improvement by fine-tuning these two layers. Project Euphonia seeks to explore additional techniques to help with the low data challenge and to create interfaces that are more accessible to people with atypical speech and accents.[12] The Wireless RERC applauds this work and looks forward to its implementation in commercially available devices. Likewise, the development of a gesture-interface for smart speakers would enable these devices to be used by people who are Deaf. Specifically, these smart speakers would include a visual output display (e.g., Amazon Echo Show) that would have utility for people who are Deaf, particularly when seeking to connect with family and friends using the "drop-in" feature.

RECOMMENDATIONS

Based on the data presented in these comments, the Wireless RERC offers the following recommendations:

- To better ensure access to emergency alerts for users with disabilities that prefer non-smartphones, increase the percentage of non-smartphones that are WEA-capable.
- To improve total access to the systems and devices, companies should explore and develop solutions for how one who is blind would be able to independently set-up the technology.
- Increased attention should be paid to ensuring access by people who are Deaf to smart speaker technologies that have a screen (e.g., Amazon Echo Show), such as the development of a gesture interface that understands ASL.
- To improve access by those with non-standard speech to smart speakers and voice input

[12] Shor, J. & Emanuel, D. (2019). Project Euphonia's Personalized Speech Recognition for Non-Standard Speech. Available at https://ai.googleblog.com/2019/08/project-euphonias-personalized-speech.html

on mobile devices, we encourage the inclusion of AI that has been trained to understand those with atypical speech patterns.

In closing, we commend the FCC's efforts to measure the impact of provisions of the *Twenty-First Century Communications and Video Accessibility Act of 2010* (CVAA) on gaps in accessibility based on disability types, device type, cost, and to ensure that future technologies have innovations in accessibility. Likewise, we are encouraged by the industry's growth in the accessibility and affordability of advanced communications technologies, as evidenced by the increasing presence and richness of new accessibility features on Lifeline-provided mobile devices.

Respectfully submitted,

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Dated this 14th day of April 2020