Breaking Barriers in the Metaverse: Improving Accessibility

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What is accessibility and why should we care?

- **ITU-T definition**
  - **accessibility** [ITU-T F.791]: The degree to which a product, device, service or environment (virtual or real) is available to as many people as possible.
  - **universal design** [ITU-T Y.4211]: The design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. "Universal design" shall not exclude assistive devices for particular groups of persons with disabilities where this is needed.
    NOTE – Paraphrased from [UNCRPD].

- Emerging technologies such as metaverse may be a new opportunity for persons with disabilities.

- Persons with disabilities are **potential early adopters**!

  (early adopter) : (price paid) < (expected benefit)

- **When persons with disabilities gain access to information systems through emerging technologies that they could not through legacy technologies, the expected benefits will be very high for them.**
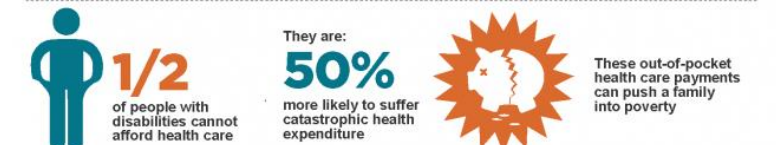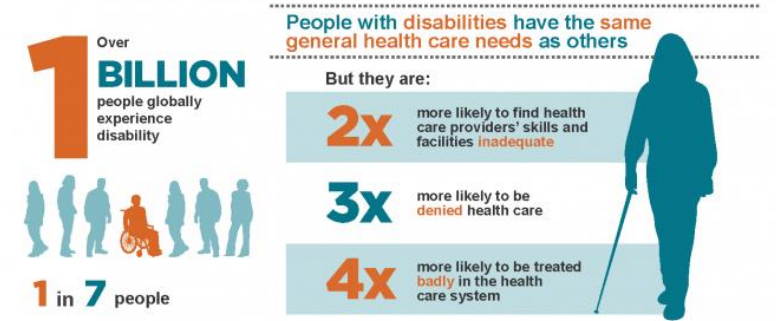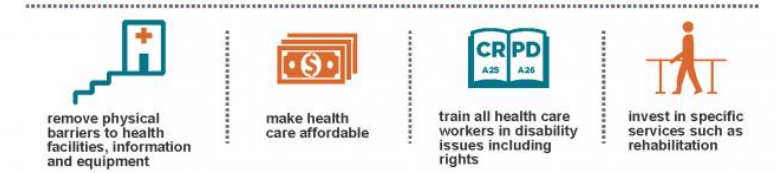

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"Accessibility" and normal distribution

- According to the Central Limit Theorem, if the needs of all ICT users worldwide are expressed as a distribution, they follow a normal distribution.

- In mathematics, the standard deviation σ(sigma) is used as a unit to measure how far from the center. The figure below shows what this standard deviation means. In other words, considering the needs from the center to the person 1σ away, it is designed to satisfy approximately 68.2% of users.

- According to the WHO's World Health Survey, 15.6 percent of the world's population is those with disabilities. That is, in the normal distribution, the area **outside the right 1σ(sigma) becomes persons with disabilities.**
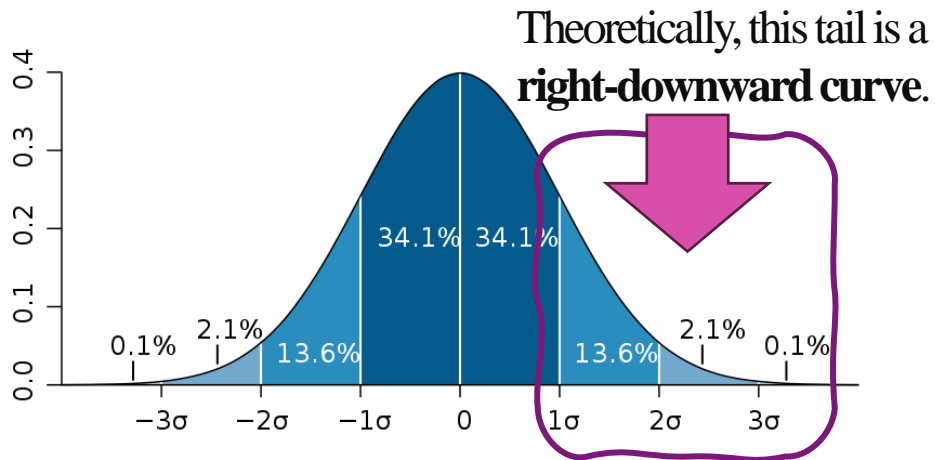
- **Characteristics**
  1. The **density is smaller** compared to the center. (Area = number)
  2. It is an **endless, long tail**.
  3. There is not much difference in the number of frequencies. (though it does decrease)

- **Perspective of accessibility**
  1. The number of customers in this area is smaller (compared to the central area).
  2. There are various needs, and **there is no single solution** that can solve everything.
  3. It is not easy to prioritize accessibility technologies.

Theoretically, this tail is a **right-downward curve**.

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Pitfalls of developers in accessibility considerations

- The answer to the question of **"How far should we develop?"** is **"As far as technology allows."**
    - → For developers, **the answer is nothing short of a "project that never ends."**

- Another difficulty would be that as these people who need access deviate to the end of the tail, **their level of "fault tolerance" becomes lower.**
    - Persons with disabilities have a lot more difficulties avoiding problems when they occur due to their already low level of accessibility (= having fewer alternative means).

- From the perspective of developers, **accessible services should be developed in consideration of the possibility of exceeding their knowledge or capabilities, and the developed results should be perfect considering all possible errors.**

- Securing ICT accessibility is a matter of considering somewhere behind **one sigma**. The manufacturing industry already began challenging the defect rate at the level of **six sigma (3 out of 1 million) in the 1980s.**

- **We need to look back on whether our "standard" may be too low.**

ICT services without accessibility (current)

6-sigma quality assurance level (1980s)

GAP
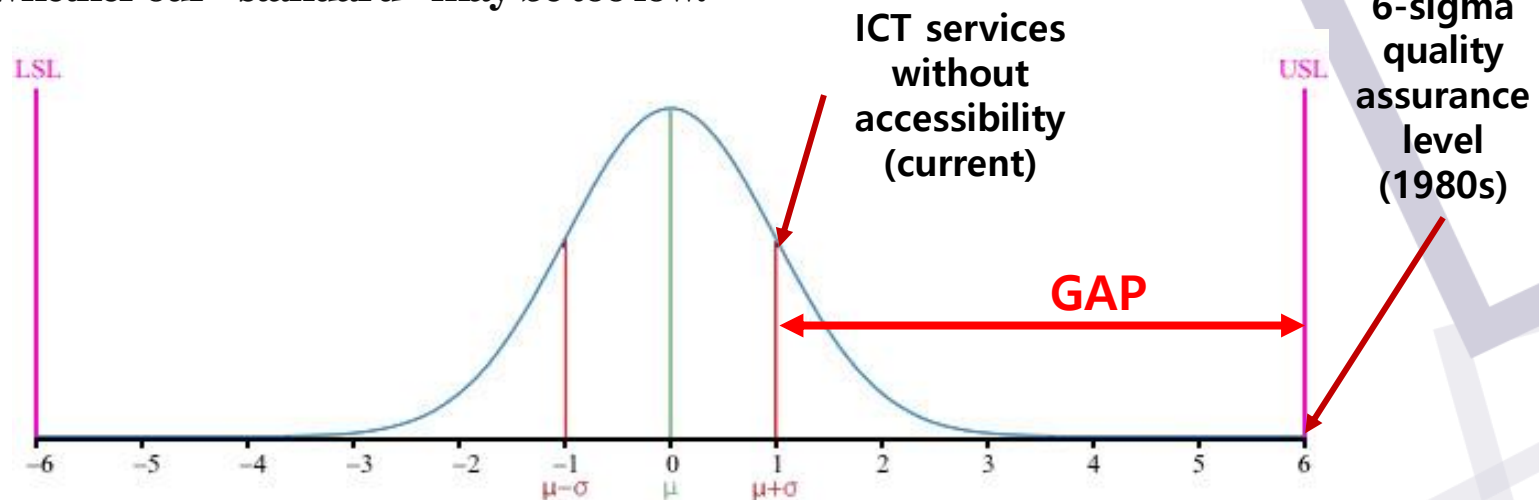
Why accessibility should be emphasized in metaverse?

- Difficulties caused by disability stem from **environmental factors** surrounding the persons with disabilities rather than the disability itself.

- **metaverse** [ITU-T FG-MV20]: An integrative ecosystem of virtual worlds offering immersive experiences to users, that modify pre-existing and create new value from economic, environmental, social and cultural perspectives.
NOTE – A metaverse can be virtual, augmented, representative of, or associated with the physical world.

- ## Metaverse = creating a new virtual environment

  - → Need to establish an environment to relieve the inconvenience of persons with disabilities

- For most people who are without disabilities, Metaverse may be somewhat interesting, charming services that provide some marginal benefit compare to the legacy ICT services.

- But, for persons with disabilities who had limited access to the legacy system, if they could enjoy the ICT services through this immersive and accessible environment, their perceived benefit of the metaverse would be huge.

- **Key point** - it should be accessible, if not, it will just enlarge the digital divide, persons with disabilities will face more difficulties in using the metaverse.

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Number	Type	Deliverables
FGMV-04 & FGMV-05	Technical Specifications	**Accessible products and services** in the metaverse Part I : System design perspective & Part II : User perspective
FGMV-03	Technical Report	**Guidelines to assess inclusion and accessibility** in metaverse standards development
FGMV-15	Technical Specifications	**Accessibility requirements** for **metaverse services** supporting IoT
FGMV-17	Technical Report	**Interpreting** in the metaverse
FGMV-16	Technical Report	**Accessibility for a Sustainable** Metaverse
FGMV-18 & (forthcoming)	Technical Report	Guidance on how to build a **metaverse for all** **Part I: Legal Framework & Part II: Survey Results**
FGMV-26	Technical Specification	Requirements for **communication between human-avatar languages** in the metaverse

4 Technical Specification & 5 Technical Report
(1 TR forthcoming)

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Human-centric metaverse - backgrounds

- **[FGMV-18] Guidance on how to build a metaverse for all – Part I: Legal Framework (Technical Report)**
  - This document proposes some guidelines to ensure by default equity, accessibility, and inclusivity in the development of the metaverse.
  - Its primary objective is to offer the context for the legal framework based on the United Nations (UN) mandates and Sustainable Development Goals (SDGs), along the derived standards. This document offers a comprehensive understanding of the current state of the background which should underlay any metaverse development.
  - The document also identifies the key challenges that hinder the achievement of equity, accessibility, and inclusivity within the metaverse, and propose potential roadmaps towards constructing a metaverse leaving no one behind.

- **[FGMV-03] Guidelines to assess inclusion and accessibility in metaverse standard development (Technical Report)**
  - This Technical Report discusses how to realize the principles on metaverse by articulating accessibility. The metaverse should be inclusive of diverse cultures, languages, and perspectives, and should promote the SDG principles. By proposing guidelines and recommendations, this Technical Report **strengthens the argument for articulating accessibility as a means of realizing inclusion in developing metaverse.**

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Human-centric metaverse – accessible products and services

- **[FGMV-04] Requirements of accessible products and services in the metaverse - System design perspective**

- This Technical Specification provides high-level requirements accessible products and services in metaverse which need to be considered during the design and implementation stages of metaverse products and services to allow and assist all users to engage in an accessible immersive experience.

- **Key highlights –**
  - for designing **accessible products** in the metaverse
    - Provide an accessibility requirements data set
    - **User-centric perspective** on functional design of a product
    - Use easy-to-understand information on instruction
    - Include diverse user representation **in all design stages**
    - Use a common or universal icon representation
  - for designing **accessible services** in the metaverse
    - Use a common or **universal icon**
    - Provide services in **multiple ways** according to the user's needs
    - Include **alternative options** for users to receive feedback
    - Include both the **customization and personalization** of services
    - Provide inclusion and adaptability to the user's needs through **translation and accessibility services**
    - Ensure interfaces and navigation related to accessibility services are adaptable to the user's specific needs

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Human-centric metaverse – accessible products and services

- **[FGMV-05] Requirements of accessible products and services in the metaverse – User Perspective**

- This Technical Specification provides requirements on how to develop accessible products and services in the metaverse taking a user perspective. This Technical Specification acknowledges the various needs and preferences of users.

- **Key highlights –**

- User needs : **Accessing, navigating, interacting** the metaverse, **creating an avatar identity**

- Accessibility considerations -
    - Subtitling/captioning
    - Transcripts
    - Audio description
    - Audio subtitles
    - Sign language interpreting
    - Oral language interpreting
    - Easy-to-understand language
    - Revoicing

- **Personalization & customization**

- **Inclusion of users** – in creating & **evaluating** accessibility services

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Human-centric metaverse – Communication needs

- **[FGMV-17] Guidelines and requirements on interpreting in the metaverse (Technical Report)**
  - This document provides guidelines and requirements on interpreting in the metaverse. It summarises typical use settings including **conference interpreting, public service interpreting and sign-language interpreting in the metaverse**. It describes technical requirements for conference interpreting, public service interpreting and sign-language interpreting in the metaverse. It also provides advice for all parties in interpreted events in the metaverse, including organizers, speakers, interpreters and audience in interpreting-facilitated events in the metaverse.

- **[FGMV-26] Requirements for communication between human-avatar languages in the metaverse (Technical Specification)**
  - This Technical Specification provides requirements for communication and mapping its architecture in the metaverse.
  - The metaverse offers a unique opportunity to create an accessible virtual world if communication requirements are considered in the architecture design. This requires consideration of the needs of a wide range of users.
  - This Technical Specification describes the different characteristics and modalities of language and provides common requirements for communication between human-avatar languages in the metaverse.

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Implementation – metaverse supporting IoT

- **[FGMV-15] Accessibility requirements for metaverse services supporting IoT**

- This Technical Specification provides accessibility requirements for the metaverse services supporting IoT. The scope of this Technical Specification concerns accessibility requirements for the metaverse services supporting IoT.
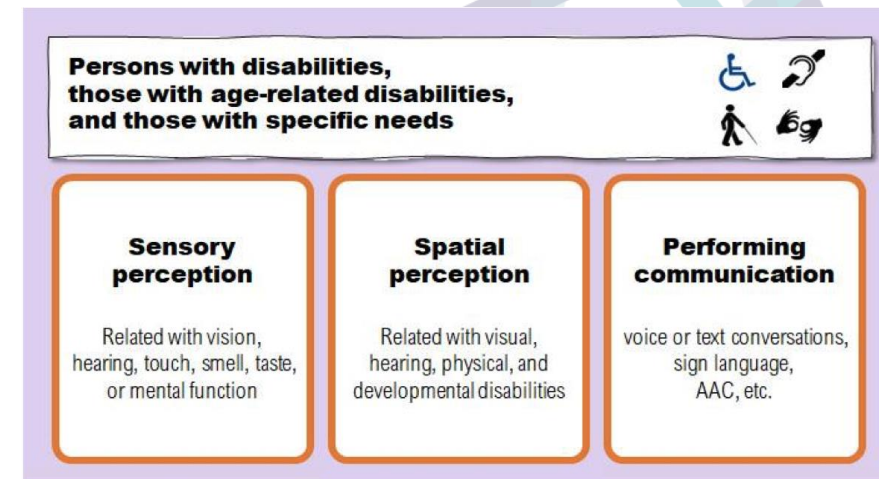
- **Key highlights –**

- The virtual world based on real-world data collected through IoT technology and using XR technology as UX is collectively referred to as a metaverse supporting IoT.

- The ideally constructed metaverse interface should prevent persons with disabilities and those with specific needs who have difficulty using certain senses in the real world from feeling this difficulty in the metaverse.

- Accessibility problems in the real world can be overcome through digital twins using the metaverse. However, **this can lead to distorted information in virtualizing and simulating the real world through digital twins to observe specific results.** Providing accessibility through digital twins and metaverse requires proper control and notification of these distortions.

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Persons with disabilities, those with age-related disabilities, and those with specific needs

Sensory perception
Related with vision, hearing, touch, smell, taste, or mental function

Spatial perception
Related with visual, hearing, physical, and developmental disabilities

Performing communication
voice or text conversations, sign language, AAC, etc.

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Metaverse supporting IoT (Con't)

- **The user problems -**

- **Sensory perception**: Sensory perceptions can vary in scope depending on the type of user experience (UX) the metaverse service provides.
  - When presenting alternative technologies to users, persons with disabilities may want to project real-world difficulties into the metaverse for a "perfect sense of reality" or, if there is a way, may not want to feel real-world difficulties as much as in the metaverse.

- **Spatial perception:** Metaverse is based on virtual space, which projects the real world.
  - In reality, persons with disabilities perceive space differently for each type of disability. The practice of recognizing space may or may not be the same as those without disabilities.

- **Performing communication/action:**
  - In reality, people communicate in various ways. In addition to the means of communication for persons without disabilities, such as voice or text conversations, additional methods, such as sign language and Augmentative and Alternative **Communication** (AAC), may also be considered for the means of communication for those with disabilities.

- This Technical Specification complements **ITU-T Y.4204 Accessibility Requirements for Internet of Things Applications and Services.**

- **It provides 22 recommendations** (13 related to sensory perception, 5 related to spatial perception and 4 related to performing communication/action) on developing metaverse supporting IoT.

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Sustainable & accessible metaverse

Editor:
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- **[FGMV-16] Accessibility in a sustainable metaverse**

- This Technical Report presents ways in which to integrate accessibility products and services in a sustainable and energy efficient metaverse for people with diverse access needs. It covers a range of guidance for making the metaverse sustainable and accessible.

- **Key highlights –**

- This Technical Report promotes and instructs on the adaptation of an integrated approach to accessibility and sustainability in the metaverse.

- Emphasizing the need for the early integration of accessibility and sustainability, This document presents information and guidance on how to incorporate sustainable accessibility products and services in the metaverse from the outset.

- Questions related to sustainability and accessibility in the metaverse need to consider the following:
  - Social benefit of sustainable accessibility products and services in the metaverse.
  - Challenges and opportunities of an accessible and sustainable metaverse.

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Thank You