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Pre-feasibility study for the development of inclusive ICT solutions for persons with disabilities in Uganda

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Acknowledgements

This report was developed by the Ministry of ICT and National Guidance and the International Telecommunication Union (ITU), with the support of Divisions and Services in ITU Headquarters and ITU Regional Office for Africa under the Technical Assistance and Training to Uganda on National ICT Development Strategy' (2021-2024) project[1]. The project is a collaboration between the Government of Uganda and ITU, supported by the Global Development and South-South Cooperation Fund (GDSSCF) and ITU's ICT Development Fund (ICT-DF).

The research was undertaken by Mythoway Services Limited under the framework of the project and its deliverables. Technical input, feedback and guidance have been provided by the ITU and Ministry of ICT and National Guidance project team members and experts in Government Ministries, agencies, institutions, and across Uganda's digital ecosystem.

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Please consider the environment before printing this report.

Foreword

It is my pleasure to present this report under the project 'Technical Assistance and Training to Uganda on National ICT Development Strategy', a collaboration between the Government of Uganda and the International Telecommunication Union (ITU), supported by the Global Development and South-South Cooperation Fund (GDSSCF) and ITU's ICT Development Fund (ICT-DF).

Through carefully co-crafted interventions in support of the country's vision to transform Uganda into a digitally enabled society that is innovative, productive and competitive, the project has applied a three-pronged approach focusing on the development of policy recommendations, enabling capacity development, and the implementation of pilot projects.

In recent years, Uganda has witnessed tremendous growth in its digital economy, reflecting broader trends across the African continent and globally. The increased access to digital technologies, new opportunities that connectivity has brought, and the surge in digital services are fuelling rapid advancements on how citizens engage with one another and with vital Government services. These developments also bring new challenges, requiring policymakers and regulators to rethink strategically and build enabling policy and regulatory frameworks that are future-ready and adaptable to this ever-changing landscape. Moreover, digital skills remain an essential need for citizens to meaningfully participate in the digital space and for professionals to fully leverage the potential of digital technologies in addressing socio-economic challenges. This has been a critical aspect of the implementation of the policy interventions within this project.

This project, co-created and initiated in support of Uganda's ambitious digital transformation journey, stands as an example of how focused and meaningful partnerships can lead to impactful change. We have witnessed the results of the policy interventions and the impact of the significant capacity development in the country. I believe the efforts will continue to impact Uganda's transformation for years to come.

I encourage ITU Member States across the African continent and globally as well as development partners to join forces and invest in digital transformation for social and economic growth. The Telecommunication Development Bureau stands ready to continue supporting countries on their digital transformation journeys with impactful project implementation and partnerships which are essential for achieving universal and meaningful connectivity and digital transformation for all.

Dr Cosmas Luckyson Zavazava
Director of the Telecommunication Development Bureau
International Telecommunication Union

Foreword

The Ministry of ICT and National Guidance is pleased to present this Pre-feasibility study for the development of inclusive ICT solutions for persons with disabilities in Uganda. This report aligns directly with our commitment to ensuring that all Ugandans, regardless of ability, can fully participate in the digital economy and benefit from the transformative power of technology.

This study provides a critical assessment of the existing landscape of ICT access for persons with disabilities, highlighting both the challenges and the opportunities that lie ahead. We are particularly encouraged by the proposed solutions, including the establishment of community ICT centres, improved Internet connectivity for inclusive schools, and the creation of a national integrated platform to connect persons with disabilities with vital digital resources.

We extend our sincere appreciation to the International Telecommunication Union (ITU) for their collaboration and technical expertise in supporting this important work. We also thank The National Union for persons with disabilities of Uganda (NUDIPU), the participating schools and community centres, and all other stakeholders who contributed their time, insights, and expertise to this study.

This report serves as a call to action. The Ministry of ICT and National Guidance is committed to working with all stakeholders to implement the recommendations outlined in this study, ensuring that persons with disabilities in Uganda have equal access to ICTs and the opportunities they provide. We believe that by working together, we can create a truly inclusive digital society where everyone can thrive.

Dr. Amina Zawedde (PhD)
Permanent Secretary
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Government of Uganda

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Introduction and context

Bridging digital divides by improving connectivity and access to information and communication technology (ICT) for marginalized groups, including persons with disabilities, is intrinsic to Uganda's digital transformation objectives, as outlined in the Digital Uganda Vision and the Uganda National Development Plan. Efforts undertaken by the Government, guided by the Ministry of ICT and National Guidance and the Ministry of Education, seek, *inter alia*, to enhance digital infrastructures, build digital skills and foster inclusive innovation.

The pre-feasibility study for the development of inclusive ICT solutions for persons with disabilities in Uganda involves the survey of existing learning centres for persons with disabilities and the conducting of a study for the roll-out of an integrated national ICT system for such centres, with the view to enhancing digital access and inclusivity for persons with disabilities, in alignment with Uganda's broader digital transformation objectives. This study is convened by the Ministry of ICT and National Guidance in collaboration with other national stakeholders and with the support of the International Telecommunication Union (ITU) through a joint project on technical assistance and training for Uganda on national ICT development strategy (2021-2024).

About the study

The study focuses on assessing the current state of ICT infrastructure in learning centres for persons with disabilities and proposes an integrated national ICT solution. Key objectives include:

- conducting a survey of learning centres for persons with disabilities across Uganda;
- performing a pre-feasibility analysis for an integrated national ICT system;
- developing technical specifications for model ICT-enabled learning centres; and
- providing budget estimates for proposed systems.

A mixed-method approach was employed, combining quantitative surveys and qualitative interviews to evaluate ICT accessibility and service delivery in both school-based and community-based centres. The study involved surveying 57 ICT centres, including 20 primary schools, 30 secondary schools and seven community centres, and engaging stakeholders through interviews and focus group discussions to gather insights on existing challenges and opportunities.

Main findings

The assessment revealed significant gaps in ICT access for persons with disabilities, including limited infrastructure and resources at many learning centres, challenges in accessing assistive technologies and digital content tailored to diverse needs and insufficient training programmes to enhance digital skills among persons with disabilities.

The study identified critical areas for intervention, emphasizing the need for a cohesive national programme to expand access to ICT infrastructure, skills and services to persons with disabilities by:

- creating ICT access centres for persons with disabilities in the community;
- expanding access to accessible digital content for persons with disabilities in areas such as education, productivity, art and culture; and
- providing skills training for persons with disabilities in the community and in schools.

Proposed solutions and recommendations

The study proposes a three-part national ICT effort consisting of:

- a community ICT centre programme;
- a school programme; and
- an integrated national platform.

Community ICT centre programme: Establish physical ICT centres in communities across the four regions of Uganda. These centres will provide access to computers, assistive technologies and the Internet, enabling persons with disabilities to engage with digital resources and participate in online activities.

School programme: Connect schools that are inclusive of persons with disabilities to the Internet. This will allow students with disabilities to access online learning resources, participate in virtual classrooms and benefit from digital educational content.

Integrated national platform: Create an integrated national platform that interconnects all learning centres in schools and communities. This platform will provide a centralized hub for accessing digital content, resources and productivity tools such as learning management systems, video conferencing and assistive technology support. It will serve as a one-stop avenue for reaching persons with disabilities with digital content and services.

Abbreviations

ADA	Americans with Disabilities Act
AES	Advanced Encryption Standard
AI	Artificial intelligence
API	Application programming interface
AWS	Amazon Web Services
CBA	Cost-benefit analysis
CDN	Content delivery network
CCTV	Closed-circuit television
DUV	Digital Uganda Vision
GDPR	General Data Protection Regulation
G3ICT	Global Initiative for Inclusive ICTs
HDD	Hard disk drive
ICT	Information and communication technology
ISP	Internet service provider
ITU	International Telecommunication Union
JAWS	Job Access with Speech
KPI	Key performance indicator
LMS	Learning management system
NBI	National backbone infrastructure
NCDC	National Curriculum Development Centre
NDP III	Third National Development Plan
NGO	Non-governmental organization
NITA-U	National Information Technology Authority-Uganda
NoSQL	Not only SQL
NUDIPU	National Union for Persons with Disabilities of Uganda
NVDA	Non-Visual Desktop Access
OCR	Optical character recognition
OS	Operating system

(continued)

PPP	Public-private partnership
RAM	Random access memory
RBAC	Role-based access control
REST	Representational state transfer
SDK	Software development kit
SIEM	Security Information and Event Management
SSD	Solid state drive
SSO	Single sign-on
TTS	Text-to-speech
UCC	Uganda Communications Commission
UI	User interface
UNAB	Uganda National Association of the Blind
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
UNESCO	United Nations Educational, Scientific and Cultural Organization
URSB	Uganda Registration Service Bureau
WCAG	Web Content Accessibility Guidelines
WIPO	World Intellectual Property Organization

1 Introduction

The Uganda Ministry of ICT and National Guidance is being supported by ITU in implementing a project on technical assistance and training for Uganda on national ICT development strategy. The joint Government of Uganda, Global Development and South-South Cooperation Fund and ITU project seeks to support Uganda's continued transformation into an innovative and competitive digitally enabled society and is framed under the Digital Uganda Vision and in line with Uganda's Digital Transformation Programme, the Third National Development Plan (NDPIII) and the Digital Transformation Roadmap. In its implementation design, a three-pronged approach has been applied focusing on:

- development of policy recommendations;
- enabling capacity development; and
- implementation of test pilots and use cases.

Under the component on development of policy recommendations, in particular those aimed at informing universal service and access in rural communities and the diffusion of digital services in critical sectors, the study seeks to support the development of an inclusive ICT solution for persons with disabilities in Uganda. In view of this, ITU, in support of the Ministry of ICT and National Guidance, commissioned this assignment to be conducted by Mythoway services, a disability-research and assistive technology consultancy firm with technical and local context expertise. The aim of the study is to survey learning centres for persons with disabilities in Uganda, perform a pre-feasibility study for rolling out an integrated national ICT system for national learning centres for persons with disabilities, develop technical designs and specifications for a model ICT-enabled learning centre for persons with disabilities and an integrated national ICT platform connecting learning centres for persons with disabilities and prepare budget estimates for the proposed systems and an implementation plan.

As Uganda has achieved lower-middle-income country status, a key goal of Uganda Vision 2040, technology is seen as a critical driver of this transformation. By promoting digital innovation and ICT competitiveness, Uganda aims to boost economic growth, improve service delivery and create a more inclusive society. Bridging the digital divide is crucial to ensuring that all citizens, including persons with disabilities, have equal access to technology and the opportunities it offers in the digital economy. Addressing this gap is essential to Uganda's pursuit of inclusive, sustainable development.

Bridging the digital divide aligns with Uganda's broader digital transformation objectives, in particular those outlined under Objective 2 of the Third National Development Plan (NDP III), which focuses on expanding broadband infrastructure and improving ICT access for marginalized groups, including persons with disabilities. This also aligns with the Digital Uganda Vision and the Digital Transformation Roadmap (2023/24-2027/28), which both emphasize enhancing digital infrastructure, building digital skills and fostering inclusive innovation.

The Digital Transformation Roadmap particularly underscores the importance of ensuring that no one is left behind in Uganda's digital future, with inclusivity embedded across several key pillars:

- Pillar One (Digital infrastructure and connectivity) focuses on expanding national backbone infrastructure (NBI) to underserved districts, including those with significant populations of persons with disabilities, ensuring last-mile connectivity for hard-to-reach areas.

- Pillar Two (Digital services) calls for the development of a digital service standard and digital services that cater to diverse abilities and needs.
- Pillar Four (Digital skilling) emphasizes the need for a digital skills acceleration programme that includes persons with disabilities, ensuring their participation in the digital workforce.

The pre-feasibility study assesses the technical, legal, financial and market feasibility of implementing inclusive, national ICT solutions for persons with disabilities. Additionally, it provides technical recommendations for the proposed systems, ensuring they are tailored to the specific needs of persons with disabilities and designed for long-term sustainability and scalability, along with a budget estimate for the proposed solution.

Methodology

The assignment utilized a comprehensive mixed-method approach to assess the feasibility of establishing ICT access centres for persons with disabilities in Uganda, alongside designing model ICT-enabled learning centres and an integrated national ICT platform. The methodology aligns with international best practice, ensuring all findings are grounded in global frameworks and the local Ugandan context.

Needs assessment

The needs assessment started with the development of survey tools, which was followed by qualitative and quantitative interviews, which included focus group discussions and site visits to evaluate ICT infrastructure, accessibility and service delivery in learning centres for, and communities of, persons with disabilities. Data from the survey were then analysed and preliminary conclusions made about the areas of focus for the next stage of the assignment, i.e. the pre-feasibility study stage.

Pre-feasibility study

The assignment required a pre-feasibility study for the establishment of an integrated ICT platform for persons with disabilities to inform a possible follow-on full feasibility study. At the pre-feasibility study stage, the key objective is to inform decision-makers whether this is a concept or idea that can be implemented, considering all aspects of feasibility such as technical, financial and legal. The initial focus was on answering the following questions:

- Is there a need for such a system in Uganda?
- Is there demand for the system?
- What would be the scope of coverage of such a system?
- Is the system technically feasible?
- Can a design of the system be proposed that is financially affordable?
- What are the existing and foreseeable legal and regulatory bottlenecks to implementation of such a system?
- Who are the possible funders and what are the funding options?
- What are the sustainability considerations?
- How can decision-makers ensure that there is no duplication of resources or efforts?

Technical design of an integrated national ICT platform connecting learning centres for persons with disabilities

The national ICT platform for persons with disabilities will be developed to network the numerous ICT-enabled learning facilities for persons with disabilities across Uganda. The platform will be designed based on principles of scalability, security and accessibility, to handle a wide range of users with ease while easily adapting to future technological advances.

Cost estimation

The methodology for cost estimation considers the preliminary design, current 2024 market prices for system components (software, hardware and applications), integration costs, associated skilled labour costs, procurement related costs, taxation if applicable, maintenance costs, running costs and awareness campaigns. The cost estimate will also be benchmarked against similar ICT systems, building modifications, software licenses and other expenses associated with projects of this nature.

Model ICT centres

The study includes the design of a model ICT-enabled learning centre based on international standards of accessibility, operability, perceivability and usability. The design of the model centre takes into account the need for integration into the proposed national ICT platform for persons with disabilities when this is realized, ensuring that both hardware and software interfaces are compatible with the proposed integrated platform. The design considerations include ensuring that the model centre conforms to international best practices for accessible environments, aligning with the Global Initiative for Inclusive ICTs (G3ict) and Inclusive Design Principles.

Learning centre and needs assessment survey

The first phase of the project involved conducting a comprehensive survey to assess the state of ICT infrastructure, accessibility and service delivery in learning centres for, and communities of, persons with disabilities across Uganda. To fully understand access dynamics, the study categorized the centres into school-based and community-based centres. Under school-based, the study assessed ICT centres attached to primary and secondary schools, as well as those based in public universities. Additionally, because the community-based ICT centres were too few and the data was insufficient to paint an adequate picture of access challenges faced by persons with disabilities in the community. The study also included a needs assessment survey involving individual community members with disabilities across 40 districts in the four regions of Uganda. A mixed-method approach was employed, combining quantitative surveys with qualitative interviews and focus group discussions. This provided a detailed view of the challenges and opportunities encountered in learning environments for, and communities of, persons with disabilities.

1.1 Development of data collection tools

Structured survey questionnaires were developed to collect data on the state of ICT in school-based and community-based ICT centres and on ICT access needs and challenges experienced by persons with disabilities in the community.

Additionally, qualitative interview guides were developed to collect data from representatives of NGOs and government agencies identified as stakeholders in the area of ICT for persons

with disabilities, as well as students with disabilities from tertiary institutions. These qualitative interviews were of two types:

- key informant one-on-one interview guides, which were administered to key informants, i.e. representatives of institutions that were determined to be stakeholders; and
- focused group discussion guides, which were used with students with disabilities from universities and other tertiary institutions.

1.2 Sampling

Multistage clustered sampling, snowball sampling and purposive sampling were used to include participants and respondents in the study.

- *Multistage clustered sampling:* The Ministry of Education Department of Special Needs and Inclusive Education provided school enrolment data which contained records of primary and secondary schools that are dedicated to or are inclusive of persons with disabilities and persons with specific needs, enrolment by types of disability across the two education levels (primary and secondary) and other types of information. This data was used as a sampling frame. The frame was divided into clusters, e.g. dedicated and inclusive school clusters, before sampling each cluster. Likewise, registries obtained from district unions of persons with disabilities were used as sampling frames for sampling persons with disabilities in the community. From each list, the registry was divided into different disability types and further into gender and then sampled. This was done to make sure that each type of disability and gender was represented in the study.
- *Purposive sampling:* Key informants were purposively sampled by first identifying the stakeholder institution and then contacting the identified institution for best representative given the context of involving the institution. The recommended representative was then included in the study as a key informant.
- *Snowball sampling:* For students with disabilities in tertiary institutions, as the Ministry of Education Department of Special Needs and Inclusive Education does not keep enrolment records relating to tertiary institutions, students were identified through movements of students with disabilities. The study identified one student in each category of disability and each student identified was then asked to identify their colleagues from the same or different tertiary institution, in the same category of disability. The process was repeated until the targeted sample size was reached.

Of the 290 dedicated and inclusive schools in the country, as per the records of the Ministry of Education Department of Special Needs and Inclusive Education for 2023, a total of 50 primary and secondary school-based centres were surveyed. In addition, two Universities, five community-based centres and 180 individual persons with disabilities in the community were included in the survey. Additionally, representatives from 10 NGOs and government agencies whose work involves persons with disabilities and the ICT sector were interviewed.

1.3 Data collection

Quantitative data was collected through structured questionnaires administered via Microsoft Forms and Google Forms, which had been rigorously tested for accessibility and compatibility with popular assistive technologies, such as screen readers and magnifiers. There were two modes of administration:

- *Self-administration:* where respondents had the requisite skillsets to work with web forms, the questionnaire URL was sent to them, and they completed the forms independently.

- *Assisted administration*: in cases of limited Internet access or inability to operate web forms, enumerators equipped with Internet-enabled devices assisted respondents on-site.

Qualitative data was gathered through semi-structured interviews with representatives from key stakeholders and focus group discussions with students with disabilities from tertiary institutions, which were then coded and analysed thematically.

1.4 Data analysis

Quantitative data analysis: Descriptive statistics were applied using SPSS to identify trends and patterns in ICT accessibility and use by persons with disabilities, as well as equipment and infrastructure in centres.

Qualitative analysis: Thematic analysis (Braun & Clarke, 2006) was used to identify key challenges in the areas of infrastructure, digital content and skills development.

1.5 Observations from analysis

Observations from the data were presented along with interpretations and discussions. Where needed, datapoints were visualized using Python analytics.

2 Findings

2.1 Findings from survey of learning centres for persons with disabilities

To gain a comprehensive understanding of the state of ICT access for persons with disabilities in Uganda, a diverse range of 57 ICT centres were surveyed. The survey encompassed 20 centres attached to primary schools, 30 centres attached to secondary schools and two centres attached to public universities. All the schools that participated are either dedicated schools for persons with disabilities and persons with specific needs or schools that are inclusive of learners with disabilities and had computer labs or libraries that are open to learners or users with disabilities. Additionally, five community-level ICT centres were included in the survey, comprising two centres operated by the National Union for Persons with Disabilities (NUDIPU) and the Uganda Communications Commission, a centre attached to Gulu district Union, a centre operated by the Uganda National Association of the Blind (UNAB) and one postal telecentre established through initiatives of the Uganda Communications Commission and Posta Uganda.

2.2 Findings from survey of school-based learning centres

The assessment of ICT access in schools revealed that 93 per cent of participating schools (47 out of 52) had access to functional computers. However, five schools reported having non-functional computer labs, mainly due to:

- computers being not functional or damaged (two schools);
- disconnected electricity supply (one school); and
- limited number of computers or required assistive technologies, leading school administrators to keep the labs closed (two schools).

The majority of school-based ICT centres surveyed (47 out of 52) had laptops as their primary ICT devices, indicating a shift towards portable and adaptable technology solutions. Printers and scanners were less common, found in only eight of the 52 schools, suggesting a lower priority for these peripherals by donors compared to core computing devices.

Photos: Insights into Gulu High School ICT centre for learners with specific needs

A group of students with visual impairments sitting at a row of desktop computers in an ICT lab. They are wearing headsets and actively using the computers, with their hands on the keyboards. A teacher stands nearby, observing or providing guidance. The room has a mix of older and newer furniture, including wooden desks and chairs.

This image shares another perspective of the same ICT lab, showing students working on desktop computers. One student, dressed in a school uniform with a tie, is seated alongside others, all wearing headsets as they use the computers. The teacher stands behind the students, providing oversight or assistance. The environment includes visible wiring and hardware, with monitors and CPUs. There is an overall functional setup for accessible learning in this space.

The availability of assistive technologies varied significantly based on the types of disabilities catered to by the schools. Schools catering to learners with visual impairments had a wider range of assistive technologies, such as screen readers, refreshable braille displays and magnifiers, demonstrating a greater awareness and investment in this area by donors and support partners in ICT for persons with disabilities. The most preferred screen reader was JAWS (Job Access with Speech), preferred over NVDA (Non-Visual Desktop Access), mainly due to JAWS's wider

range of more natural-sounding text-to-speech voice synthesizers and better performance with the Microsoft Office suite of tools.

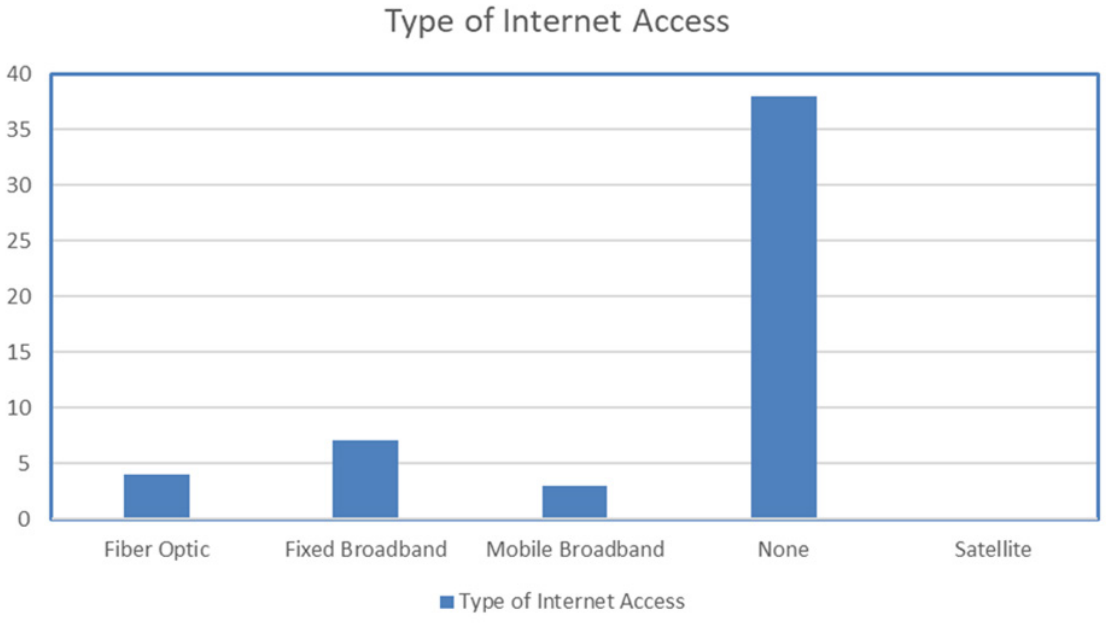
In contrast, schools catering to learners with intellectual impairments or learning disabilities had minimal or no assistive technologies available. Of the seven surveyed schools catering to learners with intellectual and learning disabilities, none of the administrators had awareness of assistive technologies that could be used for learners with intellectual or developmental disabilities, highlighting the need for awareness training in this area of disability.

School-based ICT centres catering to learners with hearing impairments show a much greater adoption of assistive communication technologies. These centres utilize tools such as communication software and live captioning services, including Google's offerings, to facilitate inclusion. When asked which specific assistive technologies they would most like to have, centre administrators consistently highlighted speech-to-text software, with Dragon Naturally Speaking being a particularly preferred choice.

2.3 Gaps

Despite the relatively better access to computers by surveyed school-based centres, significant challenges remain. ICT equipment is limited and the lack of Internet connectivity and insufficient accessible content restricts the effectiveness of these ICT centres in school. Only four of the 52 school-based centres classified their Internet connectivity as reliable, while only 14 of the 52 centres in total were connected to the Internet, see Figure 1.

Figure 1: Type of Internet access across 52 schools



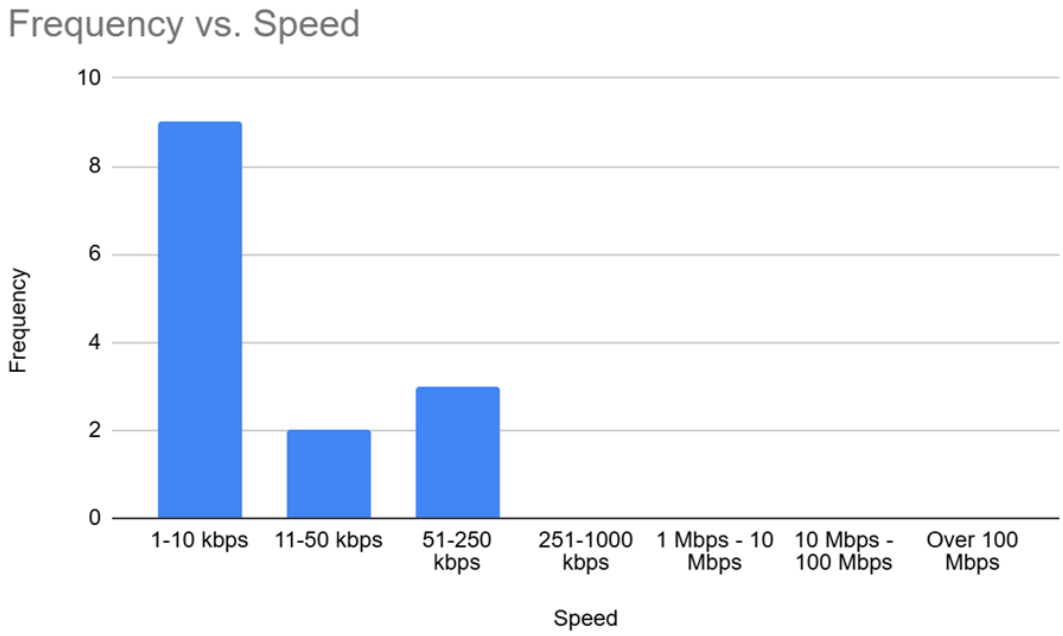
Source: Survey of ICT learning centres for persons with disabilities

Furthermore, the survey revealed a considerable disparity between access to assistive technologies and their actual use: while over 80 per cent of the learners surveyed had some form of access to computers and/or assistive technology, only 20 per cent used computers at least once a week owing to unavailability of content or connectivity issues. Internet connectivity issues are particularly significant as most assistive technology services, including speech and image

recognition, rely on cloud-based servers, which are often inaccessible owing to connectivity challenges.

Additionally, the survey revealed that even those centres with Internet access did not have high-speed connectivity. Specifically, 64 per cent of the centres surveyed had Internet speeds of lower than 100 kbit/s, which can significantly hinder the effective use of ICT resources, in particular those that rely on cloud-based services, see Figure 2.

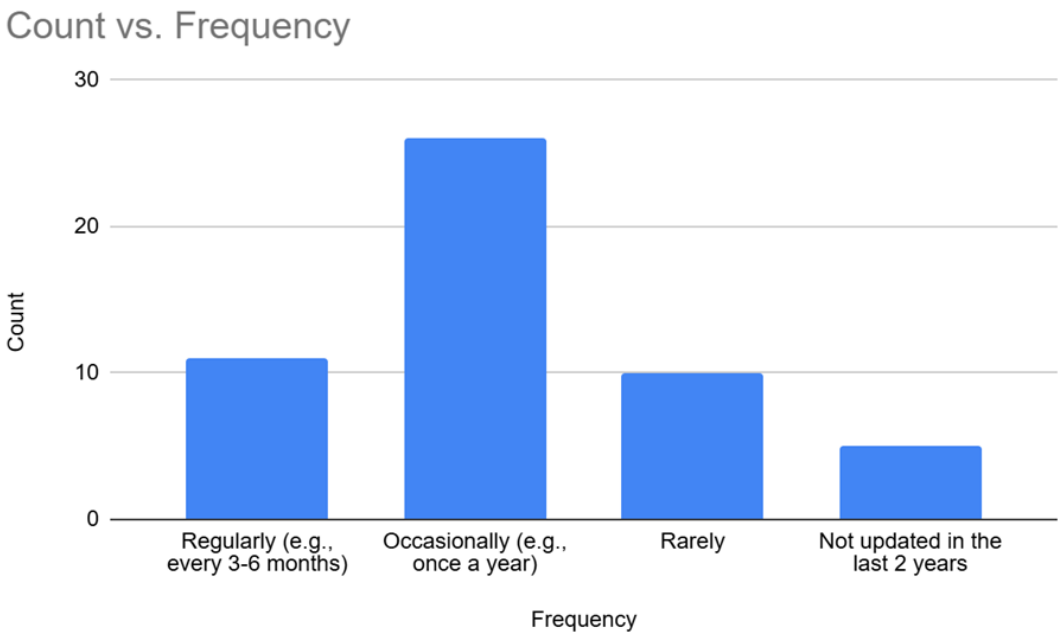
Figure 2: Average Internet speed across 14 schools



Source: Survey of ICT learning centres for persons with disabilities

Consequently, school-based centres face challenges in getting regular system updates, including operating systems, security updates and routine maintenance. Only 11 of the participating school-based centres could afford updates every three to six months, representing approximately 21 per cent of the schools surveyed, see Figure 3.

Figure 3: Frequency of maintenance and update of centre equipment

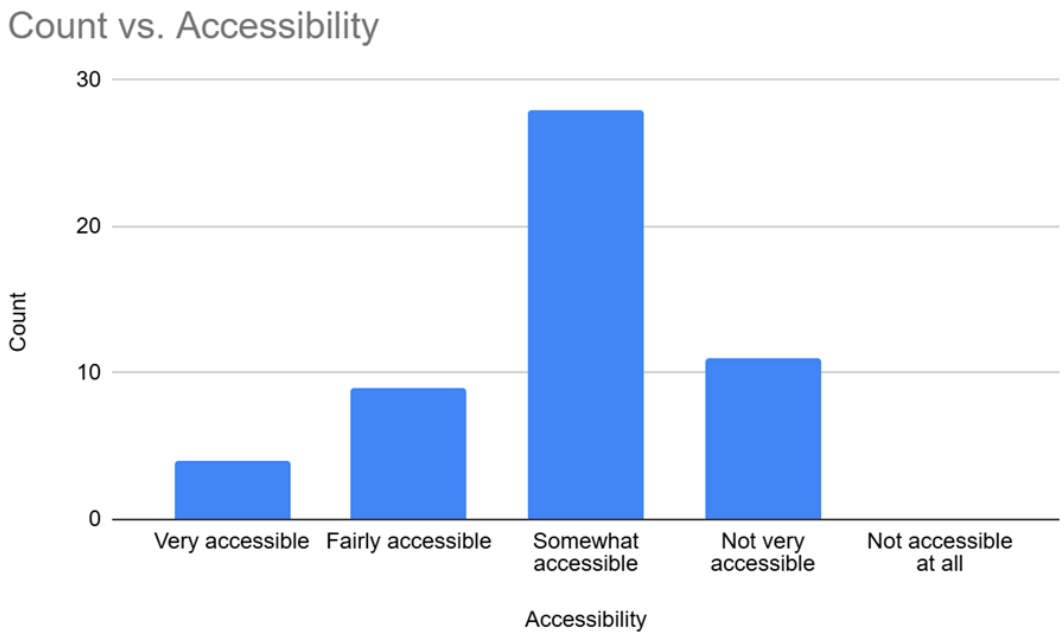


Source: Survey of ICT learning centres for persons with disabilities

The survey of learning centres highlighted a significant challenge in accessing readily available digital content repositories. Of the 52 school-based ICT centres surveyed, only two had access to a digital repository through Kolibri, an open-source e-learning platform. However, due to a lack of Internet connectivity, these Kolibri systems had not been updated since 2019, rendering them outdated and potentially less effective.

Regarding the accessibility of learning centres, the survey revealed a notable contrast between different disability types. While centres generally catered well to users with visual impairments, those with physical disabilities faced more difficulties. Centre administrators frequently described their facilities as only "somewhat accessible" to users with physical disabilities, rather than "very accessible" or "fully accessible", highlighting a potential area for improvement, see Figure 4.

Figure 4: Accessibility of ICT centres



Source: Survey of ICT learning centres for persons with disabilities

A significant finding from the survey was the lack of skills among school-based centre staff or support personnel, hindering their ability to effectively support users/learners. Nearly all participating school administrators (47 out of 52) highlighted the need for more staff training, in particular in utilizing assistive technologies and converting mainstream resources into accessible alternative formats. This widespread need for training underscores a critical gap in the current support system for these types of ICT centres.

2.4 Survey of ICT centres for persons with disabilities and of persons with disabilities in the community

To gain a deeper understanding of non-school-based ICT centres for persons with disabilities, the study surveyed seven community-based centres. However, after analysing the data from the centres surveyed and recognizing that the data fell short of fully capturing the access challenges and dynamics faced by the population of persons with disabilities in the community, the study was extended to involve 180 persons with disabilities across 40 districts to understand their unique challenges. The following sections present the survey data from both community-based ICT centres for persons with disabilities and from individual persons with disabilities in the community, providing a picture of both the state of ICT centres in the community and access to ICT by persons with disabilities outside of school.

2.5 Survey of community-based ICT centres

A total of five community-based ICT centres participated in the survey, two of which had been established through the Uganda Communications Commission (UCC) and NUDIPU pilot project in Kiboga (central) and Bugweri (east) districts. The remaining centres included one access centre attached to the Gulu Union of Persons with Disabilities (north), one attached to UNAB in Kampala (central) and one postal telecentre in Arua (northwest). The limited number

of community-based centres involved in the study demonstrates the limited number of such centres overall.

Equipment in centres

The study revealed distinct differences in the type of equipment available:

- **School-based centres**: these centres predominantly used **laptops** as their core computing devices.
- **Community-based centres**: in contrast, these centres were largely equipped with **desktop computers**, likely due to cost or logistical considerations.

Dedicated centres for persons with disabilities

Among the community-based centres:

- The two centres commissioned by **NUDIPU** and **UCC**, along with the **UNAB-operated centre**, were exclusively designed to cater to users with disabilities.
- The **postal telecentres**, on the other hand, are primarily mainstream and not specifically tailored for accessibility. The study considered it necessary, however, to assess the extent to which they were accessible for persons with disabilities.

Internet connectivity

- The **NUDIPU and UCC-commissioned centres** were connected to **fixed broadband Internet**, ensuring consistent access to online resources.
- Conversely, the other centres, including the postal telecentres, **lacked Internet connectivity**, limiting their ability to remain up to date and provide comprehensive services.

Assistive technologies

- Centres specifically catering to persons with disabilities (NUDIPU and UCC-commissioned centres, the UNAB-operated centre and the Gulu District Union centre) were equipped with **assistive technologies**, such as screen readers.
- The **postal telecentres** lacked any form of assistive technology, and their administrators were unaware of **inclusive ICT practices** or the **inclusion of persons with disabilities**.

Updates and maintenance

- The **NUDIPU and UCC-operated centres** received **system updates** within the two months prior to the survey (June 2024), thanks to their Internet connectivity.
- Other centres without Internet access did not receive any updates, reflecting the **critical role of connectivity** in maintaining up-to-date systems.

Trained personnel

- Among all the centres, only the **UNAB-operated centre** had trained support personnel skilled in assisting persons with disabilities.
- The **NUDIPU and UCC-operated centres** and the **Gulu District Union centre** lacked trained staff to provide specialized support.
- None of the centres had access to a **repository of accessible digital content**, which could enhance the learning experience for persons with disabilities.

State of operation

The operational status of the centres varied widely:

- The **postal telecentres** had ceased operations over a year before June 2024, due to the **post office's inability to sustain it**.
- The **UNAB-operated centre** was not operational, as the organization was planning to repurpose the facility for **paid skills training** but had not yet registered trainees.
- The **NUDIPU and UCC-operated centres** were also not fully operational, as they were still in the process of recruiting **trained full-time staff** to support users.
- Only the centre attached to the **Gulu District Union of Persons with Disabilities** was operational, albeit without trained full-time support personnel.

2.6 Conclusion

The survey highlights significant disparities in the availability, accessibility and operational status of ICT centres, with a clear gap in support for persons with disabilities in non-dedicated centres. Addressing issues such as connectivity, assistive technologies, trained personnel and accessible content repositories is essential to ensure inclusive ICT services for users in the community. Well-equipped community-based centres are highly beneficial for persons with disabilities, both those currently in school and those who have completed their education. Persons with disabilities in schools eventually transition out of the school system and will need continued access to ICT services to remain productive and socially included in their communities.

Persons with disabilities in schools generally have **better access to ICT** compared to those outside the school system. Even though investing in more ICT infrastructure would be beneficial, their main challenges are **limited Internet connectivity** and the lack of **accessible digital content** to support their educational needs.

In stark contrast, persons with disabilities who are out of school face **extremely limited access to ICT**, as there are very few centres specifically designed to meet their accessibility requirements. The postal telecentres, for example, lack any **inclusion strategies or approaches** to ensure that persons with disabilities are accommodated. This creates a significant barrier to ICT access and further marginalizes persons with disabilities outside the education system.

To fully appreciate the fullness of the access challenges of persons with disabilities in the community and understand the implication of those access challenges, the study surveyed persons with disabilities across 40 districts. The next section shares details on this level of access to ICT.

Respondents were prompted to indicate the ICT devices they had access to, with the following results. A significant portion of respondents (52 per cent) reported having no access to any ICT devices, including feature phones, smartphones etc., underscoring the critical need for improved digital accessibility and affordability. Smartphones, one of the most common ways people access information services, were only accessible to 4 per cent of respondents. This is lower than the national average of 16 per cent. This gap in device ownership is a substantial barrier to digital inclusion and warrants targeted interventions to bridge the digital divide.

3 Challenges in accessing ICT devices

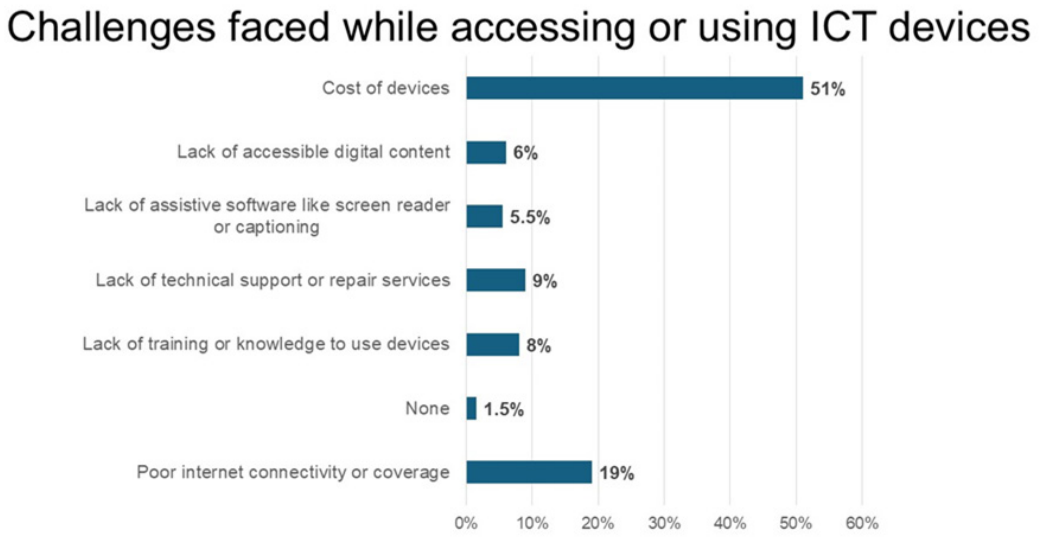
Respondents identified several challenges that impede their access to ICT devices, in order to show how serious those challenges are. They were asked to each pick one factor they thought was the most pressing barrier. Table 1 and Figure 5 share insights into these challenges.

Table 1: Challenges faced while accessing or using ICT devices

Challenge	Identified by percentage of respondents
Cost of device	51%
Poor Internet connectivity or coverage	19%
Lack of technical support or repair service	9%
Lack of training or knowledge on how to use devices	8%
Lack of accessible digital content	6%
Lack of assistive software, e.g. screen reader or captioning	5.5%
None	1.5%

Source: Project survey

Figure 5: Challenges faced while accessing or using ICT devices



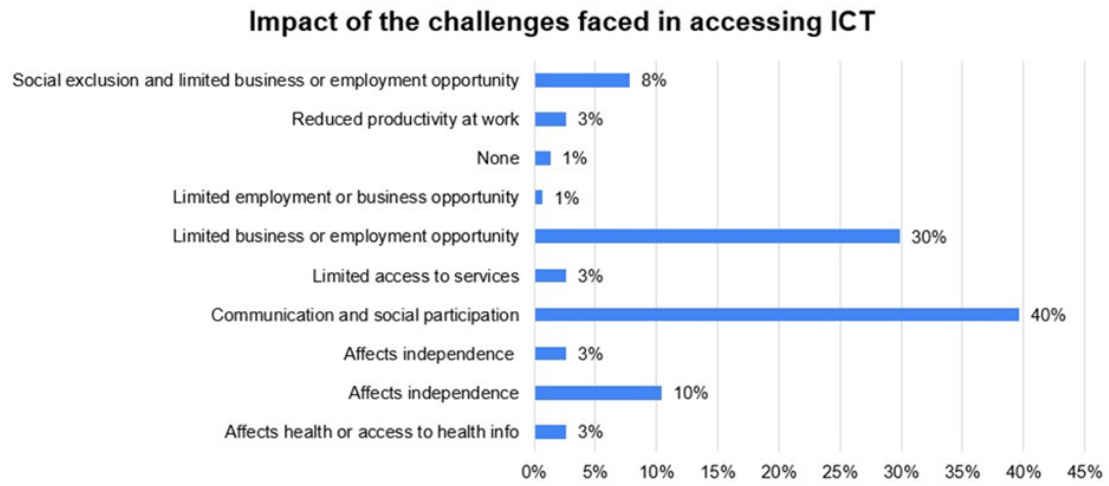
Source: Project survey

The cost of devices emerged as the most significant barrier, with over half of the respondents citing it as their primary challenge. This finding highlights the need for affordable ICT solutions and support services to enhance digital inclusion among persons with disabilities.

Considering the impact of challenges faced, respondents were asked to identify what they considered the most significant impacts of being unable to fully access ICT. The most frequently cited concern was the impact on communication and social participation, reported by 40 per

cent of respondents. This was followed by concerns over limited business and employment opportunities, which were highlighted by 30 per cent of respondents. These findings underscore the critical role of ICT in enabling social inclusion and economic participation for persons with disabilities.

Figure 6: Impact of limited access to ICT



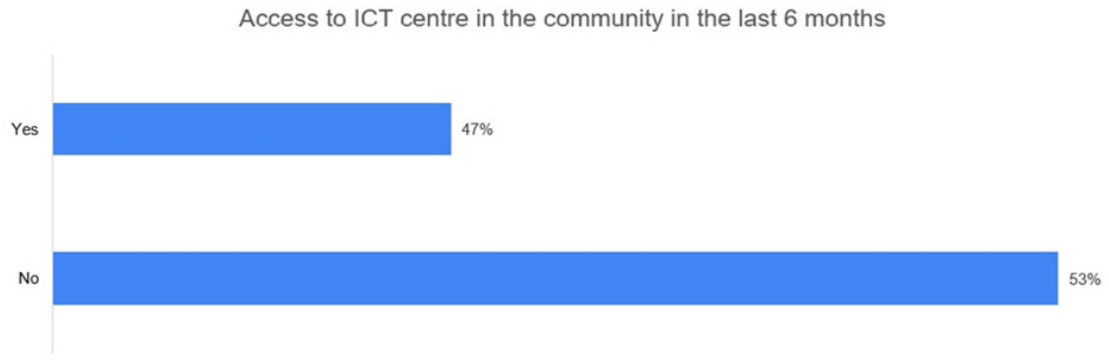
Source: Project survey

The data suggests that the impact of limited access to ICT services is profound, limiting both economic and social participation. Improved access to ICT could enhance communication, increase social inclusion and expand economic opportunities for persons with disabilities.

3.1 Access to ICT centres in the community

Regarding access to ICT centres, 47 per cent of respondents reported having visited an ICT access centre in the past three to six months, while 53 per cent had not visited any access centre. The types of ICT centres visited include computer labs connected to schools, postal telecentres, community learning centres and Internet cafes, see Figure 7.

Figure 7: Access to ICT centre in the community in the last six months



Source: Project survey

3.2 Challenges that persons with disabilities encounter at ICT centres

Respondents were asked about the challenges they faced when visiting ICT centres. Respondents identified several challenges faced when visiting ICT centres, including:

- high cost of service;
- poor Internet connectivity or slow speeds;
- lack of accessible software or assistive technology;
- limited or unavailable personnel knowledgeable in support for persons with disabilities;
- inaccessible physical environments (e.g. no ramps, narrow doorways); and
- social stigma or discrimination.

These findings indicate that even when persons with disabilities access ICT centres, in particular those that are not tailored to the access needs of persons with disabilities, they face significant barriers that limit their ability to utilize the services provided in these centres.

3.3 Most desired ICT service or provision

When asked what ICT services or provisions would most improve their access needs, respondents prioritized:

- improved access to the Internet;
- improved access to assistive technology;
- disability-inclusive ICT centres;
- training on ICT utilization;
- accessible digital content; and
- accessible online learning platforms.

3.4 Survey findings of persons with disabilities in the community

The findings of this survey underscore the significant challenges faced by persons with disabilities arising from poor access to ICT. While school-based centres provide comparatively better access than community-based centres, their facilities still require strengthening in key areas, including:

- increased availability of devices and improved Internet connectivity and speeds;
- skills training for teachers and support personnel, equipping them to better assist learners with disabilities; and
- most critically, the need for a comprehensive programme to provide accessible digital content cannot be overstated.

In contrast, the community setting reveals an alarming gap, with virtually no functional ICT centres tailored to the unique access needs of persons with disabilities. This highlights the urgent need for foundational interventions, such as building dedicated ICT centres, providing Internet connectivity and delivering skills training for both users and support personnel.

3.5 Recommendations

To address these challenges, it is beneficial to develop a cohesive national ICT programme aimed at improving ICT access for persons with disabilities. This programme could be spearheaded by the Ministry of ICT and National Guidance in collaboration with key stakeholders in the ICT-for-persons-with-disabilities ecosystem. The programme would have two main components: school-based initiatives and community-based initiatives.

For school-based initiatives, the following considerations should be made:

- **Extend Internet Access:** Leverage the **NBI** to connect schools that are inclusive of persons with disabilities and persons with specific needs to reliable high-speed Internet. The NBI, with its extensive optical fibre network, provides a cost-effective opportunity to extend Internet access, in particular to underserved areas. Schools connected to the NBI can be further equipped with wireless infrastructure for seamless student and teacher access.
- **Develop a digital content repository:** Develop an ongoing, robust digital repository for curriculum content, managed by a central production and administration unit. The repository should include tools for **collaboration**, **remote learning**, **cloud-based reading and multiple book playback capabilities**, ensuring compatibility with assistive devices and formats such as Braille, audio and large print. This will ensure that all schools are connected to this platform.
- **Collaborate on content curation:** Collaborate with key education stakeholders, including:
  - Ministry of Education and Sports;
  - Instructional Materials Unit;
  - National Curriculum Development Centre (NCDC); and
  - Department of Special Needs and Inclusive Education.

These stakeholders should support the curation of accessible content for persons with disabilities.

- **Establish skills training for teachers:** Establish a **skills training programme** for teachers, enabling them to support learners with various disabilities effectively. Special emphasis should be placed on learners with **intellectual and developmental disabilities and** learners with **hearing impairments**.

For community-based initiatives, the following considerations should be made:

- **Establish additional dedicated community ICT access centres:** Establish **dedicated community access ICT centres for persons with disabilities** in key regional districts: Gulu (north); Kampala (central); Mbale (east); and Mbarara (west). These locations already have access to the NBI and relatively reliable electricity supply, ensuring foundational infrastructure for such centres.
- **Provide reliable Internet connectivity:** Equip all centres with **reliable broadband Internet connectivity**, leveraging the NBI to ensure cost-effectiveness.
- **Provide assistive technology:** Install **comprehensive assistive technology** that caters to all types of disability from the outset, ensuring inclusivity for visual, auditory, physical and cognitive impairments.
- **Integrate with the national ICT platform:** Link all community centres to the **national digital content platform**, ensuring access to the same resources as those available in schools.
- **Establish a trustee body for negotiation and advocacy:** Form a **trustee body** to lead negotiations with publishers and oversee accessible content production. This trustee body should include representatives from: various **ministries** (ICT and National Guidance, Education, Gender, Labour and Social Development); **disability organizations**, such as

UNAB, and associations for deaf persons and persons with physical disabilities. The trustee body should be registered as an **authorized entity** to manage copyright permissions for accessible materials.

- **Maintain a repository of resources for persons with disabilities:** Maintain an **ongoing directory of resources** for persons with disabilities, including accessible educational materials; assistive devices and technology guides; services for adaptive skill-building; and vocational training opportunities. Encourage disability-focused organizations to link their resource portfolios to the platform, creating a **one-stop hub for all resources** relevant to persons with disabilities.
- **Provide awareness-raising and training for service providers:** Conduct **awareness-raising and training** for service providers (e.g. television, Internet, telecommunications) in order to improve their understanding of the needs of persons with disabilities, promote **inclusive service design** and ensure compliance with accessibility standards in their offerings.

Conclusion

This programme represents a comprehensive, unified approach to addressing the ICT access challenges faced by persons with disabilities in schools and communities. By leveraging existing infrastructure, such as the NBI, fostering collaboration among stakeholders and prioritizing inclusivity, this initiative can bridge the digital divide and empower persons with disabilities to participate fully in education, work and society.

Upon identifying data gaps after analysis of both quantitative and qualitative data, the study implemented site visits to physically assess a total of four district unions to appreciate the state of access and readiness of district unions to support implementation of community-based ICT access programmes.

4 Ecosystem analysis for pre-feasibility study of rolling out an integrated ICT system for persons with disabilities

The second phase of the project involved conducting an ecosystem analysis to determine the feasibility of implementing the national ICT platform and model ICT learning centre on a large scale. This phase considered demand analysis and the technical, legal and financial dimensions of feasibility. The key analytical steps are: demand analysis, technical, legal and administrative feasibility and risk analysis.

For the feasibility component of this assignment, it was explored how feasible it is to roll out an integrated national ICT system for learning centres for persons with disabilities. For the purpose of this study, the concept of an integrated national ICT system is understood as a cohesive national ICT repository and software platform for improving access to digital resources and content, with the following components: an ongoing centralized repository of accessible digital content; and a software platform for interconnecting the learning centres and for accessing the ongoing repository.

4.1 Demand analysis

The demand for inclusive ICT solutions for persons with disabilities in Uganda is evident from the challenges and gaps highlighted in the survey of ICT centres and community members. School-based ICT centres, while relatively better equipped, face significant limitations in infrastructure, assistive technologies and Internet connectivity. Community-based centres, on the other hand, are largely underdeveloped, with most lacking the necessary equipment, connectivity and trained personnel to support persons with disabilities effectively. Additionally, a large proportion of persons with disabilities have no access to ICT devices or inclusive content, underscoring the urgent need for a comprehensive intervention to bridge this digital divide.

Key findings

Findings reveal critical gaps in access, digital content availability and skills training. In school-based ICT centres, the availability of functional computers and assistive technologies varies significantly, with many centres unable to meet the needs of learners with intellectual or developmental disabilities. Internet connectivity is either unavailable or unreliable, further restricting the potential of these centres to deliver digital content and services effectively. Community-based centres show even greater disparities, with most centres lacking operational capacity owing to limited resources, absence of assistive technologies and poor Internet access.

Among persons with disabilities in the community, 52 per cent have no access to ICT devices, with only 4 per cent owning smartphones—far below the national average. This lack of devices is compounded by the absence of accessible digital content repositories, outdated materials and inadequate training for both users and centre staff. The demand for reliable Internet, disability-inclusive centres and digital skills training emerged as priority needs, with many respondents emphasizing the critical role of ICT in enhancing social and economic participation.

Implications of findings

The findings highlight a pressing need to establish inclusive ICT access centres that address the unique needs of persons with disabilities. These centres must be equipped with assistive technologies, reliable Internet and accessible content repositories. The limited availability of

accessible digital content further underscores the importance of developing and maintaining a centralized repository that supports diverse disabilities and ensures up-to-date resources. Additionally, the widespread lack of ICT literacy among persons with disabilities and staff necessitates robust training programmes to empower users and enhance the operational capacity of access centres. Without addressing these gaps, the potential of ICT to bridge social and economic divides for persons with disabilities will remain unrealized.

Conclusion

The demand for inclusive ICT solutions in Uganda is both substantial and urgent, in particular in the areas of access centres, digital content and training. By establishing well-equipped and accessible ICT centres, creating robust content repositories and implementing targeted training programmes, the programme can significantly enhance the ability of persons with disabilities to participate fully in education, employment and social life. This initiative will not only address existing gaps but also align with Uganda's broader goals of digital transformation and inclusivity.

4.2 Technical design

An assessment of existing ICT infrastructure and broadband penetration in learning centres for persons with disabilities was conducted, drawing on both quantitative survey data and qualitative interview findings.

This feasibility report evaluates the technical viability of establishing the proposed integrated ICT platform for persons with disabilities in Uganda. Based on an assessment of the country's connectivity landscape, electricity, access technology ecosystem and infrastructure capabilities, it is clear that the initiative is feasible with the following considerations and recommendations.

The scope of this section encompasses the two primary components of the required design, that is an integrated national ICT platform for learning centres for persons with disabilities and a model ICT-enabled learning centre for persons with disabilities. The design will focus on data management, security, accessibility and interoperability to ensure seamless operation and service delivery while the design of the model learning centre will focus on physical infrastructure, accessibility features and integration of assistive technologies. The integrated national ICT platform will link multiple learning centres across Uganda.

4.3 Financial feasibility

A cost-benefit analysis (CBA) was conducted to compare alternative strategies, such as government-led, public-private partnership (PPP) and mixed funding models, for ensuring the financial sustainability of the proposed ICT systems.

The financial feasibility analysis evaluates the cost implications of establishing ICT access centres, developing digital content and building the integrated national platform for persons with disabilities. This section explores both the projected capital and operational expenditures, funding models and potential financial risks, while outlining the sustainability and scalability of the proposed project.

The financial feasibility of the proposed solution is sound. It hinges on securing the necessary funding and ensuring its effective allocation across various components. The estimated budget for the first five years is approximately USD 1 700 400. This includes costs for building

modifications, assistive technology procurement, equipment for content creation, platform development, training and awareness campaigns. See **Annex 2** for a breakdown of costs.

4.3.1 Funding model option analysis

List of alternative strategies

To achieve the project's goal of improving ICT access for persons with disabilities, the following alternative strategies are considered:

Option 1: Full government-led implementation

In this approach, the government will lead the project, providing all necessary funding, infrastructure and training resources. The Ministry of ICT and National Guidance would be the primary implementer, working with other relevant ministries and government agencies to ensure the rollout of ICT infrastructure and services for persons with disabilities.

Option 2: Public-private partnership

This approach combines government efforts with private sector involvement. The private sector could provide funding, technology and infrastructure support, while the government sets policy guidelines and ensures accessibility standards are met. A PPP model could encourage innovation and bring additional resources through private investment. However, the private sector often views investment in disability-related infrastructure as commercially unviable due to the perceived nexus between disability and poverty.

Option 3: Private sector-led initiatives with government oversight

In this strategy, private companies would take the lead in developing accessible ICT solutions, with government oversight to ensure regulatory compliance. The private sector would focus on deploying technology solutions, while the government facilitates regulatory frameworks, tax incentives and ensures equitable distribution to persons with disabilities.

Option 4: Phased implementation with mixed funding models

This strategy would involve a phased approach where the project is implemented in stages, using a combination of government funding, international grants and private sector contributions. The phased nature allows for flexibility and adjustments based on outcomes of earlier stages.

4.3.2 Comparison of alternatives (multi-criteria analysis)

Five key criteria were used to assess the options: technical feasibility, environmental impact, legal and administrative considerations, cost and sustainability.

Option 1: Full government-led implementation

Advantages:

- Direct control over the project.
- Easier alignment with national priorities and development goals.
- Can be more inclusive and equitable as the government can focus on underserved areas.

Disadvantages:

- Budget constraints might limit the scope and speed of implementation.
- Bureaucratic delays may slow progress.
- Government may lack cutting-edge technology expertise compared to private firms.

Analysis: While technically feasible, the financial and administrative burden on the government could delay project rollout. Sustainability could be a challenge if the project is solely dependent on government funding.

Option 2: Public-private partnership

Advantages:

- Shares financial and operational burden with the private sector.
- Encourages innovation and efficiency from private sector involvement.
- Can access additional funding sources.

Disadvantages:

- Perceived lack of commercial viability due to the persistent association of disability with poverty may discourage private sector investment.
- Complex negotiations and agreements are required to balance interests.

Analysis: While this option offers a balanced approach, the private sector may hesitate to invest in disability-related infrastructure due to the limited commercial incentives. Although PPPs have potential, the feasibility of attracting private investment is questionable without strong incentives or guaranteed returns.

Option 3: Private sector-led initiatives with government oversight

Advantages:

- Leverages private sector expertise in technology deployment.
- Can result in faster implementation.
- Minimizes government expenditure.

Disadvantages:

- Risk of unequal distribution, with the private sector focusing on profitable regions rather than underserved areas.
- Government control is limited, potentially leading to less focus on inclusivity.

Analysis: This approach may expedite technology deployment but could overlook equitable access for persons with disabilities in rural or less profitable areas. It is a high-risk strategy in terms of ensuring accessibility for all, in particular given the private sector's reluctance to invest in disability-focused projects.

Option 4: Phased implementation with mixed funding models

Advantages:

- Flexible and adaptable approach that allows for learning and adjustments in each phase.

- Reduces initial financial burden on any one stakeholder.
- Can mobilize a wider range of funding sources, including international donors and development partners.
- Allows gradual scale-up, minimizing financial risk.

Disadvantages:

- Longer implementation timeline.
- Coordination between multiple funding sources can be complex.
- Risk of funding shortages mid-project if commitments aren't maintained.

Analysis: This option provides the most balanced and sustainable approach. By gradually implementing the project in phases and diversifying funding sources, the project can adapt to changing circumstances and secure resources from both government and international partners. This approach reduces the risk of financial strain on any one entity while ensuring that progress is made incrementally, based on lessons learned from earlier phases.

4.3.3 Cost-benefit analysis for the shortlisted options

Based on the comparative analysis, the top three options are:

- Option 1: Phased implementation with mixed funding models
- Option 2: Public-private partnership
- Option 3: Full government-led implementation

Option 1: Phased implementation with mixed funding models

Economic impact: A phased approach can lead to incremental economic benefits, allowing the project to expand based on proven success. It ensures that resources are not overextended at any one point.

Financial feasibility: This model mitigates financial risk by allowing for mixed funding from various stakeholders, including government, private sector and international donors. It also ensures that each phase can be adjusted according to financial availability.

Risk: While coordination between funders can be complex, the flexibility and adaptability of this model helps to mitigate larger risks such as underfunding or implementation delays.

Option 2: Public-private partnership

Economic impact: This model can stimulate investment in ICT infrastructure and promote job creation in the private sector, while persons with disabilities gain greater access to digital resources, enhancing their participation in the economy.

Financial feasibility: With shared costs, this option reduces the financial burden on the government, allowing for a broader scope of implementation.

Risk: The reluctance of the private sector to invest due to the perceived non-commercial viability of person with disability-focused infrastructure could result in limited participation.

Option 3: Full government-led implementation

Economic impact: Government investment can ensure equitable distribution of resources, directly benefiting the population of persons with disabilities. However, financial constraints could limit the overall impact.

Financial feasibility: High financial burden on the government may limit scalability.

Risk: Budget constraints and bureaucratic inefficiencies could delay project implementation.

4.4 Risk management

This section outlines possible risks with their impacts and potential mitigation measures to minimize potential negative risks while maximizing potential positive risks.

Risks and mitigation strategies

Risk: High initial capital costs

The initial investment required to establish the centres and procure assistive technologies is significant. To mitigate this, the project can be phased, with priority given to regions with the highest need. Additionally, partnerships with international donors and the private sector can offset some of these costs.

Risk: Technology obsolescence

Rapid technological advancements could render some of the procured equipment obsolete within a few years. To mitigate this risk, the project will focus on flexible, upgradeable technologies and long-term partnerships with assistive technology providers for regular updates. Additionally, a monitoring framework for assessing software and hardware status is required, see Annex 3 for model framework.

Risk: Sustainability of funding

There is a risk that initial funding may not cover long-term operational expenses. To address this, the project will seek diversified funding sources.

Risk: Copyright constraints for exploiting content under intellectual property and copyright protection

There is a potential risk that copyrighted materials, such as textbooks and other educational content, may pose challenges to digital content creation. However, under the Marrakesh Treaty to Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired, or Otherwise Print Disabled, which Uganda ratified in 2020, authorized entities may create and distribute accessible formats of copyrighted works for persons who are blind, have visual impairments or are otherwise print disabled without requiring explicit permission from rights holders. The challenge is that the Marrakesh Treaty, as of September 2024, has not yet been fully domesticated in Uganda. To mitigate this risk, the Ministry of ICT and National Guidance, Ministry of Gender and Uganda Registration Service Bureau (URSB) can designate a trustee as an authorized entity. This entity would be responsible for negotiating with publishers and ensuring the protection of all exploited materials and making sure that they are used only for the purposes of making those materials accessible.

4.5 Selection of the preferrable option

After weighing the economic, financial and social impacts, a hybrid of government-led phased implementation with a mixed funding model is the most viable and sustainable option. Unlike the PPP model, which may struggle to attract private sector investment owing to the perceived non-commercial viability of disability-related infrastructure, this approach allows for flexibility in sourcing funding from multiple stakeholders. This mitigates financial risks while ensuring that the project can scale progressively. It also allows the government to maintain oversight, ensuring that the needs of persons with disabilities are prioritized.

Government leadership provides direct control and alignment with national policies. The phased approach can proceed to the detailed feasibility study phase, with a focus on coordinating multi-stakeholder funding and adapting each phase based on early results.

4.6 Model ICT-enabled learning centre design

The design of the model ICT-enabled learning centre was centred on principles of accessibility, operability, perceivability and usability. It adhered to international best practices for accessible environments, aligning with G3ict and Inclusive Design Principles.

Key steps in design process

- Site surveys were conducted at various learning centres for persons with disabilities to assess existing infrastructure and identify gaps in set-up and service delivery. Additionally, district unions were visited to appreciate opportunities and challenges in relation to their readiness to provide support.
- Best practice reviews were performed, drawing on projects from UNESCO's ICT for inclusive education initiatives and accessibility frameworks such as the Americans with Disabilities Act (ADA).

Design principles

The design adhered to Inclusive Design Principles, which include:

- recognizing diversity and inclusion;
- providing equitable use and flexibility;
- simple and intuitive operation;
- perceptible information and error tolerance; and
- requiring low physical effort and ensuring appropriate space for approach and use.

Technical recommendations

Infrastructure recommendations include broadband connectivity, assistive devices and the design of ICT labs to accommodate the needs of diverse users. Engagement meetings were conducted with opinion leaders on ICT for persons with disabilities and assistive technology vendors to gather insights and feedback on system requirements. Additionally, a review of popular assistive technologies was undertaken to inform and refine the system specifications.

4.7 Integrated ICT platform

Internet infrastructure: Access to reliable Internet connectivity is critical for the integrated ICT platform to be accessible, usable and effective. A review of Uganda's connectivity landscape shows that broadband infrastructure is expanding, and leveraging existing resources, in particular the NBI, makes this initiative technically feasible.

Community-based centres: The proposed locations for community-based ICT centres, i.e. Gulu, Kampala, Mbale and Mbarara, are among the 52 districts already connected to the NBI's high-speed optical fibre network (NITA, 2023). This connectivity ensures that these centres can support digital learning and the integrated ICT platform for persons with disabilities.

Rural connectivity challenges: While urban areas are well-served by the NBI, rural areas continue to lag behind in Internet access. To address this gap, partnerships with local Internet service providers (ISPs) can help extend connectivity to schools and community centres that fall outside the current NBI coverage.

Software development feasibility: The development of a software platform that acts as a centralized repository for accessible digital content is technically feasible and can be achieved with modern software development practices and existing technologies. The proposed software platform would combine assistive technology support, remote learning tools and a cloud delivery network (CDN) for efficient content distribution.

Below is a detailed description of the system's components and technical feasibility:

a) Centralized repository and content management

The core of the platform will be a centralized repository for managing and storing accessible digital content. This repository will:

- store diverse content formats, including Braille-compatible materials, large print, audio files and multimedia resources;
- enable real-time updates and seamless integration of newly developed content; and
- provide robust content categorization and search features, ensuring easy access for users with different needs.

The repository can be built using scalable database technologies, such as relational databases (e.g. PostgreSQL, MySQL) for structured data storage and NoSQL databases (e.g. MongoDB, Firebase) for multimedia and unstructured content.

b) Front-end design

The platform's front-end will combine assistive technology support, remote learning tools and a user-friendly interface optimized for persons with disabilities. Key features include:

- **Assistive technology integration:** Support for screen readers, such as JAWS and NVDA. Keyboard navigation and compatibility with alternative input devices such as switches or Braille displays. High-contrast modes and customizable font sizes for users with low vision.
- **Remote learning tools:** Virtual classrooms with collaboration features (e.g. shared whiteboards, discussion forums). Real-time audio and video conferencing integrated with captioning and transcription services for deaf or hard-of-hearing users. Cloud-based readers with multiple playback options, including text-to-speech (TTS) functionality.

- **Accessibility compliance:** Adherence to international standards, such as Web Content Accessibility Guidelines (WCAG) 2.1, to ensure inclusivity for all users.

c) Robust back-end architecture

The back-end architecture will utilize CDNs to ensure scalable and efficient content distribution. Features include:

- **Cloud infrastructure:** Ready-to-use solutions such as Microsoft Azure, Google Cloud or Amazon Web Services (AWS) can host the repository and provide scalable computing resources. These platforms offer built-in CDN services to deliver content efficiently, regardless of user location.
- **Content delivery:** The system will use CDNs to cache content closer to end-users, reducing latency and improving download speeds.

Dynamic content can be streamed in real-time to accommodate interactive learning sessions and multimedia playback.

- **Data security and reliability:** End-to-end encryption to protect sensitive user information and content.

Automated backups and disaster recovery mechanisms to ensure system reliability and data integrity.

d) Scalability and integration

The software can be designed to scale as user demand grows. Key technical strategies include:

- Horizontal scaling: adding more servers or resources to handle increased traffic or larger content volumes.
- Microservice architecture: breaking the software down into smaller, independent modules to improve performance and simplify updates.
- Application programming interface (API) integration: integration with third-party systems, such as learning management systems (LMS) for schools. APIs for organizations in the disability ecosystem to contribute and access content seamlessly.

e) Readiness of existing technologies

The availability of mature cloud services and CDNs significantly reduces the complexity of implementing this platform. Tools such as Microsoft Azure CDN, Google Cloud CDN or AWS CloudFront can provide the backbone for content distribution, offering:

- global server networks for low-latency delivery real-time analytics for monitoring content usage and platform performance; and
- prebuilt AI tools for accessibility enhancements, such as automatic transcription or translation.

See **Annex 4** for full technical design and description for the platform.

Assistive technologies

The assistive technologies required for this project include screen readers, refreshable braille displays, speech-to-text systems and sign language interpretation technologies, see Annex 2 for details. These devices, while essential, are costly and will have to be imported. Leading assistive technology providers such as Edit Micro have representatives in Uganda to support importation of assistive technologies. IncPart Services Ltd, who are representatives of Edit Micro,

also provide maintenance support. Some local NGOs in Uganda, such as Sense International, have experience in providing and repairing assistive technologies. Sense International has also organized repair workshops, which indicates a growing local capacity to provide maintenance and troubleshooting for these devices. However, scaling this support across all four centres and more schools that are inclusive of learners with disabilities will require additional partnerships with international vendors, such as Human Ware and Freedom Scientific, both of which offer long-term service agreements.

The high costs of specialized software and hardware, mostly imported, can be mitigated by establishing partnerships with global assistive technology companies. For example, Freedom Scientific offers a country-wide licensing programme that allows governments to pay a fixed fee for nationwide access to specific assistive solutions for a minimum of five years. Such agreements can provide sustainable, long-term access to high-quality assistive technologies. The project should also focus on building local technical capacity through targeted training, ensuring devices are maintained locally and minimizing downtime due to reliance on external support.

Digital content development and platform

Creating accessible digital content in formats such as audio, EPUB and sign language video is a core component of this project. Local expertise exists in organizations such as Oysters & Pearls Uganda and private service providers such as IncPart Services Ltd, New Vintage and others.

Conclusion

The overall technical feasibility of the project is sound, but some refinements are necessary to align with international best practices. Key recommendations include a hybrid energy solution (power grid + solar), last-mile connectivity strategies, local capacity building for the maintenance of assistive technologies, bulk purchasing agreements to reduce costs and adherence to international accessibility standards, such as WCAG 2.1. Additionally, ensuring long-term financial sustainability through global licensing agreements and investment in local content development capacity will be critical for the success of this initiative.

5 Model ICT learning centre for persons with disabilities

This section is a comprehensive guide for the development of an ICT-enabled learning centre to accommodate persons with disabilities in Uganda. The centre will be designed in such a way that it will be compatible with the integrated national ICT platform that will connect and support learning centres across the country. The ultimate goal is to ensure that persons with disabilities have equitable access to ICT education and resources, empowering them to participate fully in the digital economy and society. The guidelines referenced above are designed to ensure that these centres are not only physically accessible but also equipped with the necessary technologies and resources to support a diverse range of disabilities.

Legal and administrative feasibility

An analysis of Uganda's legal instruments and ICT policy landscape was performed to evaluate existing legal frameworks supporting inclusion of persons with disabilities. Uganda's legal and policy framework provides a solid foundation for promoting digital inclusion for persons with disabilities, and there is a solid legal basis for a national ICT system. The 1995 Constitution, under Article 21, mandates the right to equality and freedom from discrimination, explicitly recognizing the need to protect marginalized groups, including persons with disabilities. Moreover, Article 35 of the Constitution further guarantees the rights of persons with disabilities, requiring the state to take affirmative action to address their needs. Finally, Article 41 asserts every citizen's right to access information, a critical legal basis for ensuring that digital content is provided in accessible formats for persons with disabilities. These constitutional provisions form the legal bedrock for the development of inclusive ICT infrastructure, content and services in Uganda.

Uganda has also made significant strides in policy development, with frameworks such as the Digital Transformation Roadmap and the Digital Uganda Vision prioritizing inclusivity for marginalized groups, including persons with disabilities. These frameworks emphasize the need for equitable access to digital services and infrastructure. However, the ICT for disability policy, which would provide more detailed guidance on making assistive technologies affordable and accessible, is still in draft form. This creates a legal gap that could affect the project's full-scale implementation, in particular in terms of compliance with accessibility standards and affordable access to assistive technologies.

Uganda also ratified the United Nations Convention on the Rights of Persons with Disabilities (CRPD) on 25 September 2008, thereby committing to uphold the rights of persons with disabilities in all aspects of life, including access to ICT. The CRPD provides a robust framework to support initiatives like this project, in particular through its specific articles that emphasize accessibility and inclusion.

Article 9 of the CRPD addresses accessibility, mandating that States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis to others, to information and communications, including ICT and ICT systems, and to other facilities and services open or provided to the public, both in urban and rural areas. It also requires that States Parties take appropriate measures to develop, promulgate and monitor the implementation of minimum standards and guidelines for the accessibility of facilities and services open or provided to the public. This directly supports the project's goals of providing accessible ICT infrastructure and assistive technologies.

Article 21 of the CRPD focuses on freedom of expression and opinion, and access to information, urging governments to take measures to ensure that information intended for the general public is provided in accessible formats and technologies appropriate for various disabilities. It specifically calls for the promotion of ICT accessibility for persons with disabilities, including accessible formats such as braille and sign language, which align with the project's content digitization and distribution plans.

Additionally, Uganda is a signatory to the Marrakesh Treaty, which it ratified in 2018. This treaty aims to facilitate access to published works for persons with print disabilities. However, the full domestication of this treaty remains incomplete, with the Copyright and Neighbouring Rights Act requiring amendments to create exceptions for the production of accessible content. This gap may delay the development and distribution of digital content in accessible formats, such as audio and braille.

Data privacy and security

Given the nature of the proposed integrated ICT platform, data privacy and security are paramount. The platform will collect personal information from students with disabilities, their teachers and persons with disabilities in the community, which must be protected in compliance with Uganda's Data Protection and Privacy Act (2019).

According to Section 2 of the Act, personal data must be collected lawfully, processed fairly and used for explicit, legitimate purposes. Section 24 mandates that organizations handling personal data implement appropriate technical and organizational measures to ensure data security, including protection against unauthorized access, accidental loss or destruction.

Additionally, Section 9 emphasizes the importance of obtaining the data subject's consent prior to data collection and sharing, while Section 25 outlines the obligation to store data securely, using mechanisms such as encryption and restricted access protocols.

To enhance credibility and ensure compliance with global best practices, the platform should also align with provisions of the General Data Protection Regulation (GDPR), in particular Article 5, which outlines principles of data processing, and Article 32, which requires the implementation of appropriate technical and organizational measures to secure personal data.

Implementing these safeguards—such as data encryption, secure login systems and user consent protocols—will not only fulfil the legal obligations under Uganda's Data Protection and Privacy Act but also build trust among users and stakeholders. Ensuring compliance with both national and international standards demonstrates a commitment to handling user data with the highest level of integrity and security.

Accessibility standards and copyright compliance

Both the physical access centres and the integrated ICT platform must adhere to international and national accessibility standards. WCAG 2.1 will guide the design and functionality of the platform, ensuring that persons with disabilities can access its resources with ease, regardless of their disability. Monitoring compliance will involve periodic audits and feedback from users to address any usability issues.

For digital content, copyright implications must be carefully considered. The Marrakesh Treaty allows for the creation and distribution of accessible formats of copyrighted works, but Uganda's current copyright laws need further alignment with this treaty to ensure compliance. Ensuring that all content on the platform is either licensed or falls under copyright exceptions will be key to avoiding legal conflicts. The platform should establish mechanisms for obtaining permissions from content creators when necessary and for ensuring that intellectual property rights are respected.

Conclusion

The inclusive ICT solution project has a strong legal basis, and all its specific components have sufficient legal support. Inclusion of persons with disabilities is enshrined in the 1995 Constitution and the country's development frameworks, including the Digital Uganda Vision, the Digital Transformation Roadmap and NDP III, which all provide legal support for inclusion of persons with disabilities. In terms of data privacy, Uganda's Data Protection and Privacy Act (2019) provides a strong legal foundation for safeguarding the personal information of users, while the expanding availability of data encryption technologies offers robust tools to ensure compliance with data privacy standards. Modern encryption solutions, such as Advanced Encryption Standard (AES) and end-to-end encryption protocols, can be integrated into the platform to protect sensitive data during storage and transmission. These technologies are widely available and cost-effective, making them feasible for implementation on the platform.

The platform's potential to negotiate licensing agreements with publishers for accessible content is also legally viable. While Uganda is a signatory to the Marrakesh Treaty, which facilitates access to published works for persons with disabilities, its full domestication into national law would greatly strengthen the legal framework for producing and sharing accessible materials. Until full domestication is achieved, strategic partnerships with publishers and registration of the trustee body as an authorized entity under the treaty provisions can enable the legal production and distribution of accessible materials. This approach is aligned with the treaty's objective of reducing barriers to access for persons with disabilities.

In addition to leveraging Uganda's supportive legal framework, international standards such as the GDPR can enhance the platform's credibility and compliance, especially in areas where cross-border collaboration may be necessary.

Additionally, finalizing and operationalizing the ICT for disability policy will provide a comprehensive legal framework to support the platform's long-term sustainability and scalability.

Accessible licensing framework

The Ministry of ICT and National Guidance, Ministry of Education and URSB can work together to establish clear guidelines for negotiating licensing agreements with publishers, supported by legal provisions under the Marrakesh Treaty. This can include agreements for digital libraries and repositories.

Legal awareness and capacity building

The Ministry of ICT and National Guidance can partner with the Attorney General's office, which is sufficiently aware of the Marrakesh Treaty, to conduct training for platform administrators, content creators, publishers and other stakeholders in order to ensure full understanding and

compliance with provisions of the Marrakesh Treaty and the Data Protection and Privacy Act and relevant international standards.

By addressing these legal considerations, the integrated ICT platform for persons with disabilities would not only become feasible but likely a significant driver of inclusive digital transformation in Uganda. The combination of modern encryption technologies, supportive legal frameworks and strategic partnerships ensures the platform's scalability, sustainability and alignment with national and global objectives for digital inclusion.

6 National ICT platform for interconnectivity across learning centres for persons with disabilities

To facilitate interconnectivity across learning centres for persons with disabilities, the project proposed the development of a national ICT platform. This platform would support the sharing of digital content, training resources and communication tools, connecting person with disability learners, educators and institutions across Uganda.

Platform functionality scope design recommendation process

- A system analysis was conducted to assess the technological requirements of existing learning centres for persons with disabilities.
- Engagement meetings were conducted with opinion leaders on ICT for persons with disabilities and assistive technology vendors to gather insights and feedback on system requirements. Additionally, a review of popular assistive technologies was undertaken to inform and refine system specifications.
- The platform recommendations were designed using modular components, ensuring scalability and future enhancements. The design also adhered to WCAG 2.1 to ensure inclusivity.

Security and usability considerations

The platform follows ISO/IEC 27001 standards to ensure data security and protect user confidentiality, ensuring compliance with global best practices.

Ethical considerations

The study adhered to international ethical guidelines, including the United Nations ethical guidelines on research involving persons with disabilities and the Belmont Report (National Commission, 1979). Informed consent was obtained from all participants and their confidentiality was protected throughout the study.

Budgetary estimate

The budget estimate for the inclusive ICT solutions programme spans a five-year period and outlines the financial requirements for establishing and operationalizing ICT-enabled learning centres for persons with disabilities. The budget accounts for the development and equipping of four centres: the pilot centre in Gulu, followed by additional centres in Mbale, Kampala and Mbarara. Key cost components include structural modifications such as ramps and accessible restrooms, procurement of assistive technologies, such as screen readers, refreshable braille displays and adaptive keyboards, and essential equipment such as computers and large monitors. The estimate also covers the development and maintenance of a centralized integrated ICT platform, cloud storage services and training for content management.

Recurring costs include salaries for digitization specialists, professional development for centre staff and media campaigns to raise awareness of the programme. The total estimated expenditure is approximately USD 1.7 million over the five years, with annual allocations supporting ongoing content development, system updates and scaling efforts to ensure the programme's sustainability and alignment with the needs of persons with disabilities across Uganda.

See **Annex 2** for the full budget estimate

Implementation plan

The implementation plan for the inclusive ICT solution programme is structured over a five-year period, utilizing a phased approach to ensure systematic rollout, evaluation and scalability. The plan begins with a pilot phase in Gulu, where a model ICT-enabled learning centre will be established to test the integrated ICT platform and validate workflows. Following this, the second phase introduces a regional centre in Mbale, incorporating lessons learned from the pilot phase to refine operations. The final phase expands to Kampala and Mbarara, achieving national coverage and enhancing accessibility for persons with disabilities.

See **Annex 5** for an implementation plan.

Limitations

- **Sample size:** While the survey provided valuable insights, expanding the sample size, in particular at the community level, would strengthen the generalizability of the findings.
- **Data collection challenges:** Accessibility barriers presented challenges, in particular for the deaf community, as some participants preferred to work with their own interpreters, instead of the interpreters made available by the study team.

7 Recommendations

Based on the findings from this pre-feasibility study, the following recommendations outline the necessary actions to ensure the successful implementation of the inclusive ICT solution programme tailored to the needs of persons with disabilities.

1) **Phased implementation strategy**

- **Recommendation**: To mitigate high initial capital costs and reduce risk, the project should be implemented in phases, starting with regions most in need. This allows for the gradual scaling of the project while gathering data on operational success and challenges. Early phases should focus on areas where infrastructure and stakeholder capacity are already partially developed.
- **Best practice reference:** The World Bank's infrastructure project phasing guidelines suggest that large-scale initiatives like this should adopt a phased rollout to ensure adaptability and reduce project risks, in particular in regions with varying levels of infrastructure readiness (World Bank, 2020).

2) **Development of local expertise**

- **Recommendation:** Prioritize the training and development of local technicians and staff to maintain and repair assistive technologies. Building local expertise will reduce reliance on external vendors and ensure long-term sustainability. Some capacity already exists at Sense International Uganda and All We See Is Possibility.
- **Best practice reference:** ITU's Connect2Develop initiative emphasizes the importance of building local capacity to support the operation and sustainability of ICT solutions, in particular in rural and underserved areas (ITU, 2021).

3) **Integration of emerging technologies**

- **Recommendation:** Incorporate artificial intelligence (AI) solutions and cloud-based technologies into the integrated platform for better scalability and adaptability. AI tools, such as real-time TTS and speech recognition software, can be integrated to improve accessibility for persons with disabilities, in particular those with visual or hearing impairments. Additionally, open AI APIs are readily available for powerful language models such as GPT4. The Makerere University AI lab initiative to create TTS voices in five local languages should be leveraged.
- **Best practice reference:** ITU's AI for Good programme advocates the use of AI-driven solutions to tackle accessibility challenges, including the development of local language TTS tools (ITU, 2022).

4) **Legal and policy alignment**

- **Recommendation:** Ensure that the project is fully aligned with the legal frameworks that protect the rights of persons with disabilities, including the CRPD and Marrakesh Treaty; and advocate for the full domestication of the Marrakesh Treaty and finalize the draft ICT for disability policy in order to facilitate the legal basis for producing and distributing accessible digital content. As of September 2024, URSB is working with the Attorney General's office to draft the text for exceptions for the Copyright and Neighbouring Rights Act (2006). Additionally, relevant ministries including the Ministries of ICT and National Guidance, Education, Gender, Labour and Social Development should work to form an alliance in order to create an authorized entity that will be a trustee negotiator with publishers and rights holders.
- **Best practice reference:** CRPD and WIPO emphasize the role of national governments in removing legal barriers to accessibility by fully integrating international treaties and conventions into local law (WIPO, 2020).

5) **Monitoring and evaluation**

- **Recommendation:** Implement a robust monitoring and evaluation (M&E) framework that tracks project performance metrics in areas such as person-with-disability engagement, digital literacy and technology use. This will enable continuous improvements in the platform and services offered.

6) **Content localization and development**

- **Recommendation:** Focus on the development and localization of digital content tailored to the needs of persons with disabilities in Uganda. This includes creating accessible formats such as braille, sign language videos and other alternative formats for accessibility.
- **Best practice reference**: The UNESCO ICT Competency Framework for Teachers highlights the importance of developing localized content for marginalized groups in order to promote inclusive education (UNESCO, 2019).

7) **Sustainability and long-term maintenance**

- **Recommendation**: Design sustainability models that incorporate ongoing financial support through government funding, local community contributions and income-generating activities (e.g. offering ICT training services to the broader community).
- **Best practice reference:** The World Bank advocates for the inclusion of sustainability models in ICT projects by embedding local ownership and diversifying revenue streams to ensure long-term viability (World Bank, 2020).

Next Steps

Stakeholder engagement: Begin a stakeholder engagement process, including consultations with government agencies, NGOs, private sector players and organizations for persons with disabilities in order to refine project proposal and secure commitments.

Pilot phase: Launch a pilot phase in one or two regions to test the ICT skilling, access centre and digital content creation components. The pilot phase will provide insights into operational challenges and help refine the model before nationwide implementation.

Funding proposal development: Develop a comprehensive funding proposal based on the recommendations and projected financial needs, targeting international donors, local private sector entities and government agencies.

Policy advocacy: Advocate for the fast-tracking of the ICT for disability policy and the full implementation of the Marrakesh Treaty in order to ensure legal compliance and support for the project.

These recommendations and next steps are designed to ensure that the project is implemented efficiently, sustainably and in line with international best practices, while maximizing the impact on the community of persons with disabilities in Uganda.

Annex 1: List of schools that participated in the interview

Table 2: List of schools that participated in the interview

School name	Type of school	Type of Ownership	District	Region
Apo Army P/S	Inclusive	GA	Yumbe	North
Hassan Tourabi P/S	Inclusive	GA	Kira Municipality	Central
Agola P/S	Inclusive	GA	Tororo	East
Agururu	Inclusive	GA	Tororo	East
Angal Girls P/S	Inclusive	GA	Nebbi	North
St.Charles Lwanga Bukerere	Inclusive	GA	Mukono	Central
Martin Nkoyoyo Inclusive P/S	Inclusive	PO	Mukono	Central
St. Hellens P/S	Inclusive	GA	Mbarara	West
Kamurasi Demonstration School	Inclusive	GA	Masindi	West
Misanvu Dem. Sch	Inclusive	GA	Bukomansimbi	Central
Magale Girls Boarding P/S	Inclusive	GA	Namisindwa	East
Kangole Boys P/S	Inclusive	GA	Napak	East
St. Mary Goreti Ngetta Girls	Inclusive	GA	Lira	North
Kisoro Dem. School	Inclusive	GA	Kisoro	West
Kitgum Girls P/S	Inclusive	GA	Kitgum	North
Kapchorwa Dem. Sch	Inclusive	GA	Kapchorwa	East
Kiwolera Army P/S	Inclisve	GA	Kamuli	East
Hornby Junior School	Inclusive	GA	Kabale	West
Spire Road P/S	Inclusive	GA	Jinja City	
Buckley High	Inclusive	GA	Iganga	
Gulu P/S	Inclusive	GA	Gulu	
Gulu Prison P/S	Inclusive	GA	Gulu	
Laroo P/S (Adraa)	Inclusive	GA	Gulu	
St. Ludovico's P/S Kitana	Inclusive	GA	Hoima	
Ikwera P/S	Inclusive	GA	Kwania	

Table 2: List of schools that participated in the interview (continued)

School name	Type of school	Type of Ownership	District	Region
Waluwerere P/S	Inclusive	GA	Bugiri	East
Kireka Home	Special School	GA	Kira	
Nancy P/SFD	Special School	GA	Lira	
Masaka Sch. for SNE	Special School	GA	Masaka	
St. Francis P/S FB Madera	Special School	GA	Soroti City	
Mulago school for the deaf	Special School	GA		
Mvara SS	Inclusive	GA	Arua	
Gulu High	Inclusive	GA	Gulu	
Hornby High School	Inclusive	GA	Kabale MC	
Saad Memorial S.S	Inclusive	GA	Kasese	
Bonconcil SS	Inclusive	P	Isingiro	
Sir Apolo Kagwa Nazigo S.S	Inclusive	GA	Mukono	
Iganga S.S	Inclusive	GA	Iganga	
Mbale secondary School for the deaf	Special School	GA	Mbale	
Wakiso SSFD	Special School	GA	Wakiso	
St. Francis SSFB Madera	Special School	GA	Soroti City	

Annex 2: Budgetary estimate

The following tables share different aspects of the necessary budget to implement the project.

Table 3: Building modifications and assistive technology procurement

Item description	Unit cost, USD	Number of units	Number of centres	Frequency	Total for 5 years, USD	Remarks
1. Structural modifications (including ramps, wide doorways, accessible restrooms)	15 000	1	4	1	60 000	Includes the cost of installing ramps, widening doorways and modifying restrooms to make them fully accessible for persons with disabilities.
2. Height-adjustable desks	1 000	10	4	1	40 000	Desks can be adjusted to accommodate users in wheelchairs or those who prefer to stand while working.
3. Screen readers (JAWS)	1 000	10	4	1	40 000	Screen readers allow blind users to navigate and interact with digital content using audio feedback.
4. Screen magnifiers (ZoomText)	600	10	4	1	24 000	Screen magnifiers help low-vision users by enlarging screen content and adjusting colour contrast.
5. Refreshable Braille displays (Brilliant BI)	3 500	5		1	70 000	Devices convert digital text into Braille, allowing blind users to read tactilely.
6. Braille production tools	5 700	2	4	1	45 600	Tools for converting digital text into Braille and printing Braille documents.
7. Portable OCR cameras	1 500	5	4	1	30 000	Devices convert printed text into audio output, making printed materials accessible to blind users.

Table 3: Building modifications and assistive technology procurement (continued)

Item description	Unit cost, USD	Number of units	Number of centres	Frequency	Total for 5 years, USD	Remarks
8. Real-time captioning software (Ava)	500	5	4	1	10 000	Software provides live captioning for audio content, making it accessible to deaf users.
9. Visual alert systems	1 000	5	4	1	20 000	Alert systems use visual cues, such as flashing lights, to notify deaf users of important information.
10. Adaptive keyboards and mice	300	15	4	1	18 000	Ergonomic and adaptive input devices designed for users with limited dexterity or other physical impairments.
11. Computers	1 200	15	4	1	72 000	High-end computers capable of running multiple assistive technologies simultaneously and with large enough storage capacity for multimedia content, productivity and assistive software.
12. Large monitors	300	15	4	1	12 000	Stand-alone screens to support low-vision users with amplified content and higher zoom power.
Total					**441 600**	

Table 4: Equipment and tools for accessible digital content creation and management

Item description	Unit cost, USD	Number of units	Frequency	Total for 5 years, USD	Remarks
1. High-resolution scanners and OCR software for centralized digitization hub	2 200	4	1	8 800	High-resolution flatbed scanner paired with an easy-to-use, disability-friendly OCR (Kurzweil) function for converting hard-printed materials into electronic books.
2. Development of a centralized integrated platform	50 000	1	1	50 000	A robust centralized integrated platform for managing, storing and distributing digitized content across regions.
3. Centralized cloud storage and backup services	5 000	1	Annually	25 000	Centralized cloud storage solutions for securely storing and backing up all digitized content.
4. Audio-visual content creation equipment	20 000	1	1	20 000	Procurement of equipment for audiovisual studio set-up for audio book and sign language video production.
5. Platform maintenance for dissemination of content	5 000	1	Annually	25 000	Ongoing maintenance and update of centralized content dissemination platform.
Total				**128 800**	

Table 5: Accessible digital content creation and management

Item description	Unit cost, USD	Number of units	Frequency	Total for 5 years, USD	Remarks
1. Training for content management and dissemination	15 000	4	Annually	60 000	Training of school and community ICT centre personnel in each region to ensure that they can effectively use and support persons with disabilities with digitized content.
2. Regular content review and quality assurance processes	10 000	1	Annually	50 000	Centralized quality assurance to ensure all content meets accessibility standards.

Table 5: Accessible digital content creation and management (continued)

Item description	Unit cost, USD	Number of units	Frequency	Total for 5 years, USD	Remarks
3. Salary for digitization specialists at the centralized hub	7 000	4	Annually	140 000	Skilled personnel dedicated to the centralized digitization process, ensuring high-quality content conversion.
Total				**250 000**	

Table 6: Skilling and capacity building

Item description	Unit cost, USD	Number of units	Frequency	Total for 5 years, USD	Remarks
1. Initial training for ICT centre staff on assistive technologies and support for persons with disabilities	7 000	4	1	140 000	Comprehensive training for ICT centre staff, focusing on the use of assistive technologies, supporting persons with disabilities, and delivering specialized content. This train-the-trainer approach ensures that trained staff can then train others.
2. Ongoing professional development (annual refresher courses)	8 000	1	Annually	40 000	Annual centralized refresher workshop to keep ICT centre staff up to date on the latest technologies, methods and best practices in supporting persons with disabilities.
3. Basic ICT skill training for persons with disabilities in the community	8 000	4	Annually	160 000	Training sessions designed to teach persons with disabilities essential ICT skills, including on the use of assistive technologies, Internet browsing and basic digital literacy.
Total				**340 000**	

Table 7: Sensitization and awareness creation

Item description	Unit cost, USD	Number of units	Frequency	Total for 5 years, USD	Remarks
1. National media campaigns (TV, radio, online)	15 000	3	Annually	225 000	Comprehensive media campaigns to raise awareness of the ICT needs of persons with disabilities, promote the project objectives and foster public support. The campaign will use TV, radio and online platforms to reach a broad audience.
2. Community outreach programmes (workshops and town hall meetings)	5 000	4	Annually	100 000	Local workshops and town hall meetings aimed at engaging community members, educators and local leaders in discussions on the ICT needs of persons with disabilities and promoting inclusive practices.
3. Workshops for sensitizing ICT service providers (e.g. ISPs, media houses)	8 000	1	Annually	40 000	Workshops designed to educate ICT service providers on the importance of accessible services for persons with disabilities, including how to integrate accessibility features into their offerings.
4. Sensitization programmes for schools and universities	3 500	4	Annually	70 000	Programmes aimed at educating students, teachers and administrative staff in schools and universities on the importance of inclusive education and the role of ICT in supporting persons with disabilities.
5. Workshops for policy-makers on ICT and persons with disabilities	10 000	1	Annually	50 000	Annual workshops aimed at engaging policy-makers and government officials to advocate for inclusive ICT policies and the adoption of the project's recommendations at the national level.

Table 7: Sensitization and awareness creation (continued)

Item description	Unit cost, USD	Number of units	Frequency	Total for 5 years, USD	Remarks
6. Production of awareness-raising materials (brochures, posters, digital content)	6 000	1	Annually	30 000	Creation and distribution of informational materials that raise awareness of the ICT needs of persons with disabilities, to be distributed in communities, schools and through digital channels.
7. Surveys and feedback collection	5 000	1	Annually	25 000	Regular surveys and feedback collection to evaluate the effectiveness of the awareness-raising and sensitization campaigns, with adjustments made as necessary.
Total				**540 000**	

Annex 3: Model ICT-enabled learning centre and integrated ICT resource platform

1 Introduction

This Annex serves as a comprehensive guide for the development of an ICT-enabled learning centre specifically designed to accommodate persons with disabilities in Uganda. Additionally, it outlines the technical design and specifications for an integrated national ICT platform that will connect and support these learning centres across the country. The ultimate goal is to ensure that persons with disabilities have equitable access to ICT education and resources, empowering them to participate fully in the digital economy and society.

In today's digital age, access to ICT is not just a matter of convenience but a fundamental right that enables individuals to access education, employment and social services. For persons with disabilities, the availability of accessible ICT solutions can significantly reduce barriers to participation, enhancing their independence and quality of life. However, despite advancements in technology, persons with disabilities often face significant challenges in accessing ICT due to a lack of inclusive design and infrastructure.

This study responds to the urgent need for accessible ICT centres that cater specifically to the needs of persons with disabilities. By providing detailed guidelines and technical specifications, it aims to ensure that these centres are not only physically accessible but also equipped with the necessary technologies and resources to support a diverse range of disabilities. Moreover, the blueprint for an inclusive ICT-enabled learning centre will greatly aid in achieving the objectives outlined in both Uganda's Third National Development Plan (NDP III) and the Digital Transformation Roadmap (2023/24-2027/28).

2 Two primary components

The scope of this report encompasses two primary components: a model ICT-enabled learning centre for persons with disabilities; and an integrated national ICT platform for learning centres for persons with disabilities.

Model ICT-enabled learning centre for persons with disabilities: The model ICT-enabled learning centre for persons with disabilities provides detailed technical design and specifications for the development of a prototype ICT-enabled learning centre and guidelines on physical infrastructure, accessibility features and integration of assistive technologies.

Integrated national ICT platform for learning centres for persons with disabilities: The integrated national ICT platform for learning centres for persons with disabilities provides the technical design and specifications for a centralized ICT platform that will link multiple learning centres across Uganda. The platform focuses on data management, security, accessibility and interoperability to ensure seamless operation and service delivery. It also provides a strategic framework for implementation, monitoring and evaluation to maintain high standards of accessibility and performance.

3 Key national and international policies

This report is aligned with key national and international policies that emphasize the importance of accessibility and inclusivity in ICT development. These include national policies and international standards.

3.1 National policies

Digital Transformation Roadmap (2023/24-2027/28): This roadmap prioritizes the development of inclusive digital infrastructure and services, which are essential for the empowerment of persons with disabilities and the broader digital transformation of Uganda.

NDP III: Aims to enhance ICT usage in national development and service delivery, with a specific focus on reducing inequalities and improving access to ICT for marginalized groups, including persons with disabilities.

3.2 International standards

The United Nations Convention on the Rights of Persons with Disabilities (CRPD), specifically Article 9 (Accessibility), obliges States Parties to take appropriate measures to ensure persons with disabilities have access to information and communications, including ICT (CRPD (2006), Article 9).

By adhering to these frameworks, the proposed ICT centres and national platform will not only meet legal and regulatory requirements but also set a benchmark for best practices in accessible ICT education.

Figure 8: Model ICT-enabled learning centre

Source: Mythoway Services & Gemini

Figure 8 depicts a model ICT-enabled learning centre designed for accessibility. At the entrance, there's a ramp with a gentle slope, allowing easy access for wheelchair users. The wide door is

large enough to comfortably accommodate wheelchairs. Inside the learning centre, there are adjustable-height desks, one of which is lowered and another raised, demonstrating flexibility for users with different needs. The desks are paired with ergonomic chairs and large computer monitors, providing a comfortable workspace. The environment is well lit, with tactile signage and Braille displayed near the entrance to guide visually impaired users. The space is designed to be open, providing ample room for mobility aids.

Entrance and pathways

Table 8: Entrance and pathways recommendations

Feature	Minimum spec.	Remarks	Recommended spec.	Remarks
1. Ramp gradient	1:20 (5% slope)	This gradient is manageable for most manual wheelchair users and reduces fatigue.	1:12 (8.33% slope)	This is the standard recommended by the Americans with Disabilities Act (ADA) and other international guidelines, offering a balance between accessibility and efficiency of space.
2. Door width:	900 mm (approx. 35.4 inches)	This width allows for most standard wheelchairs to pass through comfortably.	1 000 mm (approximately 39.4 inches)	Provides extra space for larger mobility devices and reduces the risk of bumping into the doorframe.
3. Corridor width	1 200 mm (approx. 47.2 inches)	This width allows for one-way traffic and enables a person using a wheelchair to pass through comfortably.	1 500 mm (approximately 59 inches)	This width accommodates two-way traffic and allows two wheelchairs to pass each other easily.

Accessible restroom

Table 9: Accessible restroom specifications

Feature	Minimum spec.	Remarks	Recommended spec.	Remarks
Toilet seat height	430 mm (approx. 17 inches)	This height is standard for most accessible toilets, providing ease of transfer from a wheelchair.	480 mm (approx. 19 inches)	Slightly higher toilet seats can be easier for some individuals to use, especially those with limited mobility in their lower limbs.

Signage

Table 10: Signage specifications

Feature	Recommended spec.	Remarks
Braille signage height	1 200 mm to 1 500 mm (approx. 47 to 59 inches)	Recommended height from the floor, positioned so that it is easily reachable for both seated and standing users.

Lighting and illumination

Table 11: Lighting and illumination recommendations

Minimum Lux	Remarks	Recommended Lux	Remarks
300	This is the general minimum recommended for working environments to ensure sufficient lighting without causing strain.	500	This higher level is recommended in areas where detailed work or reading is required, reducing glare and ensuring even lighting.

Acoustic treatment (panel noise reduction ecoefficiency)

Table 12: Acoustic treatment recommendations

Minimum spec.	Remarks	Recommended spec.	Remarks
0.7 NRC	This level of sound absorption helps to minimize echoes and background noise, making the environment more comfortable for users with hearing impairments.	0.90 NRC	Higher sound absorption improves speech intelligibility and reduces auditory fatigue, crucial in classrooms and meeting areas.

Adjustable desk stations

Table 13: Desk station specifications

Minimum adjustable height	Remarks	Recommended adjustable height	Remarks
Between 650 mm and 900 mm (approx. 25.6 to 35.4 inches)	This can accommodate users of different heights and those using most wheelchairs.	Between 600 mm and 1 250 mm (approx. 23.6 to 49.2 inches)	The recommended adjustable height offers greater flexibility and ease of use, including for users with motorized adjustable bed (mobility aid for those with spine injury) and other severe mobility challenges.

Computers

Table 14: Computer specifications

Resource	Minimum spec.	Recommended spec.	Remarks
Operating system	Windows 10 or Windows Server 2019/2016	Windows 11 or Windows Server 2019/2022	Windows 10 and above are widely compatible with most accessibility software, offering robust support and regular updates. Windows 11 is recommended as it includes enhanced security features and better performance optimization, which are crucial for running resource-intensive accessibility tools.
Processor	Intel Core i5, dual-core, 1.8 GHz	Intel Core i7, quad-core, 2.0 GHz or higher	The processor is the computer's brain, responsible for executing tasks. An Intel Core i5 processor with a dual-core setup at 1.8 GHz is sufficient for basic tasks and light multitasking. However, a Core i7 processor with quad-core and 2.0 GHz or higher is recommended for better simultaneous handling of multiple applications, such as running a screen reader alongside speech recognition software, e.g. Dragon Naturally Speaking.
Physical memory (RAM)	8 GB DDR4	16 GB DDR4	A large physical memory allows the computer to handle more tasks at once. 8 GB of DDR4 RAM is the minimum required for running basic accessibility tools and office applications smoothly. However, 16 GB is recommended, especially when using more demanding tools, e.g. screen magnifiers, or when multiple assistive technologies need to be operated simultaneously. More RAM ensures a smoother and faster user experience.
Storage (HDD/SSD)	350 GB SSD	1 TB (1 000 GB) SSD	Solid state drives (SSDs) are preferred over traditional hard disk drives (HDDs), due to their faster read and write speeds. A 350 GB SSD is sufficient for storing the operating system, essential software and some user data. However, a 1 TB SSD is recommended to provide ample space for additional software, large datasets and multimedia content, ensuring long-term usability without the need for frequent upgrades.
Video/ graphics	Integrated video/ graphics card with support for DirectX 9 or later and WDDM 1.0 driver. Display resolution of at least 1 024×768	Dedicated video/ graphics card with support for DirectX 12 or later and WDDM 2.0 driver. Full HD resolution (1 920×1 080)	Graphics capabilities are important for visual clarity, in particular when using screen magnifiers or video relay services. An integrated graphics card that supports DirectX 9 with a resolution of 1 024×768 is the bare minimum. However, a dedicated graphics card that supports DirectX 12 with Full HD resolution is recommended for better visual performance, which is crucial for users relying on visual accessibility tools.

Stand-alone monitor

Table 15: Stand-alone monitor specifications

Parameter	Recommended
Size	24~32 inch
Resolution	3 841x2 160
Aspect ratio	16:9
Brightness (typical)	200-250
Color support	16 M or 16.7 M
Pixel density	130 ppi or more
Other support	Eye saver, flicker free, gain mode
Refresh rate	60 HZ
Connectivity	HDMI, USB

Assistive technologies

Required Internet connectivity at a model learning ICT enabled learning centre for people with disabilities

The minimum requirement at a centre is a consistent connection with download speeds of at least 10 Mbit/s and upload speed of 5 Mbit/s, which will be adequate to support 15-20 users simultaneously without significant slowdowns, assuming performance of typical online activities, e.g. browsing, e-mail and document editing. The required network infrastructure for such a connection would be a basic Wi-Fi router and network cables to establish a local area network (LAN). However, for better user experience and scalability, in this study we recommend that the model centre be equipped with a high-speed broadband connection with a download speed of at least 50 Mbit/s and upload speed of at least 15 Mbit/s. Such a speed will be sufficient to accommodate 30-50 users during peak hours and support demanding tasks, such as video conferencing and multimedia streaming. A strong service level agreement (SLA) with the service provider would have to be negotiated to ensure that the reliability and availability of the connection is satisfactory for the centre.

Annex 4: Details on the integrated national platform

The integrated national ICT platform is designed to serve as the backbone of the ICT-enabled learning centres for persons with disabilities across Uganda. This section outlines the core functionalities of the platform to ensure that it meets the diverse needs of users and administrators.

1) **User Management**

- **User Profiles:**
  - Description: Allows users to create and manage personal profiles that store their accessibility preferences, learning progress and personal information.
  - Functionality: Supports customizable settings such as preferred languages, display preferences and assistive technology configurations.
- **Role-based access control (RBAC):**
  - Description: Assigns roles (e.g., student, teacher, administrator) to users, determining their access levels and permissions within the platform.
  - Functionality: Ensures that users only have access to the data and tools relevant to their roles, enhancing security and usability.
- **Single sign-on (SSO):**
  - Description: Enables users to authenticate once and access multiple services within the platform without re-entering credentials.
  - Functionality: Integrates with third-party identity providers (e.g. Google, Microsoft) to streamline the login process.

2) **Accessibility Features**

- **Customizable user interface:**
  - Description: Allows users to adjust the user interface according to their accessibility needs, such as font size, contrast and colour schemes.
  - Functionality: Supports multiple themes (e.g. high contrast, dark mode) and screen reader compatibility.
- **Screen reader support:**
  - Description: Ensures the platform is fully accessible to users who are blind or have visual impairments by providing compatibility with popular screen readers such as JAWS and NVDA.
  - Functionality: Uses ARIA roles and attributes to enhance navigation and content interaction.
- **Keyboard navigation:**
  - Description: Provides full keyboard accessibility, allowing users to navigate the platform using only the keyboard.
  - Functionality: Implements logical tab order and keyboard shortcuts for efficient navigation.
- **Real-time captioning:**
  - Description: Provides full keyboard accessibility, allowing users to navigate the platform using only the keyboard.

- Functionality: Implements logical tab order and keyboard shortcuts for efficient navigation.

3) **Learning management**

- **Course management:**
  - Description: Enables administrators and educators to create, manage and deliver courses across the network of learning centres.
  - Functionality: Includes tools for syllabus creation, assignment distribution and grading.
- **Content library:**
  - Description: Central repository for educational materials, accessible to all connected learning centres.
  - Functionality: Supports a variety of content types, including text, video, audio and interactive modules.
- **Assessment and evaluation:**
  - Description: Provides tools for creating and administering quizzes, exams and other assessments.
  - Functionality: Includes automated grading, feedback mechanisms and progress tracking.
- **Learning analytics:**
  - Description: Analyses student performance data to identify trends and provide insights into learning outcomes.
  - Functionality: Offers dashboards and reports for educators and administrators to monitor progress and adapt teaching strategies.

4) **Communication and collaboration**

- **Virtual classrooms:**
  - Description: Facilitates live online classes with video conferencing, chat and collaborative tools.
  - Functionality: Integrates with platforms like Zoom and Microsoft Teams for seamless virtual learning experiences.
- **Discussion forums:**
  - Description: Provides a space for students and educators to discuss course materials, share ideas and collaborate on projects.
  - Functionality: Supports threaded discussions, notifications and moderation tools.
- **Messaging system:**
  - Description: Enables secure, internal messaging between users.
  - Functionality: Includes one-on-one messaging, group chats and announcements.

5) **Data management and security**

- **Centralized data management:**
  - Description: Manages all user data, course materials and administrative information in a centralized, secure database.

  - Functionality: Supports encrypted storage, data versioning and backup.

- **Data analytics:**
  - Description: Analyses data across the platform to provide insights into user behaviour, system performance and educational outcomes.
  - Functionality: Includes dashboards, reports and predictive analytics tools.
- **Compliance and reporting:**
  - Description: Ensures the platform complies with international data protection regulations (e.g. GDPR) and accessibility standards (e.g. WCAG).
  - Functionality: Provides audit trails, compliance checks and automated reporting features.

6) **Integration and interoperability**

- **API management:**
  - Description: Facilitates integration with third-party applications and services through a robust API framework.
  - Functionality: Includes RESTful APIs, GraphQL support and API security features such as rate limiting and access control.
- **Third-party integrations:**
  - Description: Supports integration with external tools such as learning management systems (LMS), productivity software and assistive technologies.
  - Functionality: Includes plugins and connectors for popular systems like Moodle, Google Workspace and Microsoft Office.
- **Content delivery network (CDN):**
  - Description: Ensures fast and reliable access to content by distributing it across multiple servers.
  - Functionality: Reduces latency and enhances user experience, especially in remote areas.

1 Technical design recommendations and specifications for the integrated national ICT platform

1.1 Overview of the national ICT platform

The integrated national ICT platform is designed to connect multiple ICT-enabled learning centres for persons with disabilities across Uganda. The platform's architecture emphasizes scalability, security and accessibility, ensuring that it can support a large, diverse user base while remaining adaptable to future technological developments. This section provides a detailed guide on the architecture, tools and libraries that developers can use to implement the platform.

1.2 Platform architecture

Cloud infrastructure:

- Recommended platforms: AWS, Microsoft Azure, Google Cloud Platform.
- Services:

  - Compute: AWS EC2, Azure VMs, Google Compute Engine.
  - Storage: S3 (AWS), Azure Blob Storage, Google Cloud Storage.
  - Containerization: Docker with Kubernetes for orchestration (EKS on AWS, AKS on Azure, GKE on GCP).

Centralized database:

- Recommended databases: PostgreSQL or MySQL, with Amazon Aurora for managed services.
- Caching: Redis or Memcached for improved performance.

Content delivery network:

- Recommended services: AWS CloudFront, Azure CDN, Google Cloud CDN.

APIs for Integration:

- API management: API Gateway (AWS), Azure API Management, Google Cloud Endpoints.
- Protocols: RESTful APIs, with GraphQL for complex data querying.

1.3 Data management and security

Data management:

- User profiles: Secure, centralized storage with encrypted fields and customizable user profiles.
- Data backup and recovery: Automated backups with AWS Backup, Azure Backup, or Google Cloud Backup. Implement database replication and point-in-time recovery.

Security:

- Encryption: Use AWS KMS, Azure Key Vault, or Google Cloud KMS for encryption management.
- Access Control: Implement RBAC with frameworks like Spring Security (Java), ASP.NET Core Identity (C#), or Flask-Security (Python).
- Compliance: Ensure compliance with GDPR, WCAG 2.1, and other international standards using tools like AWS Artifact or Azure Compliance Manager.

1.4 User interface and accessibility

Customizable user interface:

- Frameworks:
  - JavaScript: React with Redux for state management.
  - Java: JSF with Prime-Faces.
  - Python: Django with React or Angular for the front end.
- **CSS Libraries**: Bootstrap or Tailwind CSS for styling.

Screen reader compatibility:

- **ARIA**: Implement ARIA landmarks, roles, and states. Test with Axe, Lighthouse, or WAVE.

Keyboard navigation:

- Implementation: Use tabindex for focus management and implement keyboard shortcuts.
- Libraries: React-ARIA, Angular Material.

Real-time captioning:

- Integration: Web Speech API or Otter.ai API for real-time captioning.

Multilingual support:

- Libraries: i18next for React or Angular, java.util.Locale for Java.

1.5 Interoperability and integration

Learning management systems:

- APIs: Integrate with Moodle, Blackboard, and Canvas using their RESTful APIs.
- SSO: Use OAuth 2.0 or SAML 2.0.

Assistive technologies:

- Compatibility: Ensure compatibility with JAWS, NVDA, and ZoomText by adhering to WCAG 2.1 standards.
- Testing tools: JAWS Inspect, NVDA Developer Toolkit.

Third-party applications:

- Communication tools: Integrate Microsoft Teams, Google Workspace, or Zoom using their SDKs and APIs.
- Productivity tools: Use Microsoft Graph API or Google API Client Libraries.

2 Monitoring and evaluation framework for the integrated national ICT platform

The monitoring and evaluation (M&E) framework is a critical component of the integrated national ICT platform, ensuring that the implementation and operation of the platform and ICT-enabled learning centres for persons with disabilities are aligned with the intended goals. The M&E framework will guide the continuous assessment of the platform's effectiveness, accessibility and impact, allowing for timely adjustments and improvements.

2.1 Objectives of the monitoring and evaluation framework

The primary objectives of the M&E framework are:

- *Effectiveness:* Assess the extent to which the platform and learning centres meet their intended goals, including the accessibility and usability for persons with disabilities.
- *Efficiency:* Evaluate the cost-effectiveness of the platform's operations and resource utilization.
- *Impact:* Measure the long-term effects of the platform on the education and empowerment of persons with disabilities.
- *Sustainability:* Ensure that the platform remains viable and scalable in the long term, adapting to changing needs and technologies.

2.2 Key performance indicators

To effectively monitor and evaluate the platform, a set of key performance indicators (KPIs) will be established. These KPIs will be measured regularly to assess performance across various dimensions.

Accessibility:

- User satisfaction scores: Regular surveys and feedback mechanisms to measure the satisfaction of persons with disabilities with the platform's accessibility features.
- Accessibility compliance rate: Percentage of platform components that meet WCAG 2.1 standards.
- Use of assistive technologies: Tracking the use and effectiveness of integrated assistive technologies such as screen readers, Braille displays and speech recognition tools.

Learning outcomes:

- Student performance metrics: Analysis of grades, course completion rates and assessment scores of students using the platform.
- Engagement levels: Monitoring the frequency and duration of student interactions with the platform, including participation in virtual classrooms and discussion forums.
- Progress tracking: Measuring individual learning progress against set goals and curricula.

Operational efficiency:

- System uptime: Monitoring the availability and reliability of the platform, with a target uptime of 99.9 per cent or higher.
- Response times: Tracking the platform's performance in terms of load times and responsiveness, in particular during peak use periods.
- Cost per user: Evaluating the cost-effectiveness of platform operations on a per-user basis, including maintenance and support costs.

Data security:

- Incident response rate: Time taken to respond to and resolve security incidents, with a target of immediate response to critical issues.
- Data breach incidents: Number of data breach incidents, with a goal of zero breaches.
- Compliance audits: Regular audits to ensure compliance with data protection regulations like GDPR and local data privacy laws.

Sustainability:

- Scalability assessments: Regular evaluations of the platform's ability to scale with increasing numbers of users and connected learning centres.
- Resource utilization: Tracking the efficient use of cloud resources, storage and bandwidth.
- Environmental impact: Measuring the platform's carbon footprint and implementing strategies to minimize energy consumption.

2.3 Monitoring tools and techniques

- The M&E framework will employ a combination of automated tools and manual assessments to gather data, analyze performance, and provide actionable insights.

Automated monitoring tools:

- Performance monitoring: Use tools like AWS CloudWatch, Azure Monitor or Google Cloud Operations Suite to continuously monitor the platform's performance, including uptime, response times and resource usage.
- Accessibility testing: Regular automated testing with tools like Axe, WAVE or Lighthouse to ensure ongoing compliance with accessibility standards.
- Security monitoring: Implement security information and event management (SIEM) tools such as Splunk, Azure Sentinel or AWS Security Hub for real-time threat detection and incident management.

Manual assessments:

- User surveys: Conduct regular surveys and focus groups with persons with disabilities to gather qualitative feedback on the platform's usability and accessibility.
- Audits: Perform periodic audits of the platform's compliance with regulatory requirements, data security and operational efficiency.
- Case studies: Develop case studies to document the platform's impact on individual users and learning centres, providing in-depth insights into its effectiveness.

2.4 Reporting and feedback mechanisms

The M&E framework will include robust reporting mechanisms to ensure that stakeholders are regularly informed of the platform's performance and any necessary improvements.

- Regular reporting:
  - Monthly Performance Reports: Provide detailed reports on KPIs, identifying any areas of concern and recommending corrective actions.
  - Quarterly Reviews: Conduct comprehensive reviews every quarter, involving key stakeholders to discuss progress, challenges, and future strategies.
  - Annual Impact Assessment: An in-depth analysis conducted annually to evaluate the overall impact of the platform on PWD education and empowerment, including recommendations for long-term improvements.

Feedback loops:

- Continuous feedback: Establish channels for continuous feedback from users, including suggestion boxes, online forms and direct communication with support staff.
- Stakeholder meetings: Regular meetings with key stakeholders, including government agencies, educators and advocacy groups for persons with disabilities, in order to discuss feedback and align priorities.

2.5 Continuous improvement strategy

The M&E framework is designed to support a culture of continuous improvement, ensuring that the platform evolves in response to user needs and technological advancements.

Iterative development:

- Agile methodologies: Adopt agile development practices, allowing for regular updates and improvements based on user feedback and monitoring data.

- Prototyping and testing: Implement a cycle of prototyping, testing and refinement to introduce new features and enhance existing functionalities.

Stakeholder involvement:

- User advisory groups: Form advisory groups consisting of persons with disabilities and educators to provide ongoing input into the platform's development and improvement.
- Public consultations: Engage in public consultations to gather a broad range of perspectives and ensure the platform remains aligned with community needs.

Annex 5: Phased implementation plan for inclusive ICT solutions for persons with disabilities

Overview

This five-year programme aims to implement inclusive ICT solutions for persons with disabilities in Uganda. The phased approach ensures a systematic rollout with continuous evaluation and improvement. The implementation phases include:

- Pilot phase: Establish a model centre in Gulu.
- Regional deployment phase: Add a centre in Mbale.
- National scaling phase: Expand to Kampala and Mbarara.

Activities such as platform development, stakeholder engagement and capacity building will occur concurrently to maximize efficiency.

Phased implementation details

Phase 1: Pilot phase in Gulu

Timeline: Months 6-18

Objectives:

- Test the model ICT-enabled learning center design and design concept.
- Pilot the integrated national ICT platform.
- Develop and validate workflows for content creation.

Key activities:

- Site preparation and infrastructure setup.
- Initial training for staff and persons with disabilities.
- Develop and test accessible digital content.
- Establish monitoring and evaluation mechanisms.

Phase 2: Second centre in Mbale

Timeline: Months 18-30

Objectives:

- Validate scalability and adaptability.
- Refine workflows based on pilot feedback.

Key activities:

- Expand the integrated platform to support multiple centres.
- Train additional staff and provide refresher courses.
- Engage the community through outreach programmes.
- Conduct mid-phase evaluations.

Phase 3: Centres in Kampala and Mbarara

Timeline: Months 30-60

Objectives:

- Establish centres in Kampala and Mbarara.
- Achieve nationwide accessibility.
- Ensure long-term sustainability.

Key activities:

- Scale the integrated ICT platform to support all centres.
- Standardize training programmes and develop online modules.
- Expand the content repository with localized materials.
- Advocate for policy finalization and funding.

Concurrent activities

Several activities will occur concurrently across the programme timeline, ensuring efficient implementation:

- Stakeholder engagement (Months 0-60): Continuous collaboration with government, NGOs and private entities.
- Integrated platform development (Months 3-24): Design, test and deploy the platform.
- Capacity building (Months 6-60): Training programmes for staff and persons with disabilities.
- Policy advocacy (Months 0-36): Finalize the ICT for disability policy and related frameworks.
- Content repository scaling (Months 6-60): Develop and update accessible digital content.
- Monitoring and evaluation (Months 6-60): Regular assessments to ensure objectives are met.

Programme timeline

The table shares details on the implementation timeline for the programme.

Table 16: Programme timeline

Activity	Start month	End month
Stakeholder engagement	0	60
Pilot phase in Gulu	6	18
Integrated platform development	3	24
Second centre in Mbale	18	30
Centres in Kampala and Mbarara	30	60
Content repository scaling	6	60
Policy advocacy and finalization	0	36

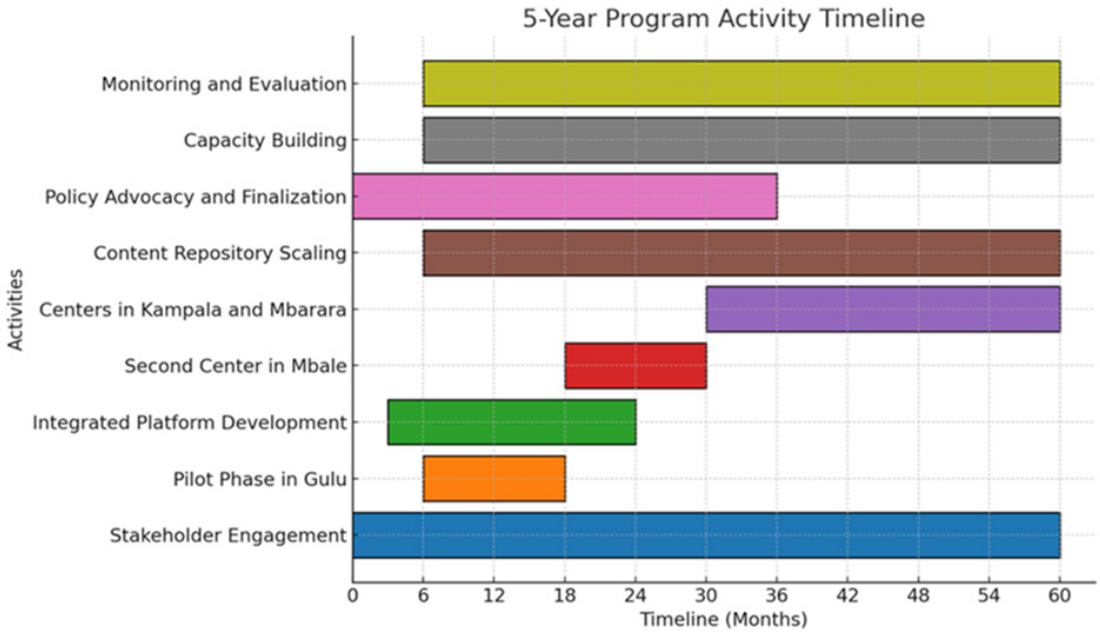
Table 16: Programme timeline (continued)

Activity	Start month	End month
Capacity building	6	60
Monitoring and evaluation	6	60

Activity timeline chart

The Gantt chart below illustrates the timeline and concurrency of activities:

Figure 9: Gantt chart showing the activity timeline



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