Empowering persons with disabilities through digital innovation

Insights from the GSMA Innovation Fund for Assistive Tech

GSMA

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The Connected Society programme works with the mobile industry, technology companies, the development community and governments to increase access to and adoption of mobile internet, focusing on underserved population groups in developing markets.

The Connected Society programme is currently funded by the UK Foreign, Commonwealth & Development Office (FCDO) and the Swedish International Development Cooperation Agency (SIDA) and is supported by the GSMA and its members.

For more information, please visit: www.gsma.com/connected-society

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Introduction

According to the World Health Organization (WHO), an estimated 1.3 billion[1] people, or 16% of the global population, experience a significant disability. Approximately 80% of persons with disabilities live in low- and middle-income countries (LMICs)[2] and are often marginalised in society, without access to the same opportunities as non-disabled persons.

For persons with disabilities, access to assistive technology (AT) can be life changing, enabling them to live independent and autonomous lives. The Global Report on Assistive Technology (GReAT)[3] estimates that 2.5 billion people need assistive technology and that this will rise to 3.5 billion by 2050. However, about nine in 10 people with disabilities do not have access to the assistive technologies that could help them live independent lives.[4]

What is assistive technology?

The systems and services used to deliver assistive products and services, including through digital technologies.[5]

For most people, mobile devices are a gateway to the digital world, with LMICs accounting for almost all growth in mobile internet adoption worldwide.[6] For persons with disabilities, access to mobile phones is crucial as they provide an easy way to access relevant, life-enhancing services and opportunities that would otherwise be out of reach, such as digital financial services, digital health, e-government services and digital jobs. Smartphones in particular can be life changing, as multiple assistive technologies can be clustered into one device and enable persons with disabilities to perform functions that might otherwise be difficult or impossible.

Still, persons with disabilities are less likely than non-disabled persons to own a mobile phone, especially a smartphone, and to use mobile internet. This is because certain barriers disproportionately affect their mobile usage,[7] including awareness of mobile and its relevance; accessibility and usability; the affordability of mobile devices, data and services; the availability of relevant content and services; knowledge and digital skills; and safety and security.

These challenges are compounded for persons with disabilities in LMICs, where digital AT innovations are nascent and not widely available, often not well known, not tailored to local contexts or simply unaffordable. A recent study by the GSMA Assistive Tech programme[8] found fewer than 100 examples of digital AT innovations in Africa and Asia. Furthermore, nearly half (around 43%) of digital AT solutions are designed by start-ups, which face many challenges in LMICs, from a lack of funding and market data on potential customers to limited network coverage and infrastructure. Digital AT start-ups need support and guidance, mentorship opportunities and resources to assess the potential of their innovations to be commercially sustainable and their suitability for persons with disabilities. More importantly, there is a pressing need for funding to enable AT start-ups to absorb risks in the early stages of their innovation journey.

To address these challenges, the GSMA Innovation Fund for Assistive Tech ("the Fund") was launched in September 2020. The Fund aims to open opportunities for innovative start-ups and micro-, small and medium enterprises (MSMEs) across Africa and Asia to address the diverse needs of persons with disabilities and tackle one or more of the key barriers preventing them from accessing and using mobile internet.

1. See: https://www.who.int/news-room/fact-sheets/detail/disability-and-health
2. Thota, A.B. et al. (2022). *Effectiveness of Inclusive Interventions for Children with Disabilities in Low- and Middle-income Countries: Protocol for an Evidence and Gap Map*. Innocenti Working Papers. UNICEF Office of Research.
3. The first Global Report on Disability was launched by the WHO and UNICEF in May 2022.
4. WHO. (18 May 2018). *"Fact Sheet: Assistive Technology"*.
5. Ibid.
6. GSMA. (2022). *The State of Mobile Internet Connectivity 2022*.
7. See, for example: GSMA. (2021). *The Mobile Disability Gap Report 2021*.
8. Aranda-Jan, C. (2020). *Opportunities for digital assistive technology innovations in Africa and Asia*. GSMA.

After a competitive evaluation process, four start-ups were selected by an independent panel of experts to receive grant funding and technical assistance. The Fund supported start-ups to scale their innovations over an 18-month period by:

— Providing funding of £100,000 to £250,000.

— Promoting partnerships with mobile network operators (MNOs) to expand the reach of their services.

— Mentoring them on the use of mobile technology, including providing expert advice and bringing organisations together (physically or virtually) to share insights on business growth and best practices in overcoming the barriers to digital inclusion for people with disabilities.

— Providing learning exchange opportunities with other start-ups and networking opportunities with the Assistive Tech programme's networks.

— Providing monitoring and evaluation (M&E) support to provide evidence of socio-economic impact and improve products.
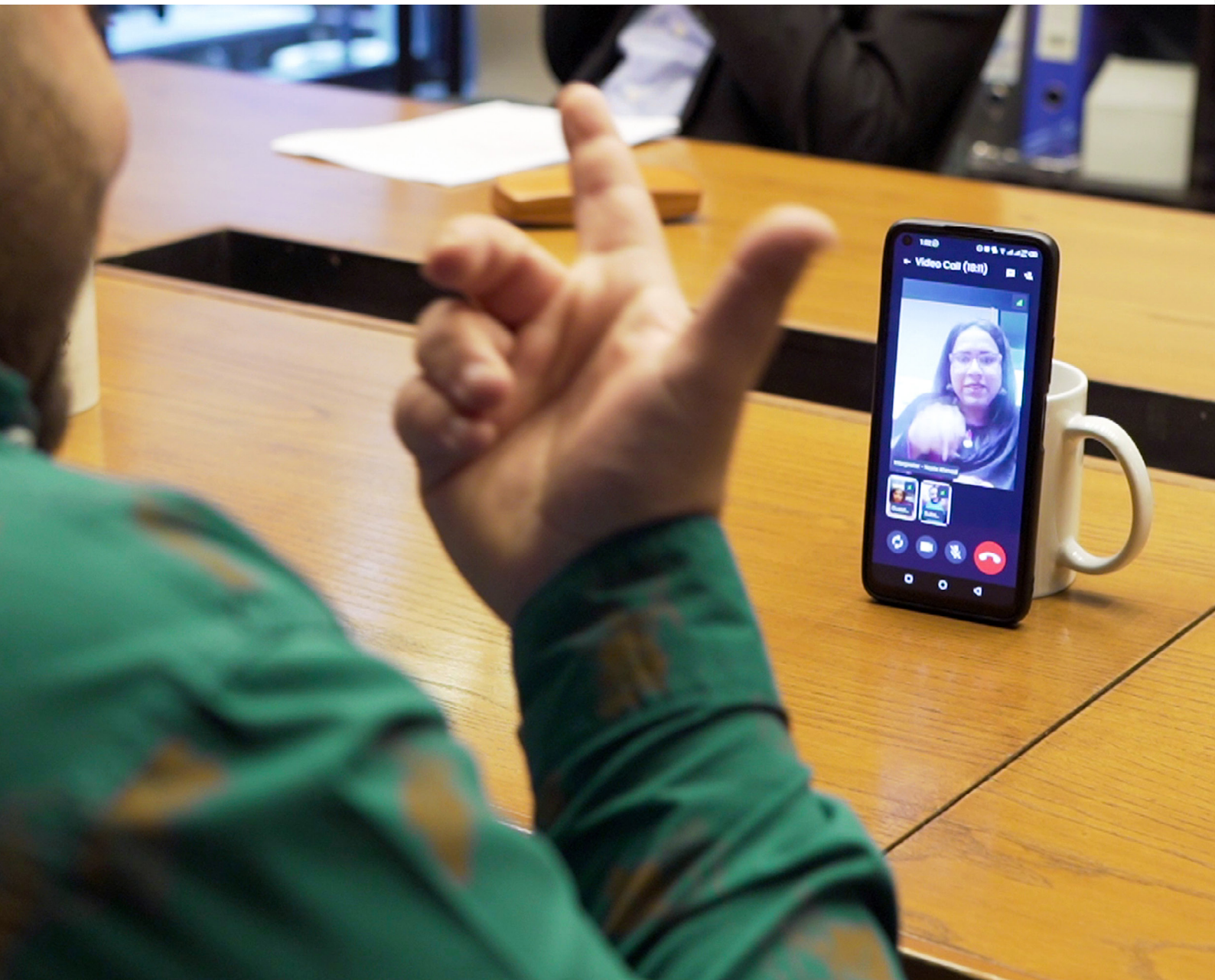
Innovation Fund recipients

Four start-ups from India, Pakistan and Kenya were selected for the Fund.

Figure 2
Map of Innovation Fund recipients
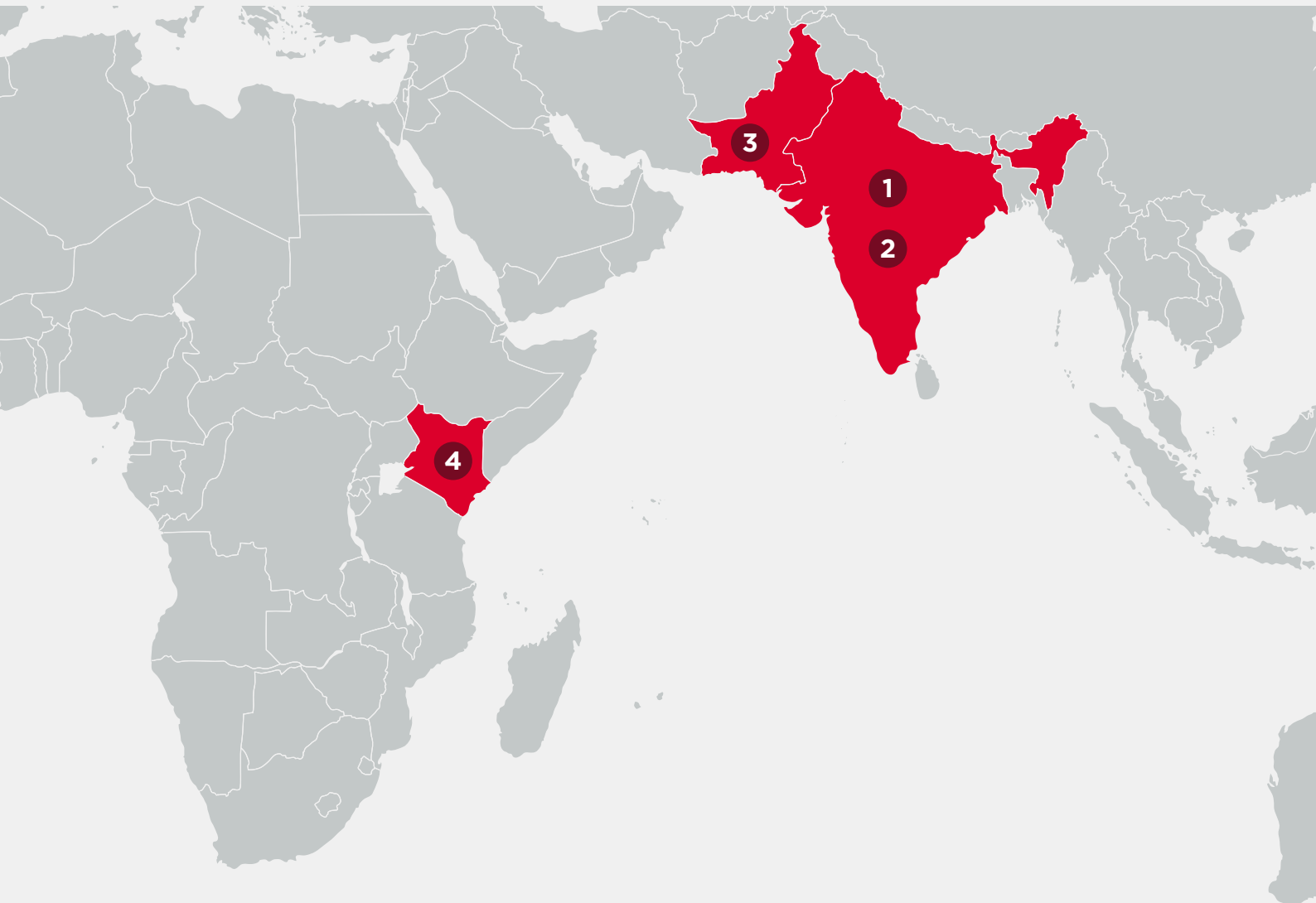
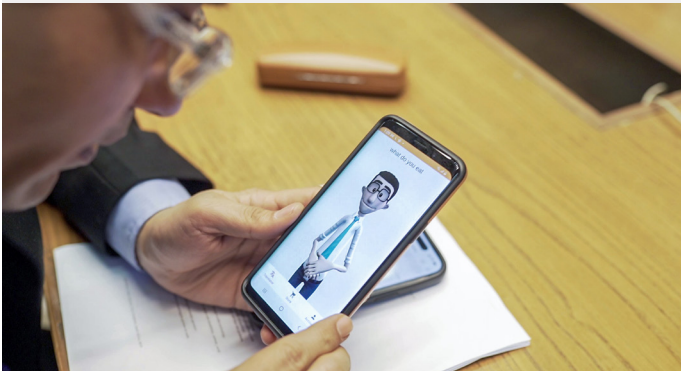| 1 India | 2 India | 3 Pakistan | 4 Kenya |

1 DeafTawk | Pakistan

Real-time, on-demand access to sign language interpretation (SLI) services.

Disability focus: Hearing impairment

Innovation: The use of new functionality, such as artificial intelligence (AI) avatar-enabled SLI and video-to-call communication using Voice over Internet Protocol (VoIP) technology.

Barriers addressed: Relevance; accessibility and usability.

2 SignAble Communications | India

Real-time, on-demand access to sign language interpretation (SLI) services.

Disability focus: Hearing impairment

Innovation: Expanded functionality of the SignAble app to provide users with on-demand access to Indian Sign Language (ISL) interpretation services and trials of new pricing and business models.

Barriers addressed: Relevance; accessibility and usability.

3 I-Stem | India

AI-enabled digital services to provide high-quality accessible documents, media and online experiences for persons with disabilities.

Disability focus: Visual and hearing impairment

Innovation: A mobile app that uses AI to provide accessibility conversion services for documents and visual and audio media files, as well as a currency reader for blind persons.

Barriers addressed: Relevance; knowledge and skills; accessibility and usability.
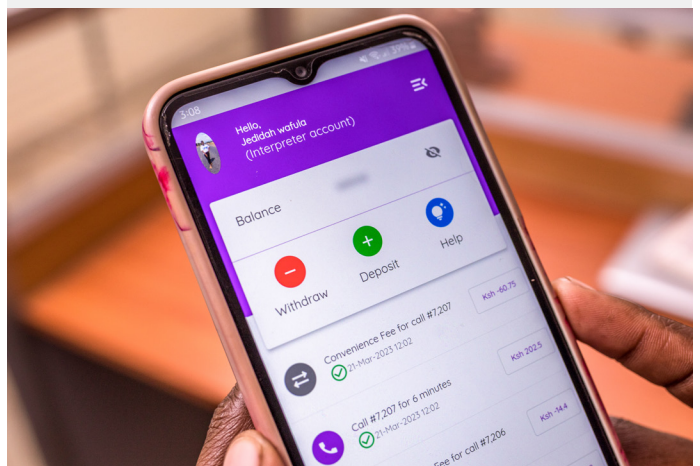

4 Signs Media Kenya Ltd. | Kenya

Real-time, on-demand access to sign language interpretation (SLI) services.

Disability focus: Hearing impairment

Innovation: Development and scaling of the assistALL Android app for easier and more affordable access to a growing pool of sign language interpreters.

Barriers addressed: Relevance; accessibility and usability.

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The focus of this report

There is currently very little publicly available evidence of how AT start-ups, MNOs and other ecosystem stakeholders can drive digital inclusion and mobile internet adoption among persons with disabilities. This report synthesises insights from the Innovation Fund for Assistive Tech, highlighting how digital innovations can influence how persons with disabilities use mobile internet and drive inclusion more broadly. The report draws out important lessons for AT start-ups seeking to reach persons with disabilities more effectively. The report also encourages other ecosystem stakeholders, including investors and donors, to continue to fund such initiatives to close the mobile disability gap in mobile internet use.

Methodology

Throughout the grant period, the GSMA monitored the progress of each start-up through regular calls, end-user surveys, scalability surveys, baseline and endline user feedback surveys, user-centred design sprints and start-up progress reports. The lessons presented in this report are gleaned from these results.

1. Impact of the GSMA Innovation Fund for Assistive Tech

The Innovation Fund start-ups aimed to deliver innovative solutions that would address the diverse needs of persons with disabilities and tackle the barriers preventing them from accessing and using mobile internet. Each of the four start-ups were at different stages of product development, which meant some innovations were available sooner than others. This had an impact on the total number of active users the start-ups could realistically reach within the grant period.

This section looks at the extent to which the objectives of the Fund were achieved, highlighting the impacts across several key indicators (see Table 1).

Table 1

Impact of the GSMA Innovation Fund for Assistive Tech

	Launch date	Active users*	Active female users*	Percentage of users without access to a good alternative to the start-up solution[9]	Percentage of users who report an improvement in their quality of life[10]	Percentage of users who report that their quality of life has "very much improved"	Percentage of users who report using mobile internet services more as a result of the solution
DeafTawk	December 2021**	22,965	6,720	75%	91%	24%	33%
I-Stem	March 2022	3,449	776	84%	86%	45%	54%
SignAble Communications	May 2022	31,476	4,718	70%	88%	34%	55%
Signs Media	April 2022	5,658	4,658	72%	44%	11%	64%

Note: "Active users" refer to the number of users who used the service at least once during the grant period. For DeafTawk, this includes both users with hearing impairments and interpreters. For SignAble, active users include deaf and close associates of deaf people who use the ISL interpretation service.

*Represents active users as of December 2022

**DeafTawk's original app launched in November 2019 and the significantly improved version (with group calling and enhanced scalability) was launched in December 2021.

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9. Users were asked to reflect on whether there are alternatives to the grantee solution. The top self-reported alternatives include WhatsApp, friends and family and other apps, such as InstaReader and Google Lookout.

10. Users were asked to reflect on whether their quality of life has "got much worse", "got slightly worse", "not changed", "slightly improved", or "very much improved" as a result of the start-up's solution. Users who said their lives had improved attributed the improvements to benefits such as reduced communication burden, connecting better with the deaf community, ease of doing tasks, access to information and learning new skills.

Reach of solutions

The start-ups cumulatively reached more than 60,000 active users throughout the life of the Fund. The data indicates that at this early stage of implementation, solutions gained traction among persons with disabilities, particularly in urban areas, although they generally reached more male users than female users. This trend is likely due to restrictive social norms particularly in South Asia, or other factors such as affordability, which tend to limit women's access to, and usage of, mobile phones and smartphones.[11] For instance, in Pakistan and India, only 15% to 30% of service users were women. In contrast, more than 80% of Signs Media's customers in Kenya were women.

Impact on mobile internet use

By providing more relevant solutions and services for persons with disabilities and addressing the barriers they face, the start-ups helped to increase usage of mobile internet services. On average, only a small proportion of the start-ups' customers reported being first-time internet users (less than 5%). This may reflect the relatively high levels of mobile internet penetration in urban areas or the fact that those who own smartphones and use digital solutions are already from relatively higher-income groups. However, for all the AT start-ups, users reported increasing their mobile data consumption and using mobile internet-enabled services more frequently since adopting the start-ups' solutions:

— 54% of I-Stem users reported increased mobile data consumption as a result of using the I-Stem app while 5% were first-time mobile internet users.

— Only 4% of SignAble users reported being first-time mobile internet users, but 55% reported using mobile internet services more since they started using the SignAble app.

— DeafTawk did not have first-time mobile internet users, but 33% reported using mobile internet services more.

— In Kenya, 4% of Signs Media's assistAll users were first-time mobile internet users and 64% reported using mobile internet services more since adopting the app.

While the data indicates that the start-ups' AT solutions have both driven the use of mobile data services and the frequency of mobile internet use, this was restricted primarily to the AT solutions or other familiar apps, but not necessarily a new or wider range of mobile internet-enabled services. For example, the I-Stem app converts inaccessible content into accessible formats, enabling users to use mobile internet content and services more effectively. This results in increased mobile internet use. However, most users reported that it did not significantly change what they used mobile internet for. The typical internet use cases for customers remained mostly the same: education, social media, payments, alternative AT solutions, Google Maps and search.

The following quote highlights the link between using the solutions of the start-ups and higher mobile internet usage:

> "
>
> **Now, I use mobile internet most of the time and I need more mobile data in my phone to use the app."**
>
> **DeafTawk user**

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11. Women's mobile access and usage, particularly that of women in South Asia, may be limited by social norms, including gatekeepers denying access as well as other structural inequalities. See, for example: GSMA. (2022). *The Mobile Gender Gap Report 2022*.

End-user surveys also indicated that customers are using the app to support their work and livelihoods:

> **In my job, I have to regularly read and process documents that are inaccessible. Now, I use my internet [the I-Stem app] to also convert my inaccessible documents into accessible formats which I earlier used to ask someone to record for me.”**
>
> I-Stem user

> **Everything that used to take a lot of time is now available at the touch of a button. For me, this means that I must spend the majority of my time online to access the latest designs and information.”**
>
> DeafTawk user

Socio-economic impact

For persons with disabilities, digital AT innovations can contribute to socio-economic well-being in a variety of ways, including providing access to solutions and services that may otherwise be unavailable or difficult to access independently, such as government and health services (see Table 1). Through these innovations, users derive benefits that enhance their independence and overall quality of life or provide access to employment opportunities.

— In India, 86% of I-Stem customers reported an improvement in their quality of life. Also, 84% of users could not find a good alternative to I-Stem's solution, an indication that the start-up is addressing a critical unmet need. Improved access to employment and income opportunities was cited by 74% of customers, with 55% saying that they were "very much improved" because of I-Stem.

> **This app has impacted my life positively. For instance, it has allowed me to read my heavy books of mathematics comfortably. Also, the quality of the OCR [Optical Character Recognition] seems quite satisfactory, much more than the others.”**
>
> I-Stem user
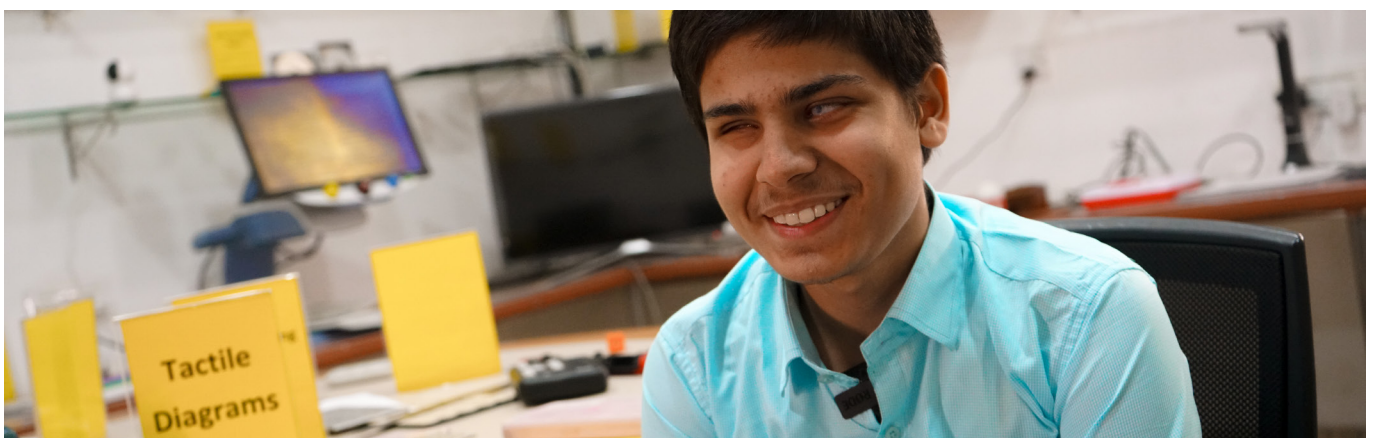
> **"**
>
> **I have had to rely on assistants to read out documents to me. But, now with the I-Stem app, my dependence on others has reduced substantially."**
>
> **I-Stem user**

— In Pakistan, 91% of DeafTawk's customers reported an improvement in their quality of life, with 75% reporting that they did not have a good alternative to the solution. The following quotes capture how DeafTawk is empowering users with hearing impairment by making communication easier, reducing their dependence on others and improving their earning potential.

> **"**
>
> **I always used to bother my son to help get things done but I never liked that. He never declined helping with my interpretation needs but he is also busy, which becomes very inconvenient for both of us. Luckily, DeafTawk made our lives easy now."**
>
> **DeafTawk user**

> **"**
>
> **Being deaf made me feel like a liability for my family. I wanted to change that by contributing towards the society in a positive way. DeafTawk has made this possible. I started using DeafTawk's mobile app after meeting them at a marketing event. Now, I am working at DeafTawk as a management intern, where I constantly learn and grow into a more useful part of my society."**
>
> **DeafTawk user and intern**
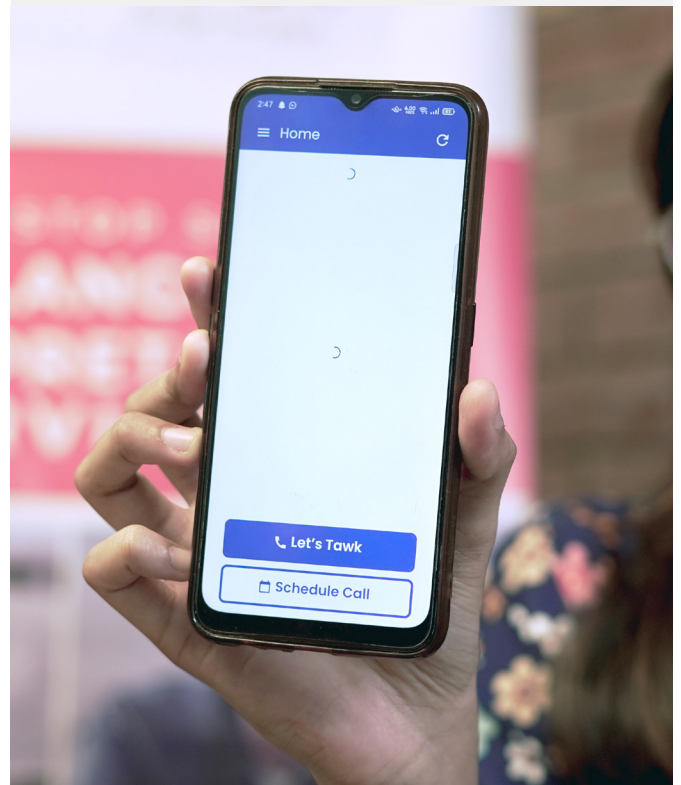
— In India, 88% of SignAble Communications' customers reported an improvement in their quality of life, with 70% reporting that they had no good alternative to the solution. The most-cited benefits related to breaking down communication barriers and enhancing job opportunities.

> **"**
>
> **I was looking for a job. I used to convey my message by writing in a paper and had no success. Once I got introduced to the app, with the help of the interpreter, I was selected in many top companies and finally I have a job in a bank because of the interpretation."**
>
> SignAble Communications user

> **"**
>
> **I was planning to build a house but was finding it hard to communicate. When I heard about SignAble, I started the construction work and completed the house halfway with the help of interpreters."**
>
> SignAble Communications user

— In Kenya, 44% of Signs Media's assistAll users reported an improvement in their quality of life. Furthermore, 87% of Signs Media's users were accessing an app like assistAll for the first time, while 72% of users reported not having a good alternative. This indicates that Signs Media is providing a unique service and meeting a critical unaddressed need for persons with disabilities in Kenya.

> **"**
>
> **With assistAll, I can now go back to school and study beauty and hairdressing which has always been my passion."**
>
> Signs Media user

Further evidence of socio-economic impact included boosting the earning potential of sign language interpreters. For example, DeafTawk, SignAble and Signs Media are improving employment opportunities for interpreters who can connect easily to their customer base without having to travel, saving time and costs. These interpreters derive personal satisfaction from being a bridge that connects marginalised deaf communities with the world around them.

> **"**
>
> **I am a sign language interpreter and I love my profession. I started using DeafTawk about two years ago. DeafTawk has positively impacted my life. Firstly, I am earning more and secondly, I enjoy talking to deaf people on an app."**
>
> DeafTawk sign language interpreter

2. Driving uptake of digital AT innovations

Knowing and prioritising customer needs and aspirations is essential to the design of any product or service. For persons with disabilities, this becomes even more important because of their limited ability to use digital AT innovations or mobile services, as well as the socio-cultural and economic factors that have a disproportionate impact on their access to, and use of, mobile and other essential services.[12] Uptake and usage of digital AT innovations by persons with disabilities can be greatly enhanced by implementing inclusive or participatory design processes. This can drive innovations that better meet the needs of users. It also gives start-ups the opportunity to understand customer pain points and barriers to usage, which in turn helps them to implement a mix of strategies and approaches to raise awareness, create more effective onboarding processes and design more user-friendly products.

Lesson 1: Involving persons with disabilities in the development and implementation of digital AT solutions is critical to driving uptake

The involvement of persons with disabilities throughout the design, development and implementation process is key to enhancing trust, ensuring that users' voices are heard and creating products and services that truly meet their needs and capabilities. All these drive greater uptake and usage. A participatory approach also aligns closely with the motto, "Nothing About Us Without Us", coined by the disability rights community to emphasise that no design or implementation activity should be carried out without the direct and active participation of persons with disabilities.

The involvement of persons with disabilities can be facilitated internally or externally. First, persons with disabilities who work within an organisation can provide product development teams with critical insights. Second, persons with disabilities who are existing or potential customers can participate in the development process and provide feedback through participatory workshops or other customer feedback mechanisms.

tailored offerings by incorporating user needs and aspirations; and support innovative approaches to product design and implementation. Three of the Fund start-ups have owners and employees who live with disabilities themselves. Through their lived experience, they understand some of the challenges experienced by persons with disabilities and how their innovations can best address them.

> "
>
> **[This is] an app developed by persons who are blind – they know what they are talking about."**
>
> **I-Stem user**

Having persons with disabilities in a start-up's ownership or organisational structure can help improve design of effective AT solutions

Integrating persons with disabilities in start-ups' organisational structure and involving customers in the product development process, can give start-ups the knowledge and understanding of disability-related specifications or requirements they need to design effective AT solutions. This can also engender trust among users and enhance the ability of start-ups to improve product accessibility and usability; deliver

By engaging with customers with disabilities, the start-ups learned about in-demand features that would meet broader user needs and potentially drive more active usage of their products:

— I-Stem learned that users wanted more accessible news content since mainstream news sources were largely inaccessible. Moreover, while existing currency readers identify local currency and support local languages, their accuracy is limited, and the interface is not user-friendly. In response, I-Stem developed additional and complementary features to meet users' needs and ultimately drive more active usage of their solutions.

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12.   See, for example: GSMA. (2021). _The Mobile Disability Gap Report 2021_.

— In Kenya, Signs Media's design sprints with deaf users and sign language interpreters highlighted several usage challenges experienced by both groups. Signs Media learned that the user experience depended on the environment in which they were making calls. For instance, when using the app for interpretation of phone conversations, deaf users struggled to position the phone so that both they and the person they were calling could see the on-screen interpreter and, likewise, that the interpreter could hear the person they were calling clearly, which is especially challenging in noisy public spaces. There are also certain use cases that require discrete placement of the device to protect the privacy of deaf users, for example, during health consultations. Signs Media has since added guidance on best practices to mitigate these issues.

— Signs Media learned that their assistALL app was not pushing notifications of incoming calls to the devices of sign language interpreters, resulting in high numbers of missed calls and lost business. Signs Media was able to fix this bug and interpreters are now always notified of incoming assistALL calls during their self-assigned work hours. The assistALL interpreters had valuable insights on the challenges that they and customers experience when using the app. Signs Media therefore began engaging regularly with their interpreters to optimise the user experience.

While core digital AT solutions can help with the daily challenges experienced by persons with disabilities, AT providers also need to address the usage challenges that may hinder or limit active or continued use. Participatory approaches to design can uncover these challenges and provide opportunities to explore additional features that could add value for their users.

Involving persons with disabilities in the marketing and distribution of AT innovations increases reach and uptake

Start-ups can involve app users or members of organisations for persons with disabilities (OPDs) in at least two ways. First, they can learn from users and OPDs to market digital AT innovations to persons with disabilities effectively. Through partnerships with OPDs, start-ups can benefit from their understanding, networks and trust to better reach persons with disabilities, especially in areas where the start-ups have no active presence. In India, SignAble Communications' partnership with a Deaf Women's Association helped them to understand the unique challenges deaf women encounter using SignAble's service and to adjust their service provision accordingly.

Second, start-ups can also leverage the support and direct involvement of persons with disabilities in marketing and outreach activities. For example, three of the Fund start-ups – SignAble, I-Stem and DeafTawk – have customers with disabilities who are ambassadors of the service in their close-knit communities. These start-ups found it valuable to connect with the groups that persons with disabilities form (e.g. WhatsApp, Facebook, e-mail groups and support groups), not only to promote the product but also to educate them on the value of the solutions and perhaps even provide ongoing support to fellow users. By involving users and leveraging these close-knit communities, start-ups can increase the uptake of their solutions.

Lesson 2: Understanding the needs and technical requirements of persons with disabilities – and designing solutions to meet them – enhances usability and drives adoption of digital AT innovations

To accelerate mobile internet use and the uptake of AT solutions by persons with disabilities, start-ups should focus on the practical challenges they encounter with mobile devices and services, including accessibility and usability issues, security and privacy considerations and the cost of services, which can be prohibitive. Services need to be designed and adapted to meet these needs.

Designing for accessibility and usability

AT products (and digital solutions in general) that are designed to meet the diverse accessibility requirements of persons with disabilities are more likely to be adopted and used long term. This includes having an easy-to-follow onboarding process, simple interfaces and intuitive menu flows that not only address disability-specific access challenges, but also those arising from lower digital literacy levels.[13] It is also important that solutions are fully compatible with other solutions commonly used by persons with disabilities. The Fund start-ups adopted several innovative approaches:

— I-Stem included short, easy-to-access descriptions of how to use each app feature under each feature button, and the app was fully compatible with TalkBack, the commonly used mobile screen reader on the Android platform.

— SignAble and DeafTawk support new users by providing onboarding videos tailored to their capabilities. SignAble also shares overview videos of new features to closed WhatsApp user groups.

— SignAble found that many deaf users with lower literacy levels do not have bank accounts or alternative means to make online payments and may often input their details incorrectly. This had a negative impact on the conversion of SignAble's registered customers. They responded by providing more post-sales support to specifically help these users with payments.

Designing for safety, security and privacy

The start-ups found that SLI services expose persons with disabilities to a variety of vulnerabilities and risks, including user privacy issues, harassment of customers or interpreters and the accuracy of interpretation.

— **User privacy:** Privacy concerns are two-fold. First, for app-based SLI services, interpreters are privy to the intimate details of a user's life and interpreted information must remain confidential. Start-ups that offer such services should educate interpreters about high-risk scenarios and consider ways to address ethical issues of confidentiality and safeguard users' concerns, including creating a safe and reliable process for app users to report any breach of confidentiality.

Second, SLI users are vulnerable to sensitive and private information being overheard by people in public places during audio translation. Therefore, it is important that onboarding tutorials and terms and conditions include information for deaf users on safe and appropriate use of the app. Signs Media's response to privacy concerns was to recommend the use of headphones to mitigate privacy risks. They also caution deaf users about appropriate placement of the phone camera during health consultations to protect their privacy.

— **Harassment:** Having mechanisms in place to report harassment is an important element of the design of interpretation services. Certain segments of the population, including women, tend to face disproportionate barriers to adopting and reaping the full benefits of digital AT solutions. These barriers are exacerbated by disability. A 2020 GSMA report14 on the intersection of gender and disability found that women and girls with disabilities are often victims of gender-based violence, harassment and discrimination, and face more stigma and segregation because of their disability. To protect persons with

13. The GSMA's *The State of Mobile Internet Connectivity Report 2022* identified a lack of literacy and digital skills as one of the biggest perceived barriers to mobile internet adoption among mobile users in LMICs who are aware of the internet but do not use it.
14. GSMA. *The Digital Exclusion of Women with Disabilities: A Study of Seven Low- and Middle-Income Countries*. GSMA.

disabilities, both male and female, digital AT start-ups should include a harassment clause in their terms and conditions and in the onboarding process. When SignAble learned that deaf women faced challenging privacy and security concerns and experiences, they responded by giving users the option to select interpreters of the same gender. Similarly, DeafTawk allows users to select interpreters of the same gender for meetings of a sensitive nature, such as health consultations.

— **Accuracy of interpretation:** It is important to mitigate the risks of inaccurate interpretation, for example, due to unclear audio or noisy environments. This is especially important when sensitive or personal information is being translated, such as healthcare instructions or legal advice. To help ensure information is interpreted accurately, SignAble gives users the option to select interpreters who are more experienced in their subject of interest, such as for legal, banking and healthcare-related conversations. Deaf users can also book an interpreter they have used previously for follow-on meetings. As with harassment, it is important to have mechanisms to address customers' unsatisfactory interpretation experiences

Efforts to address accuracy concerns should also extend to business and professional clients that are in communication with customers via the app. For example, medical professionals are asked to write down prescription details and medication dosages to ensure the patient understands them correctly. In Kenya, Signs Media provides bespoke onboarding guidance to professionals who use the app to consult with deaf patients or clients.

Designing for limited infrastructure

As of the end of 2021, 89% of the population of LMICs were covered by 4G networks.[15] However, in the countries where the start-ups are located, some rural populations have only 2G and 3G coverage. To enhance the user experience and uptake in these contexts, SLI solutions need to be designed that allow low-bandwidth video calling.

Designing for affordability

Often, persons with disabilities face disproportionate barriers that limit their economic and employment opportunities, making traditional in-person interpretation prohibitively expensive. Digital AT solutions can significantly reduce this cost. It is estimated that digital SLI start-ups are providing services for their customers at less than a third of the cost of in-person interpretation services.[16] However, affordability remains a barrier, as users must not only pay for the data they use to make calls, but also for the digital SLI services. For this reason, services need to be designed as inexpensively as possible.

— SLI providers DeafTawk and SignAble implemented a low-bandwidth video calling solution to help reduce costs for users.

— In Pakistan, DeafTawk trialled AI-based SLI to complement human-based SLI and try to reduce costs for users. While the use of AI avatar interpreters may make SLI services more affordable, several challenges remain that may limit their effectiveness for persons with disabilities in LMICs, such as a preference for human interpreters, social norms, digital literacy and the accuracy of AI avatars.

Start-ups can also enhance access to ATs for persons with disabilities by finding ways to offer free or discounted services. For example, they could offset costs for users by generating revenue elsewhere (see Lesson 5 for more on DeafTawk's approach to offsetting costs in their market), while innovative commercial relationships with governments, MNOs and other companies could help to subsidise costs. For example, DeafTawk had an agreement with Jazz, an MNO in Pakistan, to zero-rate all data use for their app for the first six months after launch. This led to a very high sign-up rate and increased active usage.

15. GSMA. (2022). _The State of Mobile Internet Connectivity 2022_.
16. Manchanda, G.S. and Viljoen, K. (2 December 2022). _._ GSMA Mobile for Development Blog._

Lesson 3: Using a mix of marketing and outreach strategies to raise awareness is an important way to drive adoption of digital AT solutions

It is important for start-ups to consider marketing approaches that reach persons with disabilities most effectively and to promote use cases that meet their needs. This includes marketing and awareness activities that are tailored to users' abilities, needs and aspirations, and that are accessible and targeted effectively to increase discoverability. For example, start-ups can develop accessible marketing materials, such as audio resources or material that can be read by screen readers, to enable persons with visual impairment to fully experience and understand the product and service features.

Use the right mix of approaches to raise awareness

Persons with disabilities can be reached in a variety of ways, including through outreach workshops, by engaging with trusted networks and close-knit communities, using product ambassadors and the right media channels to promote a product and reach people effectively.

— **Outreach workshops:** This can be an effective way to reach many people in one setting. For example, outreach workshops helped I-Stem onboard many users in the early stages. To make this approach even more effective, I-Stem conducted word-of-mouth marketing after the workshops, which enabled them to answer users' questions and help them through the onboarding process.

— **Ambassador programmes:** This can involve leveraging existing customers of digital AT solutions or sign language interpreters. For example, DeafTawk is identifying deaf influencers to target hard-to-reach deaf communities and using creative ways to reach women through one-on-one communications (see Box 1). However, using ambassadors in marketing and outreach does not necessarily achieve the desired results, especially if it is not accompanied

by easy sign up and onboarding. I-Stem noted that their ambassador programme did not achieve the intended reach, as it required ambassadors to share a code with potential new users instead of providing a simple link to sign up. Furthermore, in some cases, ambassador programmes may not be effective when implemented alongside other marketing channels, as ambassadors may find it challenging and unmotivating to recruit new users in areas where other marketing channels are already in place. For example, I-Stem had ambassadors among well-connected, digitally savvy blind communities, but I-Stem's blind founders were already actively marketing in the same areas. This limited the effectiveness of the ambassador programme and led I-Stem to expand its search for ambassadors and to target communities that weren't as digitally savvy.

— **Targeting gatekeepers and caregivers of persons with disabilities:** For example, DeafTawk found friends and family to be strong acquisition channels for persons with disabilities and are targeting them in their marketing activities.

— **Using social media and trusted platforms and networks: I**n Kenya, Signs Media used social media to raise awareness among existing smartphone users, as well as family members and caregivers of potential deaf customers. DeafTawk and SignAble are using WhatsApp and Facebook groups to reach persons with disabilities and explain new product features. In India, I-Stem partnered with OPDs to promote their app widely and disseminate information to their deaf members. I-Stem also partnered with community radio stations and YouTubers to promote their app more widely across India.

BOX 1

Serving female deaf customers and underserved deaf populations better

DeafTawk, a Pakistani start-up providing on-demand SLI services via an app, found that deaf women were less comfortable accessing new services or sharing personal information, or were not empowered to do so, and were also less likely to be able to afford service fees.

To promote uptake among women, the start-up provided free use of the DeafTawk app to rural women and incentivised women ambassadors with free minutes when they referred other women. They also worked with deaf women's organisations and implemented a mix of strategies tailored to the everyday needs and realities of women. These included radio campaigns that aired during times when women were likely to be listening, and face-to-face onboarding activities that provided an opportunity to address concerns raised by the women's family members or gatekeepers.

Overall, DeafTawk found that better results were achieved through one-to-one female ambassador or female interpreter-led promotions, smaller community communications and WhatsApp groups than larger, mainstream campaign efforts. To address safety and privacy concerns, especially among women, DeafTawk introduced the option to have interpreters of the same gender, including during conversations of a sensitive nature.

DeafTawk's approach was not limited to deaf customers. They also implemented flexible service agreements that were particularly valuable for female interpreters, allowing them to work on their own terms. This led to more female interpreters in DeafTawk's portfolio than male interpreters. Overall, DeafTawk's intentional approach to tackling the barriers faced by the deaf population in Pakistan has had positive impacts, with more than 22,000 users onboarded, 30% of which are women (see Table 1).

3. Scaling digital solutions for persons with disabilities

Start-ups in LMICs face many challenges, including limited infrastructure and lack of funding. These are often amplified for start-ups in the AT space. For AT innovations, relevant data on disabilities is sparse and most companies do not disaggregate customer data by disability, especially in LMICs. These challenges, along with many other factors, make it more difficult to achieve commercial sustainability and scale digital AT innovations. More investment is required, as AT innovations are still nascent and require more funding.

Lesson 4: Fostering partnerships and leveraging creative sustainability models with more established players can help expand the reach of digital AT solutions and enhance commercial sustainability

Serving persons with disabilities at scale, in a commercially sustainable way with a B2C model, has several challenges. These include the lower disposable incomes of persons with disabilities and, therefore, slower penetration of digital AT solutions. AT start-ups can leverage innovative sustainability models such as B2G, B2B2C and B2B to diversify their revenue sources, deliver their solutions at scale or offset costs to end users. Start-ups can also leverage a partner's assets or marketing and distribution capabilities to drive scale. Hence, start-ups should explore ways to add or demonstrate the potential to create mutual value with their partners. Partnerships with more established players can also leverage the licensing technology start-ups need to expand the reach of their solutions.

Alternative business models to scale AT innovations and achieve commercial sustainability

Like every business, digital AT start-ups need to balance the costs of providing their services with generating the right amount of revenue to ensure financial sustainability. For SLI services, costs are primarily the overhead expenses of operating the business. For example, SignAble's approach to training SLIs seemed to help retain valuable in-house resources, but covering their monthly salaries was not sustainable. SignAble's switch to sourcing SLIs through an "Uber-like" model and training interpreters on an as-needed basis significantly reduced cost. In contrast, Signs Media and DeafTawk adopted the on-demand SLI payment model from the start, which meant they did not encounter the same challenges as SignAble.

A B2C model alone may not be enough to offset the costs of providing AT solutions to underserved persons with disabilities. To overcome the challenges of selling directly to customers via a B2C model, digital AT start-ups can explore short- or long-term relationships with governments, MNOs and other large organisations (e.g. universities).

Business-to-government (B2G) model: Start-ups can extend the reach of their solutions or offset costs to users by having government as clients and leveraging their interest in public service delivery in areas such as education and health. In Kenya, the United Nations Development Programme (UNDP), through a partnership with the Independent Electoral and Boundaries Commission (IEBC), helped Signs Media's customers to vote during the Kenyan national elections, paying for their use of Signs Media's app and offsetting the cost for end users. The Government of Pakistan, through the Disabilities Income Support Programme, covered the cost for up to 200 deaf users in rural areas to access SLIs for free through DeafTawk's app. This provides revenue for DeafTawk and contributes to the government's mandate to enhance the welfare of all citizens of Pakistan.

Some of the Fund start-ups are exploring licensing arrangements with government. For example, I-Stem is partnering with the Government of India to facilitate integration with Diksha, India's national portal for school education. This partnership will help I-Stem integrate their technology with the Diksha national portal. This will ensure that users with disabilities can access any content on Diksha in accessible formats. I-Stem is also in another conversation with India's Ministry of Education to disseminate information about their app on various educational boards in India.

Governments can also play a critical role in strengthening the policy and regulatory environment for start-ups. In Pakistan, the government has approved a bill that mandates the provision of SLI on all media. DeafTawk

emerged as the government's preferred partner to provide these services given their wide reach across Pakistan. This provides a critical scaling opportunity for DeafTawk and shows that active and progressive engagement with government can put start-ups in a position to seize new commercial opportunities when governments advance inclusive policies.

Business-to-business-to-customer (B2B2C) model: Many digital AT innovations rely on creative B2B2C models in which digital AT start-ups can extend the reach of their solutions to persons with disabilities via third-party businesses (e.g., MNOs), with the cost of the service borne by the end consumers. In Kenya, Signs Media has a partnership with Safaricom to deploy the assistALL app in the Safaricom M-Pesa Super App. This can help increase the visibility and usage of the assistALL app to a wide range of potential customers[17] and enhance the financial inclusion of persons with hearing impairments in Kenya. The partnership can also enhance Safaricom's reach, sustainability agenda and market reputation.

Similarly, I-Stem and DeafTawk secured a cross-border partnership with Dialog Axiata PLC to launch their app to users in Sri Lanka and implement local payment integrations. Specifically, Dialog provided support to develop a suitable go-to-market strategy for digital AT start-ups in Sri Lanka, a new market for them. Dialog also enabled local testing of DeafTawk's app among deaf customers and helped to source local interpreters via their OPD partners in Sri Lanka. When fully implemented, this partnership will extend the reach of the start-ups and could enhance Dialog's inclusion objectives and value proposition for deaf customers on their network. Through B2B2C models, the start-ups have acquired new customers and derive additional benefits, such as sales leads and improved publicity via MNOs' mass channels.

Business-to-business (B2B) model: Providing solutions directly to a company is one of the most important avenues to commercial sustainability for digital AT start-ups. Since this requires understanding the needs and preferences of their client, start-ups can tailor their product offerings and marketing approach to them. For example, in

Kenya, Signs Media derived insights on business clients from different sectors to quickly learn and adapt their B2B marketing campaign and create sector-specific use cases. This enabled them to understand how different organisations (e.g. banks, airline companies and academic institutions) could benefit from the assistALL app and better serve their deaf customers.

— In India, I-Stem is partnering with academic institutions (including the Indian Institute of Technology, Delhi and Ashoka University) to provide document accessibility services to staff and students with visual impairments through a portal that offers accessibility conversion services and digital learning resources and products.

— SignAble has a B2B arrangement with Amazon India to provide access to SignAble's on-demand SLI service. This will enable seamless workplace communication within Amazon India and enhance real-time troubleshooting for employees with hearing and speech impairments. Through this partnership, SignAble Communications is helping to drive inclusion in the workplace for Amazon India.

> " **The tool empowers associates with hearing and speech impairments to communicate with other associates on the floor, by virtually connecting them an interpreter in real time. The easy access to interpreters who speak multiple vernacular languages has not only resulted in higher collaboration but also strengthened morale."**
>
> **Amazon India publication[18]**

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17. For context, more than 9 million customers and 320,000 businesses have downloaded the M-Pesa Super App since its launch. See: https://www.safaricom.co.ke/media-center-landing/press-releases/m-pesa-celebrates-15-years-of-transforming-lives

18. See this Amazon India publication for more on how Amazon is partnering with SignAble to enable seamless communication for Amazon India's employees with hearing and speech impairments.

Start-ups can leverage the complementary assets and resources of their partners to scale AT innovations

Start-ups can extend the reach of their offerings and create mutual value through partnerships with a range of stakeholders, including MNOs and OPDs. This can be done by leveraging their complementary assets, brand recognition, marketing and distribution capabilities.

MNO partnerships: The Innovation Fund demonstrated the important role that MNOs can play in the growth and scalability of AT start-ups. In Pakistan, Jazz is providing resources and expertise to support DeafTawk's early-stage growth through their Xlr8 accelerator programme. This partnership also enabled DeafTawk to offer lower data rates for app usage for the first six months of use. This helped to drive customer acquisition and satisfaction for DeafTawk users. Meanwhile, Jazz can leverage DeafTawk's solution to improve their brand reputation and deliver truly inclusive communication services for their deaf customers.

Dialog's partnership with I-Stem and DeafTawk has also been critical to the growth of the start-ups, providing them with market insights, access to mass communication channels and technical knowledge and advisory. The start-ups are also exploring broader opportunities for collaboration, which will help to make Dialog products and services more accessible.

OPD partnerships: AT start-ups can also partner with OPDs to learn how to market digital AT innovations effectively to persons with disabilities, using their existing relationships with persons with disabilities to better reach this segment (see Lesson 1). In India, I-Stem collaborated with OPDs such as Mitra Jyothi and the NAB Centre for Blind Women to reach more women with their solutions.

Lesson 5: To increase the likelihood of scaling, start-ups must balance commercial sustainability priorities with their core AT objectives

The AT space is challenging; the technology is nascent, funding opportunities are limited and AT innovators must explore different opportunities to scale and achieve commercial sustainability. Yet, applying different approaches, managing partners' expectations and using multiple business models concurrently is complex. To manage this challenge, the AT start-ups focused on establishing their core offering before seeking out new commercial opportunities.

Demonstrate the value proposition and efficacy of the core AT solution for persons with disabilities before expanding

Start-ups can pursue commercial sustainability by expanding their target audience beyond persons with disabilities. This could also increase opportunities for funding and sponsor-related partnerships, which would indirectly help them to become commercially sustainable.

— I-Stem understood that their document and media reading technology is also relevant for non-disabled people, especially populations with low literacy levels, since audio translation of written text can improve accessibility for all. This technology may also add value for people with dyslexia. I-Stem is actively exploring the option of targeting a wider base of users while still focusing on achieving significant progress with their core customer segment.

— DeafTawk iterated their innovation until they could demonstrate the value and effectiveness of their core products, reaching more than 22,000 users in Pakistan before expanding to international markets. In choosing new markets, DeafTawk prioritised high-income countries to support commercial sustainability in LMICs, reinforcing their intention to accommodate lower-income AT customers in LMICs. Through a cross-subsidy model, customers from high-income countries subsidise AT for customers in Pakistan.

— Both DeafTawk and SignAble were successful with their core products, demonstrating value and achieving traction before adding new features and service use cases for deaf users. One was VoIP integration,[19] which allows users to make calls via the app to 2G lines, something that has been inaccessible for deaf people for more than three decades. Deaf users can video call an interpreter via the app, who then makes a 2G audio call to the desired number and interprets the audio information into sign language back to the deaf user. When fully implemented on a commercial scale, this has the potential to significantly increase the reach of the start-ups. Because not all services are accessible via video call, this approach would enable DeafTawk's and SignAble's customers to call any 2G line, significantly expanding the potential use cases for the service beyond smartphone-enabled devices.

19. Voice over Internet Protocol (VoIP) integration demonstrates the important role that a government's progressive inclusive policies can play in enabling the growth of digital AT start-ups, as such licenses are usually only offered to MNOs.

Conclusion

Persons with disabilities are at a disadvantage when it comes to accessing and using most services that are essential for daily living. They face several barriers, including those associated with the disability itself, which exclude them from accessing the opportunities they need to enhance their quality of life. These barriers to inclusion are exacerbated by lack of access to affordable and relevant AT and a lack of digital skills to use them.

In LMICs, digital AT innovations are not widely available or localised for persons with disabilities, and innovations are typically led by OPDs and early-stage start-ups with limited resources and expertise needed to serve these user segments at scale. Digital AT start-ups can deliver their innovations directly to persons with disabilities (or their relatives/caregivers), but few traditional commercial models have been established. Most digital AT innovations tend to rely on creative business models to reach persons with disabilities in a commercially sustainable way.

This includes providing AT solutions via third-party organisations, which can also be a greater opportunity to achieve scale.

To close the mobile disability gap and ensure digital inclusion for all, stakeholders from the public, private and non-profit sectors all have a critical role to play in complementing the efforts of digital AT start-ups. For MNOs in particular, there is an opportunity to extend their customer base to more persons with disabilities and provide more accessible services that will also likely benefit their existing user base. These efforts and collective action are important to ensure that no one is left behind in an increasingly connected world.

Appendix

DeafTawk

Country: Pakistan

Target market: Hearing impaired and deaf persons

Problem: According to the WHO, there are more than 10 million people in the deaf community in Pakistan. They face communication barriers due to limited access to SLIs and are therefore the most marginalised community in the country.

Solution: An app to enhance access to quality SLI services. This involves a video relay solution for one-on-one live interpretation, group calling and AI/machine learning (ML)-powered interpretation.

Key partnerships: Jazz, Telenor and Government of Pakistan

Impact: More than 22,000 people (deaf users and SLIs) are using the app, giving them an online presence and enabling quick and easy connections between deaf persons and SLIs. Up to 75% of DeafTawk users do not have a good alternative to DeafTawk.

I-Stem

Country: India

Target market: Persons with visual and hearing impairments

Problem: Most people with visual impairments, especially those in school or at work, face challenges with inaccessible documents (e.g. textbooks, notices, receipts, pamphlets), as well as online media and apps. These users also lack awareness of, and access to, the latest digital ATs, leading to missed opportunities and the further exclusion of students and employees.

Solution: Conversion of the I-Stem web portal into a mobile app that uses AI to provide document accessibility and audio/visual accessibility services.

Key partnerships: Dialog and Mitra Jyothi

Impact: I-Stem has reached more than 3,400 users, improving their quality of life. Of the users surveyed, 86% report an improvement in their quality of life while 84% cannot find a good alternative to I-Stem's solution.

SignAble Communications

Country: India

Target market: Hearing impaired and deaf persons

Problem: Deaf persons in India face social isolation since most are illiterate and have little access to education and employment. To facilitate communication for the deaf community, SignAble's app offers a mobile interpretation service in Indian Sign Language, enabling them to communicate with anyone, anywhere, anytime.

Solution: A two-way calling app that allows family, friends and other essential service providers to call deaf persons. The app's user interface is optimised to improve the user experience and optimise video streaming for low-bandwidth settings.

Key partnerships: Nasscom

Impact: SignAble has reached more than 30,000 users in India, 88% of whom report an improvement in their quality of life and 34% describing it as "very much improved". 70% reported having no good alternative to SignAble's solutions.

Signs Media

Country: Kenya

Target market: Hearing impaired and deaf persons

Problem: In Kenya, there are only 500 SLIs serving more than 260,000 people with hearing impairments, and the interpreters are mainly located in urban areas. These services remain out of reach for low-income and rural populations.

Solution: Affordable, virtual, on-demand SLI services for the hearing impaired, businesses and professionals through the assistALL app, enabling them to communicate seamlessly when conducting their everyday business transactions.

Key partnerships: Safaricom

Impact: Signs Media has reached more than 5,600 users in Kenya, 80% of which are women. 87% of Signs Media's users were accessing an app like assistAll for the first time.