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Accessibility and Audio Enhancement in Broadcasting

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Abstract

Audio accessibility in broadcasting is becoming increasingly important as technology advances and the need for inclusive services for people with disabilities increases. This study aims to analyze the implementation and key challenges in the adoption of four major audio accessibility technologies, namely Object-Based Audio (MPEG-H), AI-based dialogue enhancement (Dialog+), Auracast™ public broadcasting, and Smart TV interfaces with Text-to-Speech (TTS). The method used is secondary data analysis from various literature reports and international institutions, focusing on five countries: Germany, Japan, the United States, Indonesia, and Thailand. The results show that developed countries have implemented all four technologies comprehensively, while developing countries still face significant adoption gaps. The main barriers identified include device compatibility, high device prices, lack of user education, unprepared infrastructure, and limited local regulations. The findings emphasize that the successful implementation of audio accessibility technologies depends not only on technical readiness, but also on policy support, public-private partnerships, and public awareness. The comprehensive integration of MPEG-H, Dialog+, Auracast™, and TTS forms an inclusive broadcast ecosystem that can have a real impact on vulnerable groups. The study recommends a holistic approach to accelerate adoption and bridge the accessibility gap across countries.

Keywords: Audio accessibility, Auracast™, Dialog+, Object-Based Audio, Text-to-Speech

1. Introduction

The view of modern broadcasting is increasingly demanding high inclusivity, especially for audiences with special needs such as the blind and deaf. Without the support of technologies such as audio description, captioning, and assistive listening systems, much crucial information in news, sports, and entertainment programs fails to be conveyed evenly, creating an accessibility gap. As technology advances, object-based audio systems such as MPEG-H Audio have emerged as a revolutionary solution. This technology allows dialogue, background music, and sound effects to be flexibly separated, allowing users to adjust the audio level of the dialogue to clarify communication without disrupting the overall sound composition (Grewe et al., 2021).

However, not all past content has been produced with this object metadata, which has led to the development of innovations such as Dialog+, a deep learning-based technology from Fraunhofer to enhance the dialogue level of old recordings. The results have proven significant in clarifying dialogue for the elderly and those with hearing impairments (Torcoli et al., 2021). On the other hand, the need for audio description in live broadcasts, such as sports or entertainment events, has been addressed through automated systems being piloted by institutions such as NHK. These systems are able to extract text in real time and convert it into synthetic voice narration, with the option to personalize the level of detail of the information.

Audio accessibility technologies do not stop at software: hardware solutions such as inductive loops, infrared, RF, and now Bluetooth Auracast™ are being adopted in cinemas, airports, churches, and convention halls (Botelho, 2021). Auracast™ offers high sound quality, improved privacy, and ease of deployment, simplifying the way people with hearing impairments access public broadcasts (Millett, 2023).

The standards are increasingly mature: MPEG-H supports not only descriptive audio, but also multi-language selection, accessibility presets, and dynamic loudness control that ensures consistent dialogue volume levels across different playback situations (William et al., 2023). The system also supports formats from stereo to immersive 3D audio for a more personalized and immersive audio experience. Auracast™ adoption in devices such as hearing aids, earbuds, TVs, and smartphones is growing rapidly. With Bluetooth LE Audio, Auracast receivers can connect to public audio sources such as airports, gyms, or conferences without the need for pairing, like choosing a Wi-Fi network. This opens up the possibility for listeners with hearing loss to listen to announcements, sports, or presentations directly through their hearing aids (Johnson, 2025).

The application of Auracast™ in public stations, theaters, or formal conferences also expands the functionality of assistive audio into a tool for experiences ranging from silent screens in airports to multilingual tour guides in museums. These locations benefit from easy installation, high sound quality, and personalization options. The evolution of audio systems from MPEG-H-based objects, AI-enhanced dialogue, to modern ASL infrastructures like Auracast™ provides a strong foundation for inclusive broadcasting. The future of broadcasting enables real-time, customizable audio experiences: users can adjust dialogue levels, select languages, enable audio description, and even enjoy immersive audio, without losing the essence of the original content. Therefore, this study aims to discuss the development of modern broadcasting technology that supports inclusivity, especially for individuals with special needs such as the blind and deaf. The main focus is given to the role of object-based audio technology, narrative automation systems, and the latest hardware and standards that expand accessibility in broadcasting and public spaces.

2. Literature Review

Object-based audio (OBA) technology, specifically MPEG-H Audio, has become a milestone for accessibility. By allowing the separation of audio objects such as dialogue, music, or sound effects, users can adjust the dialogue level without disturbing other elements. Grewe et al. (2021) show that producing content with OBA metadata requires only minor changes to the traditional workflow, but significantly improves accessibility capabilities, including adding audio descriptions and dialogue enhancement.

For legacy content that lacks object metadata, Fraunhofer, through Dialog+, has developed a deep learning-based method to enhance the intelligibility of dialogue in mixed audio. A large field test involving more than 2,000 participants aged 60 and over who had difficulty understanding dialogue, 83% of whom welcomed the dialogue personalization capability (Torcoli et al., 2021). This proves that AI-based dialogue enhancement technology is effective in closing the access gap for historical content.

Meanwhile, Auracast™ Broadcast Audio, introduced via Bluetooth LE Audio since 2022, is revolutionizing the way public audio is distributed. The technology offers high quality using the LC3 codec, low latency, and eliminates the need for traditional pairing, opening up simultaneous access to airport announcements, theatre audio, and sports broadcasts for multiple users, including those with hearing aids.

Auracast also represents a new generation of assistive listening systems (ALS) solutions. Unlike legacy induction loops or FM/infrared systems that are expensive and limited, Auracast™ allows for easier and more economical deployment, and supports security options such as encryption. Organisations such as the HLAA and IFHOH strongly support Auracast as the new ALS standard. In practical terms, Auracast-enabled devices are already available. Samsung and Sony already support Auracast on their latest TVs and smartphones, and GN Resound and Jabra are integrating the technology into hearing aids, providing high-quality, low-latency streaming in real-world environments such as airports and concerts.

However, Auracast adoption is not without challenges. Better Hearing Australia notes that barriers remain, including device compatibility, lack of infrastructure, the need to educate users and service providers, and potential spikes in battery consumption. Compatibility constraints and device penetration make the use of Akuracast uneven (Todorov et al., 2022). For UI navigation on smart TVs, text-to-speech (TTS) support is an important part of the accessibility trajectory. IEC 62731:2013 has become an international reference in providing guidelines for voice menus, EPGs, and setup instructions for visually impaired users. This makes accessibility not only focused on content, but also on user interface access.

The literature also shows technological synergies: OBA provides metadata structures for audio personalization, Dialog+ empowers legacy content, Auracast expands public distribution, and TTS bridges the user interface. All of these are combined in an increasingly mature inclusive ecosystem, supported by industry standards and support from professional organizations. Recent literature and research confirm that advances in object-based audio, AI for dialogue enhancement, auracast streaming, and TTS not only understand accessibility needs but also shape new standards for personal, adaptive, and inclusive audio experiences. While adoption challenges remain, the technological foundation and regulatory support build a strong path towards universal broadcasting for all audiences (Pham, et al., 2022; Wang et al., 2025).

3. Methods

This study uses a descriptive qualitative approach to explore and analyze various current technologies and initiatives in improving accessibility and audio quality in the broadcasting sector. This approach was chosen because it is able to describe phenomena in depth, contextually, and comprehensively based on valid and reliable secondary data.

This type of research is a library research with a descriptive-qualitative approach. Researchers do not conduct direct experiments, but rather explore data from various written and digital sources to identify trends, concepts, and implications of implementing audio technology for broadcast accessibility.

The data sources in this study are secondary data, obtained through:

a) National and international scientific journal articles (Scopus, IEEE, ACM, Springer, etc.)
b) Standard technical documents such as MPEG-H, Bluetooth LE Audio, and WCAG
c) Publications from technology development institutions (Fraunhofer IIS, NHK STRL, Bluetooth SIG)
d) Whitepaper reports and user documentation from device manufacturers (Samsung, GN Hearing, Sony)

Data were collected through a systematic review of literature using keywords such as "object-based audio," "dialog enhancement," "Auracast," "audio accessibility," and "assistive listening systems." The scope of the literature was narrowed to focus on five countries with varying levels of technology adoption: Germany, Japan, the United States, Indonesia, and Thailand.

Data analysis used the thematic analysis method. The data obtained were categorized into main themes, such as:

a) Object-based audio technology (MPEG-H)
b) AI-based dialogue enhancement (Dialog+)
c) Automatic audio description
d) Public audio distribution system (Auracast™)
e) Accessibility interface and device support (TTS, audio presets)
f) Each theme was analyzed to identify benefits, challenges, and potential developments in the context of inclusive broadcasting.

To ensure validity, data was cross-checked from various credible sources and references. In addition, researchers used source triangulation to ensure that the information used came from trusted institutions or publications.

4. Results and Discussion

This section presents the analysis and interpretation of data collected from secondary sources regarding the current implementation and challenges of audio accessibility technologies across several countries. The findings are organized thematically based on the technological domains identified in the methodology: Object-Based Audio (OBA), AI-based Dialogue Enhancement, Auracast™ public broadcasting, and TTS-enabled accessibility on Smart TVs.

4.1. Comparative Analysis of Technology Implementation by Country

Based on data synthesized from literature and institutional sources, a comparative analysis was conducted to evaluate the adoption of four key audio accessibility technologies OBA (MPEG-H), Dialog+ AI, TTS-enabled Smart TV, and Auracast™ across five countries: Germany, Japan, United States, Indonesia, and Thailand. As illustrated in Figure 1, a radar chart visually presents the uniform adoption of all four technologies in Germany, Japan, and the US, contrasted with partial or non-existent adoption in Indonesia and Thailand.

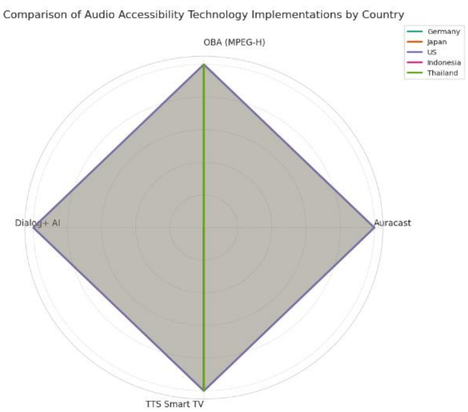

Figure 1: Comparison of audio accessibility technology implementations by country (radar chart)

The bar chart in Figure 2 provides a clearer categorical breakdown. Germany, Japan, and the United States have implemented all four technologies (implementation level = 1). Indonesia and Thailand, however, show significant gaps, particularly in the deployment of OBA, Dialog+ AI, and Auracast™. Thailand appears to have made progress solely in deploying TTS-enabled Smart TVs.

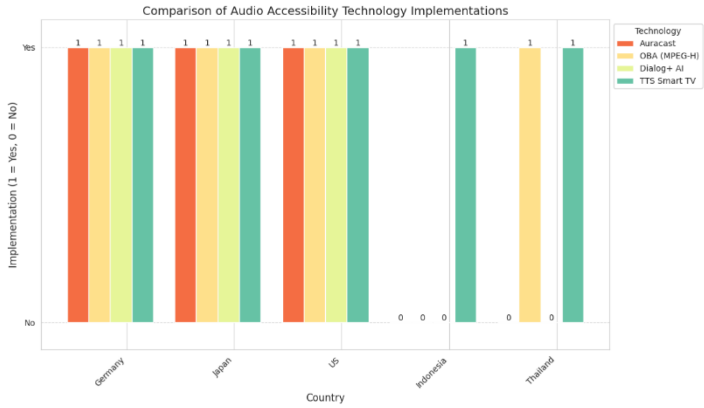

Figure 2: Implementation status of audio accessibility technologies by country (bar chart)

This disparity underscores a geographic divide in accessibility readiness. While industrialized countries lead in comprehensive implementation, developing nations face systemic barriers that hinder technology penetration. This supports literature findings such as those by Pham et al. (2022) and Wang et al. (2025), which highlighted gaps in infrastructure, regulation, and awareness across regions.

4.2. Barriers to Adoption

A thematic analysis of secondary data identified five primary barriers to the adoption of audio accessibility technology in broadcasting, as summarized in Figure 3.

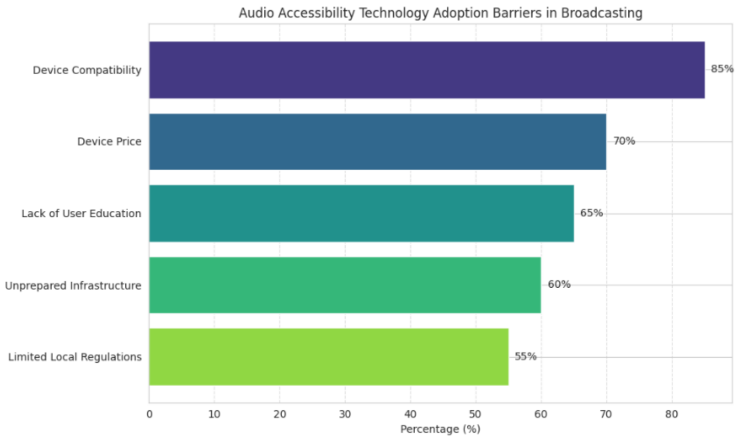

Figure 3: Audio accessibility technology adoption barriers in broadcasting

The most critical barrier is device compatibility (85%), reflecting the fragmentation across consumer hardware ecosystems. Although platforms like Auracast™ offer advanced streaming capabilities, their effectiveness is limited by the uneven availability of compatible receivers (e.g., hearing aids, earbuds, smart TVs).

Device pricing (70%) was the second most cited obstacle. Despite improvements in cost-efficiency, next-generation systems such as OBA and TTS-enabled smart interfaces often require significant hardware upgrades. This is followed closely by a lack of user education (65%), which limits the ability of users with disabilities to optimally utilize these technologies.

Other substantial challenges include unprepared infrastructure (60%), particularly in developing regions, and limited local regulations (55%), which often do not mandate or incentivize inclusive broadcasting standards. These findings are consistent with the institutional reports from Bluetooth SIG and Fraunhofer IIS, which emphasize the need for harmonized regulation, public-private partnerships, and consumer education to accelerate adoption.

4.3. Integration of Inclusive Audio Ecosystems

The intersection of the technologies discussed MPEG-H Audio, Dialog+, Auracast™, and TTS-enabled interfaces constitutes a robust ecosystem of inclusive broadcasting. Countries that have embraced all four systems demonstrate higher accessibility readiness, indicating not only technological maturity but also policy support and public awareness.

Germany's full implementation, for example, is supported by strong regulatory mandates (e.g., EU Accessibility Act), government-funded pilot projects, and industry-academia collaborations. In contrast, the absence of integrated standards and support mechanisms in countries like Indonesia and Thailand has constrained their ability to implement assistive listening systems widely.

The success of the ecosystem also depends on synergy between object-level metadata (MPEG-H), AI-powered enhancement (Dialog+), and ubiquitous connectivity (Auracast™), with TTS functionalities bridging the interface-accessibility gap. As the literature (Grewe et al., 2021; Torcoli et al., 2021) suggests, these technologies must be implemented holistically to ensure meaningful accessibility for all, including the visually and hearing impaired.

5. Conclussion

This study concludes that the advancement of audio accessibility technologies such as Object-Based Audio (MPEG-H), AI-driven dialogue enhancement (Dialog+), Auracast™ public broadcasting, and TTS-enabled interfaces on smart TVs has contributed significantly to the inclusivity of modern broadcasting systems. The comparative analysis shows that developed countries like Germany, Japan, and the United States have successfully implemented all four technologies, supported by robust infrastructure, regulatory mandates, and public awareness. On the other hand, countries like Indonesia and Thailand lag in adoption, primarily due to systemic challenges.

Thematic findings reveal that key barriers to adoption include device compatibility (85%), high device pricing (70%), lack of user education (65%), unprepared infrastructure (60%), and limited local regulations (55%). These factors collectively hinder the equitable distribution and utility of assistive audio technologies, especially in emerging markets.

Ultimately, this study emphasizes the importance of holistic integration. An effective ecosystem must synergize object-level audio metadata (MPEG-H), AI-based enhancement for legacy content (Dialog+), seamless public distribution (Auracast™), and accessible user interfaces (TTS). Countries that align technological innovation with policy, public engagement, and education are better positioned to achieve universal audio accessibility in broadcasting

References

Botelho, F. H. (2021). Accessibility to digital technology: Virtual barriers, real opportunities. *Assistive Technology*, 27-34.

Grewe, Y., Eibl, P., Simon, C., Torcoli, M., Rieger, D., & Scuda, U. (2021, October). MPEG-H Audio production workflows for a Next Generation Audio Experience in Broadcast, Streaming and Music. In *Audio Engineering Society Convention 151*. Audio Engineering Society.

Johnson, A. (2025, March 14). *Android 16 is getting a major hearing accessibility feature*. The Verge. Accessed from https://www.theverge.com/2025/3/14/android-16-hearing-accessibility-auracast.

Millett, P. (2023). The Connected Life: Using Access Technology at Home, at School and in the Community. Education Sciences, 13(8), 761.

Pham, H. A., Le, T. M., Le, V., Phuong, T. M., & Tran, T. (2022, October). Video dialog as conversation about objects living in space-time. In *European Conference on Computer Vision (pp. 710-726)*. Cham: Springer Nature Switzerland.

Todorov, M., Galvin, K., Punch, R., Klieve, S., & Rickards, F. (2022). Barriers and facilitators to engaging in mainstream primary school classrooms: Voices of students who are deaf or hard-of-hearing. *Deafness & Education International, 24*(1), 2-23.

Torcoli, M., Simon, C., Paulus, J., Straninger, D., Riedel, A., Koch, V., ... & Murtaza, A. (2021). Dialog+ in broadcasting: First field tests using deep-learning-based dialogue enhancement. *arXiv preprint arXiv:2112*.09494.

Wang, H., Guo, B., Zeng, Y., Chen, M., Ding, Y., Zhang, Y., ... & Yu, Z. (2025). Enabling harmonious human-machine interaction with visual-context augmented dialogue system: A review. *ACM Transactions on Information Systems, 43*(3), 1-59.

William, P., Gupta, M., Chinthamu, N., Shrivastava, A., Kumar, I., & Rao, A. K. (2023, July). Novel approach for software reliability analysis controlled with multifunctional machine learning approach. In *2023 4th International Conference on Electronics and Sustainable Communication Systems (ICESC)* (pp. 1445-1450). IEEE.