

Transitioning from Analogue to Digital Radio Broadcasting: A Simulcast System Approach in Indonesia

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Abstract

The Indonesian government's initiative to transform digital radio broadcasting has commenced, facilitating the transition from analogue to digital radio transmission via a simulcast system. Comprehensive implementation of these technological changes has the potential to yield optimal digital radio broadcasting ecosystems. A distinguishing attribute of this simulcast system is its capacity to transmit analogue and digital frequencies concurrently. Despite its considerable practical relevance, there is a paucity of systematic knowledge regarding the reasons why analogue and digital radio broadcast simulcast systems must be implemented to maintain pace with the development of broadcasting technology in this digital age. This research contributes to the future of radio broadcasting by exploring the ecosystem factors of a multiplatform simulcast broadcast model. This analysis is grounded in a qualitative examination of the simulcast system (both analogue and digital) within the Internet sector of the broadcast industry. The research identifies several factors: first, terrestrial analogue radio; second, terrestrial digital radio; third, Internet radio and human resources; fourth, analogue and digital simulcast systems; and fourth, Internet multi-social media platforms.

Keywords: Radio Broadcasting, Analogue, Digital, Multi-Platform, Internet.

Introduction

The analogue radio industry must transition swiftly into the digital broadcasting era. This necessity arises from the mounting demand for broadband radio and wireless communication. Consequently, the conversion of analogue to digital radio frequencies has become imperative. (Li et al., 2022) It is imperative for the radio industry to adapt to the transformation of the digital radio broadcasting ecosystem into a medium for media and entertainment, with the objective of revitalising the broadcast industry. To this end, it is imperative that all relevant stakeholders adhere to established policies through specific, tangible actions. (PRZEMYSŁAW FALKOWSKI-GILSKI & FALKOWSKI-GILSKI, 2021) It is incumbent upon governments to determine the optimal approach toward radio broadcasters, ensuring that they operate in a manner that aligns with the public interest and the imperatives of radio providers, encompassing public services and the digital transformation of the economy. Digital transformation initiatives must be implemented to facilitate access to a platform-based business model that provides proximity to potential customers, radio listeners, and advertisers. (Rohn et al., 2021)

Historically, the construction industry has exhibited a gradual adoption of digital technology, leading to suboptimal workflows, frequent cost overruns, and delays. This challenge is further compounded by the fragmented structure inherent in the market dynamics. (Moshood et al., 2024) In order to address the digital divide and facilitate connectivity between unconnected populations and those already served by remote communities, the digital transition is expected to leverage existing technological infrastructure. This digital system has been used in 85% of the world's territory since 2015. A pragmatic perspective, termed "change", can be used as a direct example of the change that is occurring in radio management in the digital age. Once radio managers internalise these values, it becomes imperative to understand the implications of this transformation. This study focuses on radio broadcasting using analogue and digital cast systems. To provide resources for a high-performance hybrid computer system with an integrated digital platform

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framework, service issues must be considered.

It is widely acknowledged that the evolution of radio broadcasting stands as a "dramatic" facet within the annals of communication history. Conversely, the resurgence of broadcasting can be characterised as a narrative marked by significant challenges and struggles. Radio, akin to newspapers, magazines, and television, is a medium of mass communication that enables individuals to interact with others for specific purposes. Nevertheless, contemporary radio broadcasting in Indonesia remains largely unchanged since the advent of AM (amplitude modulation) and FM (frequency modulation) technologies in the mid-1980s.

The development of a simulcast system is predicated on the creation of a series of digital broadcasting services consisting of integrated digital platforms from both analogue and digital sources, in addition to the incorporation of Internet-based mobile application-based services as receivers of interconnected radio broadcasts. This approach fosters the development of an ecosystem characterised by a diverse array of listening services and ad installers, aimed at enhancing convenience and achieving economic efficiency. Radio broadcasting using simulcast systems (analogue and digital) is essential for the maintenance of terrestrial broadcasts (Mansoor et al., 2020). The primary objectives and outcomes of this research are to enhance the efficiency of radio broadcasting management, improve listener comfort, and enhance the effectiveness of advertising persuasion by listeners by leveraging the principles of digital transformation in technology and management processes. This study will produce a clear and objective picture of how and why radio management with simulcast systems (analogue and digital) has an impact on broadcasting.

Literature Review

Researchers have increasingly explored ways in which media content can touch, move, and inspire audiences, leading to many beneficial outcomes including increased feelings of connection with and increased motivation to do good to others (Mary Beth Oliver, Arthur A. Raney, Anne Bartsch, Sophie Janicke-Bowles, Markus Appel, 2021) Research related to this digital radio broadcasting is in the country of Nigeria and even around the world. Broadcasting digitisation has become a trend. Since 2015, all broadcasting stations must be digital, and studies have been conducted to identify the challenges in making the transition from analogue to digital broadcast in Nigeria, as well as providing advice to address the challenges identified, including technical and financing challenges, human resources, and knowledge gaps. (Oyedokun & Ajayi, 2022) Technical and financing issues include issues faced by the organizer and the audience. The organiser must provide digital devices from the production to the transmission device. Technical and funding problems include those faced by both the organisation and the listener. Research shows that in Indonesia, radio stations are ready to digitise radio broadcasting, the government is not ready because there are no regulations on digital radio standards, and the public is not prepared because of the lack of socialisation and the importance of digital connectivity in all sectors, including radio broadcasters. Thanks to this network connectivity between people, organisations, resources, and the entire industry, value and economic growth can be produced in an interactive ecosystem of digital platforms. (Rohn et al., 2021)

Media is the first thing that comes to people's minds when they think about their free time. By contrast, mass communication studies all types of media. Currently, it is difficult to clearly define the mass media. However, in the digital world of computers and communications, the word "media" can refer to digital content such as images and videos, which have been published for digital broadcasting or distribution. Any tool used to extend symbols throughout space or thought time is basically a communication medium. Many media are accessible for use in contemporary communication. Nowadays, the way people exchange information is also undergoing major changes, and the connection with computer networking technology is becoming deeper, making people's lives more colourful. (Shan, 2023) A radio is an electronic medium that requires sophisticated electromagnetic equipment and related materials. Programming is the output of radio transmissions in symbols. Broadcasting media usually stretch their symbols over large areas, but not for sufficiently long periods of time. Their symbols are not often used, as they are found in print, photos, and video media, although they can be stored for further use in various electronics applications. (Xu et al., 2019)

The oldest electronic media is radio, which has survived for almost a hundred years and has tried to compete with other media. The persistence of a radio organisation is a major factor in determining its survival. Because radio agents are a group of humans, the purpose is to provide value to a radio program that is accessible to the public. However, we now need a change that affects changes in markets and technology. (Gangwani & Bhatia, 2024) To deliver a program, a radio station needs adequate infrastructure and equipment, ranging from broadcast studio equipment, recording studios, transmission equipment, towers, and antennas.

Like other conventional media, radio focuses on specific segments of the market. Radio and its activity are interrelated, not only its form, but also the human soul and body, both physical and inner. As a result, when defined physically or separately, the radio is a combination of a transmitter, studio, and receiver. Radio technology is very popular in the developing world. The voice transmits information through radio media. The images were in our capacity as listeners. A radio is different from a television because television planes do not have images. Radio is also very different from adventure television programs, because advertisers and program promoters do so creatively. (Fraccastoro et al., 2021) Radio is accessible, unique, and expanding. Another unique feature of radio is that the delivery of messages can be based on geography and demography. Radio recommendations are a form of broadcast medium that can improve the quality of human life. Today, AM and FM radio can only broadcast voice services, but in the future, they will be able to broadcast their broadcasts using digital broadcasting technology, which can transmit audio, text, images, and even visual content. (Plekhanov et al., 2023) Radio broadcasters in Indonesia are now preparing for the development of digital-based radio, which will surely add value to the evolution of the radio industry in the modern era. While digital migration is not as necessary as migration to television, it is an option because radio broadcasting technology is very old and almost perfect in terms of the audio signals transmitted and the price of the receiver devices. (Song et al., 2023)

Radio listeners have different attitudes and skills owing to the diversity of their backgrounds. (Sima et al., 2020) This will cause problems for radio operators who have to determine the right segment for the interests of the personality of the radio station. In addition, listeners receive radio programs from different locations with different levels of disturbance when receiving symbols. (Balsebre-Torroja et al., 2023) This idea concerns the things the audience does when listening. This includes working, reading, driving, sitting, concentrating on a radio programme, and performing other activities. (Antwi-Boateng et al., 2023) Radio is a means of personal and collective communication. As we know, the results are influenced by the way people listen to communication. (Parry D; le Roux D, 2020)

Digital radio broadcasting is radio technology that uses digital signals to transmit information. Radio stations often operate in the public interest through the dissemination of important information (Spence, 2023) which is a generation successor to analogue radio transmission and has many advantages, such as clearer sound than analogue radio better signal quality, and the ability to be interrupted, replayed, or stored temporarily for later listening. (Li et al., 2022) The Digital radio broadcasting aims to improve the frequency spectrum, network transmissions, power consumption, and power transmission efficiency. They also want to improve the quality and stability of the signal so that there is no interference, noise, fatigue, sharper sound resolution, or better sound stability. In addition, it allows the development of different types of demodulation, improves signal interoperability compatibility, and corrects transmission disturbances, known as error correction. (Zhang, 2023)

Digital radio broadcasting is a radio technology that aims to enhance the transmission, network, and frequency spectrum. The aim of this study is to provide a deeper overview of the implementation of analogue and digital radio media simulcast systems in Indonesia, with the basic components to be found. (Harliantara, 2024) Furthermore, the aim of the research is to gain a more profound understanding of the application of analogous and digital multimedia simulcast in Indonesia. Another goal of this study is to obtain a better understanding. An additional objective is to produce responsive theoretical models and methods for radio broadcasters associated with digital and analogue multimedia broadcasting applications. (Singh, 2018) Simulcast (simultaneous) is the maintenance of broadcasting analogue radio and digital radio broadcasts at the same time. This shows that broadcasters simultaneously broadcast multiple transmissions of the same content through different media, allowing them to reach a wider audience. (Przemyslaw

Falkowski-Gilski & Falkowski-Gilski, 2021)

Methodology

To determine the implementation of digital radio transition in Indonesia with the key questions to be found, this study aims to provide a comprehensive overview of the simulcast system: the transition of analogue to digital radio broadcasting in Indonesia. This research uses qualitative case study techniques, a type of qualitative data analysis that emphasises specific issues with the development of digital radio in Indonesia. A qualitative research approach allows for a deeper understanding of the phenomena studied. (Stephen Attuh & Kankam, 2022) Data collection and analysis serve as a flexible framework for understanding research cases. The findings of this study were interpreted by considering the implementation of digital radio in Indonesia. To process the data from multiple sources, descriptive patterns for digital radio implementation were set, checked, and explained. Researchers use methodologies of data reduction analysis, data display, and conclusion writing to conduct research within a framework relevant to case studies. The scientific benefit of this research is the development of communication science, particularly in the field of radio broadcasting. Researchers are convinced that, at present, especially in Indonesia, there is not much research on the transformation of analogue radio technology towards digital radio with a simulcast system.

Results and Discussion

Broadcasting Technology

Radio broadcasting technology in Indonesia will become digital. Nowadays, the only thing that is migrating to digital technology is television. The radio has not yet migrated to the digital world. Radio still looks for the best form. The Indonesian government is studying the advantages and disadvantages of broadcasting technologies that use either digital terrestrial Digital Audio Broadcasting (DAB) or DRM. (Digital Radio Mondiale). Article 41 of Ministerial Regulation No. 6 of 2021 states that (1) the maintenance of the broadcasting services of Broadcasting Services digitally through the terrestrial system includes program services, multiplexing services, and auxiliary services. (2) The program can be conducted by the Agency of the Republic of Indonesia, LPP (local public broadcasting, private broadcasting (LPS), and LPK. (community broadcasting). (3) Multiplexing Services can be performed by public broadcasting (LPPs) and private broadcasting (LPSs). (4) Additional Services can be provided by the LPP, LPAs, LPs, and LPC. An important note in the regulation affirms that radio maintenance permits are still granted where the Government of the Republic of Indonesia has not enforced the ASO. (Analogue Switch Off). He is still studying the process of transformation toward digital and deadly analogue radio broadcasts. This regulation refers to additional services as value-added services organised by using the supply of multiplexing capacity on a digital broadcasting system to provide other services such as audio content and data casting services for weather information, education, capital markets, and the latest news. The broadcasting technology that currently exists in Indonesia is terrestrial analogue radio, with special permission from the government. Digital terrestrial radio broadcasting is still in the study and testing phases of DAB+ and DRM, while the Internet is the broadcaster's initiative to adapt to the digital Internet through streaming broadcasts. For clarity, we can see the first picture of radio broadcasting technology.

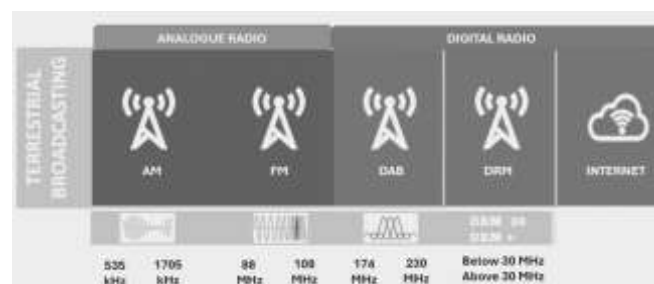


Figure 1. Radio Broadcasting Technology

Source: Processed Research

Broadcasting technology in Indonesia is going to become digital today and has migrated to digital television only. Radio still looks for the best form. The Indonesian government is studying the advantages and disadvantages of broadcasting technologies that use either digital terrestrial Digital Audio Broadcasting (DAB) or DRM. (Digital Radio Mondiale). Article 41 of Ministerial Regulation No. 6 of 2021 states that (1) the maintenance of the broadcasting services of Broadcasting Services digitally through terrestrial systems includes broadcast program services, multiplexing services, and auxiliary services. (2) Broadcasting programs can be carried out by broadcasters in the Republic of Indonesia, local public broadcasting (private broadcasting), and private broadcasting (LPK). (community broadcasting). (3) Multiplexing Services can be performed by Public Broadcasts (LPPs) and LPS. (Private Broadcasting) The results of the research show that the Indonesian government is currently studying a land-based digital system, not an ASO (analog switch off), but such a terrestrial digital option has not been defined and regulated in the Broadcasting Act. Therefore, the government allows analogue ground radio stations (AM, FM) to choose digital land can DAB or DRM included in integrated with the Internet and run simultaneously (Simulcast). (Harliantara; Heny; Deni; & Nurannafi, 2024)

Figure 1 shows that broadcasting technology radio stations in Indonesia do not migrate to digital entirely, but can run analogue radio simulcasts still running alongside digital terrestrial radio and the Internet. The 2002 Broadcasting Act No. 32 is still in force, and the current situation of media penetration in Indonesia is changing, where Internet media has dominated public life, and this has affected the decline in the number of radio listeners. The Government of the Republic of Indonesia continues to socialise and dialogue to find the best solutions so that the radio industry can survive in the era of competitive communications and information technology. The future of the radio industry in Indonesia will begin with a simulcast system, where analogue and digital land radio will run together and the Internet will continue to be used as a complement and adaptation of radio agents to the digital age. While waiting for the digital terrestrial radio infrastructure to work as it should, radio broadcasters are now using it for the innovative integration of analogue radio and the Internet. (digital). Currently, using the Internet, the station has real listener data, which is rarely done in analogue listener research. However, not all radio stations use Internet-based digital radios. To prepare for the digital transformation of radio broadcasters, they need to be equipped with digital skills that can be used for Internet-based radio competencies to enhance creativity and innovation. However, not all radio broadcasters have maximum digital thinking. Moreover, the most digitally intelligent radio managers can earn extra money from creative channels on the Internet. However, not all radio stations can take advantage of this opportunity.

Analog Radio Broadcasting

Any tool used to extend symbols throughout space or thought time is basically a communication medium. Many media are accessible for use in contemporary communication. A radio is an electronic medium that requires sophisticated electromagnetic equipment and related materials. Programming is the output of radio transmissions in symbols. Broadcasting media usually stretch their symbols over large areas, but not for sufficiently long periods of time. Their symbols are not often used, as they are found in print, photos, and video media, although they can be stored for further use in various electronics applications. The oldest electronic media is radio, which has survived for almost a hundred years and has tried to compete with other media. The persistence of a radio organisation is a major factor in determining its survival. Because radio agents are a group of humans, the purpose is to provide value to a radio program that is accessible to the public.

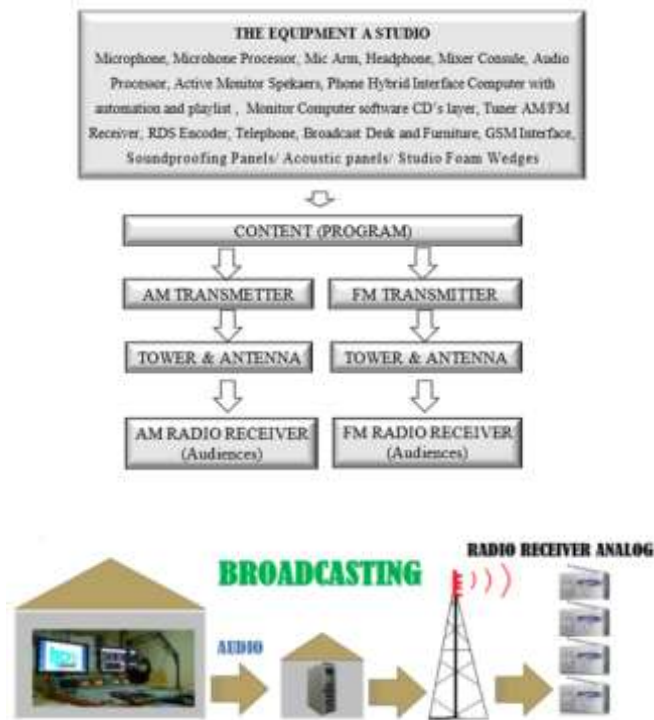


Figure 2. Analog Radio Broadcasting Terrestrial

Source: Processed Research

Figure 2 shows an analogue radio broadcasting scheme with each system managing the broadcast itself with FM frequency and broadcast power tailored to the Capital Category (maximum 20,000 Watt) and Provincial Capital (maximum 10,000 Watt) District Cities (maximum 5000 Watt). This is governed by government regulation. Therefore, the broadcast range varies depending on the transmitter power at each radio station. The results of this study show that analogue radio uses Amplitudo Modulation (AM) transmission and is still used worldwide for medium (MW), long (LW), and short (SW) waves. Moreover, AM transmission is much more susceptible to signal interference than FM or digital, and often has lower audio, as AM tends to be in spoken word formats such as spoken radio, all news, and sports. Frequencies LF 153 – 279 KHz, MF 531 – 1602 KHz and MF 2.3 – 26.1 MHz (FM). FM broadcasts can produce better sound quality than AM broadcasts. Worldwide, FM broadcasters are a part of the VHF portion of the radio spectrum. Usually, between 87.5 to 108.0 MHz.

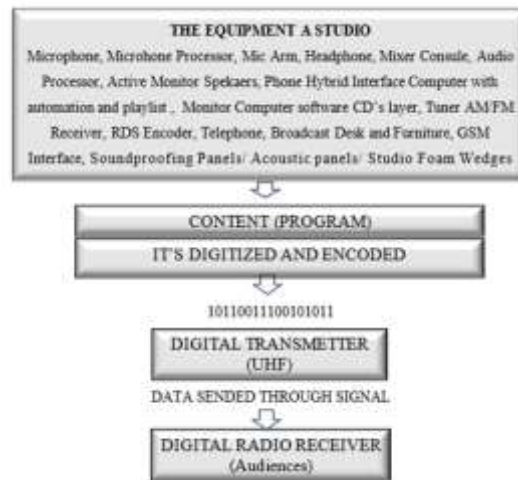
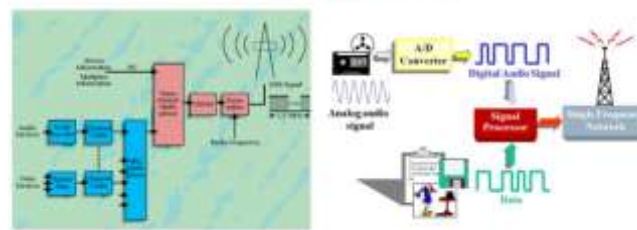
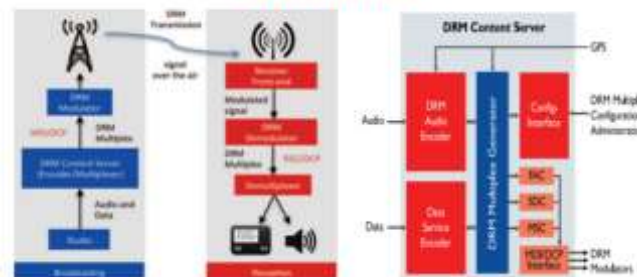
Digital Radio Broadcasting**D A B SYSTEM****D R M SYSTEM**

Figure 3. Digital Terrestrial Radio Broadcasting

Source: Processed Research

Figure 3 shows that digital radio using the DAB system is a standard digital radio audio broadcasting service that is used in many countries around the world. DAB is more efficient at using the frequency spectrum than AM or FM radio. DAB also offers more services with the same bandwidth, and the sound quality can feel lower if the bit level is assigned to each audio program. DAB is not directly compatible with DAB+, which means that the receivers from DAB broadcast cannot receive DAB+ broadcasts. In addition, DAB uses frequencies with the bandwidth assigned to Band III (174-240 MHz) and the L Band. (1.4452-1 – 492 GHz). The original version of the DA uses an enhanced MP 2 codec called DAB + using the HE-A audio codec vAC2. Digital radio using a DRM system is a digital radio standard designed to operate on bands that are currently used for AM and FM analogue radio broadcasts. Furthermore, DRM is more spectrally efficient than AM or FM, allowing more stations with a higher quality for a certain amount of bandwidth. DRM also uses various MPEG-4 and DRM 30 audio encoding formats using frequencies below 30 MHz

as well as generally in band II (87.5 – 108 MHz) and Band III. (174 -230 MHz).

To date, the government has granted permission to the radio industry, which means that ASO (Analog switch off (ASO) has not yet been implemented, but the option is to use a simulcast system in which radio stations use audio broadcasting that can be done simultaneously on two or more channels and can be used by private radio broadcasters. If the future is determined, the government must formally determine which digital radio maintenance is used, including the channel rental rate for the multiplexing service. These additional rent charges are related to the technology infrastructure used, such as location, electricity, towers, and shared antennas, as well as the human resources responsible for managing the multiplex service. The research finds that, so far, the Government of the Republic of Indonesia is conducting studies and socialisation, as well as dialogue with radio industry actors on how the process of transforming analogue terrestrial radio broadcasting into digital terrestrial radio can go well. There are two accepted research systems: the DAB and DRM. Both have their own advantages and disadvantages. This study is based on Indonesia's extensive geographical location and the existence of flat lands, mountains, and oceans.

The result of this study is that digital radio using the DAB system is a standard digital radio audio broadcasting service used in many countries around the world. (O'Neill, 2009) DAB is more efficient at using the frequency spectrum than AM or FM radio. DAB also offers more services with the same bandwidth, and the sound quality can feel lower if the bit level is assigned to each audio program. DAB is not directly compatible with DAB+, which means that the receivers from the DAB broadcast cannot receive DAB+ broadcasts. Moreover, DAB uses frequencies with the bandwidth assigned for Band III (174-240 MHz) and the L Band. (1.4452-1 – 492 GHz). The original DA version used an enhanced MP2 codec called DAB+, using the HE-AAC2 audio codec. Digital radio using a DRM system is a digital radio standard designed to work on the bands currently used for AM and FM analogue radio broadcasts. Furthermore, DRM is more spectrally efficient than AM or FM, allowing more stations with a higher quality for a certain amount of bandwidth. DRM also uses various MPEG-4 and DRM 30 audio encoding formats using frequencies below 30 MHz as well as in band II (87.5 – 108 MHz) and Band III. (174 -230 MHz). To date, the government has granted permission to the radio industry, which means that ASO (Analog switch off (ASO) has not yet been implemented, but the option is to use a simulcast system; in this case, radio stations using audio transmission can be broadcast simultaneously on two or more channels and can be used by private radio broadcasters. If the future is determined, the government must formally determine which digital radio maintenance is used, including the channel rental rate for the multiplexing service. These additional rent charges are related to the technology infrastructure used, such as location, power, towers, and shared antennas, as well as the human resources responsible for managing the multiplex service.

From an interview with the Director of Broadcasting of the Ministry of Communication and Information of the Republic of Indonesia, Ir. Geryantika Kurnia, M.Eng, MA. Delivered at the facilitation of human resource capacity building and empowerment of radio broadcasting in Semarang on 3 October 2024 “*the government is currently conducting DAB (Digital Audio Broadcasting (DAB) trials in several areas such as Jakarta, Bandung and Surabaya, Semarang, Yogyakarta, and Malang, (Digital Radio Mondiale) trials in Pelabuhan Ratu City, Painan, Cilacap, and Labuan Bajo. This trial was implemented by the Public Broadcasting Organization Radio Republik Indonesia (RRI).*

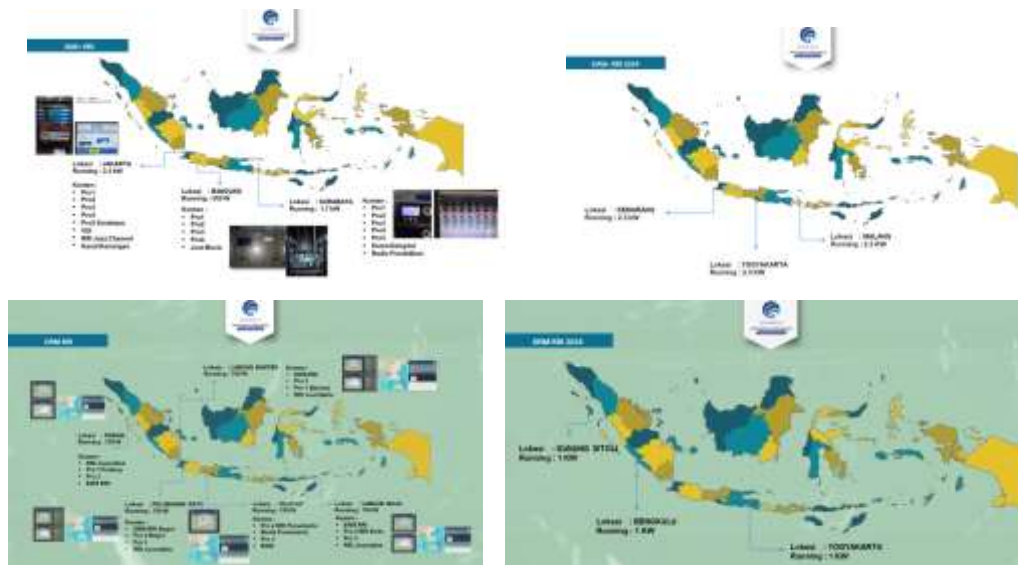


Figure 4. DAB & DRM Trial Locations in Indonesia

Source: Directorate of Technology and New Media LPP RRI

Activities in cyberspace or, second, the need to apply a real-world equity model to the virtual world. The Government of Indonesia strives to provide support for the development of information technology, particularly the management of information and electronic transactions, as well as legal and regulatory infrastructure, so that the use of information technologies can be performed safely with the minimisation of its negative consequences. Finally, the Electronic Information and Transactions Act (ITE Act) was adopted by the President of the Republic of Indonesia on the proposal of the Department of Communications and Informatics through the Directorate-General of Telematics Applications to implement Act No. 11 of 2008 on electronic information and transactions, and was implemented as of 21 April 2008. The ITE Act consists of thirteen chapters and fifty-four chapters that form the legal domain to regulate cyberspace in Indonesia. The development of radio broadcasting that now integrates radio and Internet broadcasts, in legal terms, in addition to having to comply with existing broadcast regulations, radio broadcasters now face new areas of law in Indonesia, especially in information technology and activities. The legal aspects used in cyberspace include Internet law, information and technology law, telecommunications law, and computer law. Cyber law as a newly reviewed jurisdiction to regulate specifically activities in cyberspace, including, among other things, copyright, trademarks, disguise or pollution of good name, privacy, liability, crime, electronic contracts, electronic commerce, electronic government, pornography, and theft. Societies in the 21st century are highly dependent on computer technology, hardware and software, communication networks, and multimedia technology. However, behind the benefits of this computer technology, recent problems such as intellectual property violations, fraud in electronic transactions, taxes in electronic commerce, and cybercrime. Therefore, Indonesia needs to consider cyberspace activities more seriously. The Government of Indonesia strives to provide support for the development of information technology, particularly the management of information and electronic transactions, as well as legal and regulatory infrastructure, so that the use of information technologies can be performed safely with the minimisation of its negative consequences. Finally, the Electronic Information and Transactions Act (ITE Act) was adopted by the President of the Republic of Indonesia on the proposal of the Department of Communications and Informatics through the Directorate-General of Telematics Applications to implement Act No. 11 of 2008 on electronic information and transactions, and was implemented as of 21 April 2008. The ITE Act consists of thirteen chapters and fifty-four chapters that form the legal domain to regulate cyberspace in Indonesia.

Communication processes are optimized according to convergence outcomes (Shunli Wu, Haoping An, Yan Gao, 2022) In the sense of technology, convergence activities are major convergent technologies that are classified as telecommunications or communication technologies, computerization or computing, and

content or content loads. Efforts to integrate next-generation telecommunication regulations with broadcast content have been very weak. The risk of political interference in such regulations surely arises when it comes to broadcasting content regulations, independence, and accountability. Cyber law is specifically touched by legal certainty, but when using internet media or cyberspace (virtual world), regulations will refer to the Information and Electronic Transactions Act. (UU ITE). This has been in force since 2008, when the Broadcasting Act came into force in 2002. On 2 December 2022 the researchers attended the Radio Discussion Forum (FDR) with stakeholders and private broadcasters, represented by the Organizational Centre Manager (PRSSNI) and DKI Regional Manager. (PRSSNI). Generally, the organogram does not consider implementing the simulated system and waiting for further regulation. The Radio Discussions Forum (FDR) says Indonesia should implement a single platform (DAB or DRM). If there are two platforms, radio listeners will be hesitant to use digital terrestrial radio, because each city will switch platforms from DAB to DRM. Instead, listeners would continue to use FM analogues because they do not want difficulty switching channels. The government must create a comprehensive "road map" to support the transition from radio broadcasting technology to simulated systems and boost the development of digital radio in Indonesia. Regulation relating to the funding scheme and financing of the national digital transformation with the simulcast system is very important. In today's technological age, Indonesia must take strategic action to improve the competitiveness of its radio broadcasting industry. Therefore, the government must prepare a broader infrastructure for conducting additional trials, such as planning digital radio, setting standards for digital radiation broadcasts, testing digit radio, simulcasting analogue and digital radio, and full digital radio.

A team study and Radio Discussion Forum conducted on 17 November 2022 showed that some important elements in managing radio broadcasting with a simulcast system have been discussed. Business aspects: business model radio broadcasting simulcasting, multiplex radio maintenance, radio simulcast maintenance benefit; technical aspect: infrastructure is transmitter and radio receiver, and broadcast receiving service quality. Supporting aspects: The development of the digital radio ecosystem and the socialisation of education in society. In addition, the government must address issues related to legal and policy requirements. Digital radio maintenance permit: Multiplex radio maintenance permit and radio program maintainer permit. Evaluation and Validation of Digital Radio Broadcasting Operations: Operational Eligibility Test, Radio Multiplexing Conservation, Operational Skill Test, Radio program conservancy. Licence fees for maintenance of television broadcasts: National broadcasting licence fees for radio multiplexing maintenance, broadcast licence costs for local radio multiplex management, and licence fees for the surveillance of radio programs. Area of service: Service area for radio-multiplex maintenance and service area for radio program maintenance. Rental fees for slots: Rental charges for chopper slots to maintain national radio multiplexing and charges to rent chopper slots for local radio multimedia.

Internet Radio and Human Resources

The licencing policy for digital radio with a simulated system should be restricted. This is because the licencing process is carried out through a selection or evaluation process, with priority given to radio broadcasters who already have licences. Furthermore, a selective licence must comply with applicable legal provisions. More than 3,000 radio stations are currently broadcasting their programs over the internet. The Internet offers unlimited possibilities for radio access. Radio broadcasts can be retransmitted over the Internet. The development of radio via the Internet has grown since the birth of radio in the United States. Since the 1990s, radio has become available on the internet. There are two types of Internet radio stations: one that comes from the broadcast and the other that comes only from the Internet. In the first category, stations usually broadcast broadcast signals through the Web. The second category of Internet stations typically offers programming electronically and independently in the cyber world. Traditional ground stations have limited range and operational parameters, but Internet radio has no geographical constraints. With web access, anyone can enjoy Internet media. Internet radio is a radio that uses the development of Internet technology and social media applications. The need for access to Internet-based services is increasing. Radio has also tried to use a version of the broadcast over the Internet. In Indonesia, few people use this technology because of poor Internet connections. If you want to use it, you should choose streaming software that does not use a lot of bandwidth resources, and the encoder setting should be as

short as possible, such as 16-24 Kbps. (mono). Some Internet radio servers are not too large; for example, the Shoutcast server is only 136kb. There are several advantages of online radio or internet radio, namely: unlimited broadcast range if it has internet access, digital sound quality, and does not require permission like traditional radio

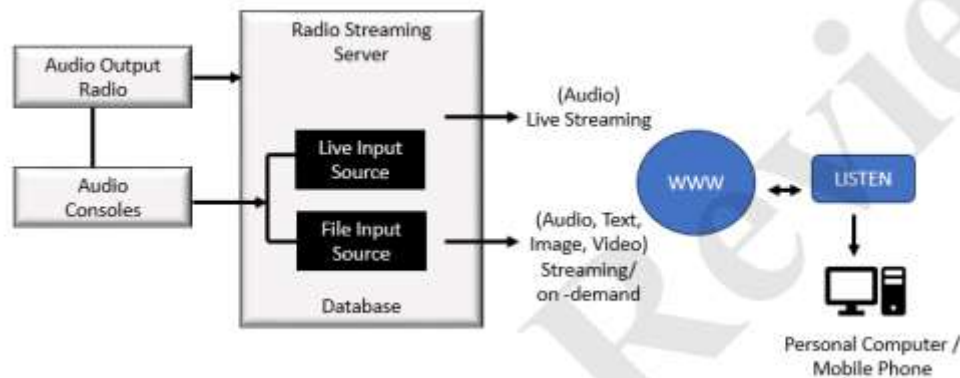


Figure 5. Internet Radio

Source: Processed Research

The radio program was sent to the internet. The use of the Internet by radio stations expands the content of radio broadcasts distributed on the Internet. On traditional ground stations, the parameters of range and operation are limited, but on internet radio, there are no geographical constraints. With web access, anyone can enjoy Internet media. Internet radio can provide a wide range of visual data such as images, text, and links, in addition to interactive services. There are several advantages of online radio or Internet radio, namely, an unlimited broadcast range if it has Internet access, digital sound quality, and does not require permission, as in conventional radio. Many radio broadcasters use radio streaming with bitrate 24, Encoder Type AAC plus, Server Type Iccast, and can be accessed alongside PCs via phones, and they simply have to instal an application on Google Play. A comprehensive review of the emerging concept of the Internet of Intelligent Things (IoIT) adopting an integrated perspective centred on the fields of embedded systems, edge computing, and machine learning. (Oliveira et al., 2024)

Therefore, in operating it, a radio station needs human resources to understand the digital environment. Human resource management is crucial for achieving the goals of radio-broadcasting organisations. The ability to effectively manage these elements is crucial for the success of radio broadcasting. A successful institution, if it has high-quality human resources, despite having sophisticated and modern equipment, must provide human resources that can analyse data and think critically. Since human resources require the ability to keep up with technological progress and adapt to change, it is now necessary to prepare human radio resources with digital capabilities to produce creative and innovative radio content or programs as required in the digital age of the radio broadcasting business. The organisation must provide appropriate training and education to enhance the competence of radio station managers. They must also keep up with current technological developments and trends to compete with other companies. The development of sustainable and comprehensive human resources is a path to such a strategy. Education, competence quality, creativity, innovation, and independence are ways to develop human resources. Good leadership, satisfactory performance, knowledge transfer, group effectiveness, employee support, and work strategy should be the basis of organizational climate support. Organisations, governments, and educational institutions must continue to encourage efforts to enhance these capabilities. Human resources must keep up with technological and human resource advances. The interests of individuals, companies, and associations are why radio human resource planning is so important in today's digital age. Human resource planning is vital to every employee, as it can help them achieve their goals and make them happy with their careers. It is important for an organisation to obtain qualified candidates and prepare them for future leadership positions. In addition, broadcasting industry associations can benefit from these high-potential

staff by increasing the rate of radio output industrially. These can be radio broadcasters that help the process towards the radio broadcasting industry.

Simulcast & Multi-Platform

Globally, conventional radio is facing fierce competition from streaming and on-demand content. (Stanley Tsarwe & Sibanda, 2024) Radio broadcasting business prospects must follow the trend of communication and media information technology convergence so that technology will continue to move the world revolution and radio must capture this prospect. These changes must build subjective human relationships in virtual reality. (Chokwithaya et al., 2023) As a result, radio must survive to be a major force in how to make change. This change will happen in a very fast time because today there are many technological services available and the latest broadcasting innovations, and radio broadcasts must last in the future one is to pay attention to the rapidly evolving technology. In addition to Radio Broadcasting, relevant challenges include heterogeneity, integration, interoperability, distributed security, trust, scale, and resource management. After observing the evolution of analogue-to-digital radio testing, it seems that Indonesian radio broadcasting remains convinced of the transition from analogue to digital. (Belli et al., 2024) Better audio and visual outputs are another advantage of digital broadcasting signals. It is worth mentioning that transmission gadgets will replace PCs and phones with digital technologies. "Digital imperative" and the pressure placed on to go digital. This means that the radio device will be able to connect to the internet. Data from the audio and visual signals received are also stored. (Bennich, 2024) With the emergence of the Internet and the rapid development of technologies such as artificial intelligence, cloud computing, and the Internet of Things, increasing the amount of data that is transmitted becomes more important. The problem with traditional broadcasting and the existing infrastructure is how to adapt knowledge to the growing business needs of a high-efficiency media industry. (García et al., 2024) multi-platform enabling listeners to many choices of listening to digital radio, the proliferation of digital consumer platforms is one of the developments that transform the parameters of commercial transactions and consumer behavior. (Neeley & Leonardi, 2022) Besides, with "Industry 4.0", both for solutions in social and environmental harmony and for innovative and socially responsible economic attractiveness. (Bouças Teixeira & Perez Teixeira, 2022)



Figure 6: Simulcast System (Multi-Platform)

Source: Processed Research

Conclusion

In general, private radio broadcasters have no objections to implementing simulcast systems. They will wait for the rules set by the government and will incorporate the current analogue system used not on the right "off". In addition, private radio broadcasts are licenced, and members of PRSSNI (Existing) hope to prioritise the filling of digital terrestrial broadcast channels prepared by the government. At the same time, the transformation of radio digitisation will surely be a unique challenge for governments as regulators,

consumers (radio listeners), public and private radio providers, and communities. However, the government must determine its attitude toward radio broadcasting, whether to be regulated or allowed to run naturally, according to the needs of the public and radio providers. Digital audio broadcasting (DAB), or G-System Digital Radio Mondiale (DRM), is the most suitable digital radio technology standard for Indonesia. Therefore, Indonesia must implement a single platform, both the DAB and DRM. The choice for digital radio broadcasting standards is based on an open system, which allows an open standard to be used internationally; many countries use it, with no annual fees for licences, adequate frequencies for Indonesia's location, cost efficiency, easier migration processes, and more receiver devices.

Radio listeners would be hesitant to use digital terrestrial radio if there were two (or two) different platforms as the platform shifted from DAB to DRM in each city. On the contrary, listeners will still use FM analogues because they do not want trouble changing channels. We need to meet with DAB or DRM providers because we need them to provide data on how many digital radio listeners are listening to the broadcast. Radio transmission can compete with digital broadband if it can display listener data in real-time. Not all receivers can provide data; only receivers that are integrated with broadband (such as car radio and HP) can send broadcast data to the server, and the radio receiver can download data. The government should set the subject for digital radio maintenance, including the rental rate of multiplexing channels and additional services. The rental of multiplexing services requires special consideration, as it relates to the cost of the technology infrastructure used, including location, electricity, towers, and shared antennas, as well as the human resources responsible for managing additional multiplex services.

To ensure that all products sold in Indonesia, regardless of brand, can capture analogue and digital terrestrial radio broadcasts, the government must encourage mobile and electronics manufacturers. In Indonesia, analogue radio broadcasts are not turned off, but analogue receivers are very rare. In addition, to produce a reproducible product, "the development of an analogue radio receiver" is required. The term refers to the use of innovative ideas to produce interesting and modern products or to add value to modern products commonly used by society, such as power banks or refrigerators in the home, the addition of SW/AM/FM channels, and the development of DAB and DRM. Government socialisation of radio broadcasting digitisation must be enhanced in the implementation of digital radio transmission systems through simulcast systems for radio stations and the public as listeners.

Author Contributions

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author, Harliantara, upon reasonable request.

References

- Antwi-Boateng, O., Musa, M. D., & Andani, M. A. I. (2023). Audience listenership of FM radio: A case study of rural development in Northern Ghana. *Cogent Arts and Humanities*, 10(1). <https://doi.org/10.1080/23311983.2023.2184750>
- Balsebre-Torroja, A., Ortiz-Sobrino, M. Á., & Soengas-Pérez, X. (2023). Cross-media radio and hybrid radio: the new way to inform and entertain yourself on the digital stage. *Revista Latina de Comunicacion Social*, 2023(81), 17–39. <https://doi.org/10.4185/rlds-2023-1848>
- Belli, D., Barsocchi, P., & Palumbo, F. (2024). Connectivity Standards Alliance Matter: State of the art and opportunities. *Internet of Things (Netherlands)*, 25(November 2023), 101005. <https://doi.org/10.1016/j.iot.2023.101005>
- Bennich, A. (2024). The digital imperative: Institutional pressures to digitalise. *Technology in Society*, 76(November 2023), 102436. <https://doi.org/10.1016/j.techsoc.2023.102436>
- Bouças Teixeira, C. H. S., & Perez Teixeira, R. L. (2022). CONVERGENCES BETWEEN CIRCULAR ECONOMY AND INDUSTRY 4 . 0 PRACTICES Convergences Between Circular Economy and Industry 4 . 0 Practices 1 INTRODUCTION The shift to a " Circular Economy " with " Industry 4 . 0 " technologies is an opportunity for business ,. 1–18.
- Chokwitthaya, C., Zhu, Y., & Lu, W. (2023). Ontology for experimentation of human-building interactions using virtual reality. *Advanced Engineering Informatics*, 55(January), 101903. <https://doi.org/10.1016/j.aei.2023.101903>
- Fraccastoro, S., Gabrielsson, M., & Pullins, E. B. (2021). The integrated use of social media, digital, and traditional communication tools in the B2B sales process of international SMEs. *International Business Review*, 30(4), 101776. <https://doi.org/10.1016/j.ibusrev.2020.101776>
- Gangwani, K. K., & Bhatia, M. S. (2024). The effect of market orientation and technology orientation on industry 4.0 technologies and market performance: Role of innovation capability. *Industrial Marketing Management*, 118, 231–241. <https://doi.org/10.1016/J.INDMARMAN.2024.03.004>
- García, Á., Bregon, A., & Martínez-Prieto, M. A. (2024). Digital Twin Learning Ecosystem: A cyber-physical framework to integrate human-machine knowledge in traditional manufacturing. *Internet of Things (Netherlands)*, 25(November 2023), 1–22. <https://doi.org/10.1016/j.iot.2024.101094>
- Harliantara. (2024). Adaptation of Digital Technology in Radio Stations in Indonesia). *Indonesian Journal of Business Analytics (IJBA)*, 4(3), 1325–1335.
- Harliantara; Heny; Deni; & Nurannafi, Z. (2024). SIMULCAST SYSTEM : IMPLEMENTATION OF ANALOGUE AND DIGITAL RADIO. 9(2), 616–627. <https://doi.org/http://doi.one/10.1729/Journal.38082>
- Li, D., Zhao, X., Liu, S., Liu, M., Ding, R., Liang, Y., & Zhu, Z. (2022). Radio frequency analog-to-digital converters: Systems and circuits review. *Microelectronics Journal*, 119. <https://doi.org/10.1016/j.mejo.2021.105331>

- Mary Beth Oliver, Arthur A. Raney, Anne Bartsch, Sophie Janicke-Bowles, Markus Appel, and K. D. (2021). Model of Inspiring Media. *Journal of Media Psychology*. <https://doi.org/doi:10.1027/1864-1105/a000305>
- Moshood, T. D., Ob, J., Shahzad, W., & Bamgbade, J. A. (2024). Technology in Society Infrastructure digital twin technology : A new paradigm for future construction industry. *Technology in Society*, 77(February), 102519. <https://doi.org/10.1016/j.techsoc.2024.102519>
- Mansoor, M., Fatima, T., & Ahmad, S. (2020). Signaling effect of brand credibility between fairness (price, product) and attitude of women buyers. *Abasyn University Journal of Social Sciences*, 13(1), 263.
- Neeley, T., & Leonardi, P. (2022). Developing a Digital Mindset. *Harvard Business Review*, 2022-May-June, 50–56.
- Oliveira, F., Costa, D. G., Assis, F., & Silva, I. (2024). Internet of Intelligent Things: A convergence of embedded systems, edge computing and machine learning. *Internet of Things (Netherlands)*, 26(November 2023), 101153. <https://doi.org/10.1016/j.iot.2024.101153>
- O'Neill, B. (2009). DAB Eureka-147: A European vision for digital radio. *New Media and Society*, 11(1–2), 261–278. <https://doi.org/10.1177/1461444808099578>
- Oyedokun, D. M., & Ajayi, M. P. (2022). Analogue To Digital Broadcast Switchover : An Inquiry Into The Progress , Challenges , And Benefits Of Digitising The Nigeria. *Nasarawa Journal of Multimedia and Communication Studies (NJMCS)*, August.
- Parry D; le Roux D. (2020). Introducing the Media Use Behaviour Conceptual Framework. https://doi.org/https://doi.org/10.1007/978-3-030-45002-1_15
- Plekhanov, D., Franke, H., & Netland, T. H. (2023). Digital transformation: A review and research agenda. *European Management Journal*, 41(6), 821–844. <https://doi.org/10.1016/j.emj.2022.09.007>
- Przemysław Falkowski-Gilski, & Falkowski-Gilski, P. (2021). Digital Transformation of Terrestrial Radio: An Analysis of Simulcasted Broadcasts in FM and DAB+ for a Smart and Successful Switchover. *Applied Sciences MDPI*, 11(11114). <https://doi.org/https://doi.org/10.3390/app112311114>
- Rohn, D., Bican, P. M., Brem, A., Kraus, S., & Clauss, T. (2021). Digital platform-based business models – An exploration of critical success factors. *Journal of Engineering and Technology Management*, 60, 101625. <https://doi.org/10.1016/j.jengtecman.2021.101625>
- Shan, D. (2023). New Media Development Model Based on Computer Network Technology. 228, 655–662. <https://doi.org/doi:10.1016/j.procs.2023.11.076>
- Shunli Wu, Haoping An, Yan Gao, J. W. and Z. S. (2022). Converged communication method of multi-source data about underground equipment based on internet of things. *International Journal of Information and Communication Technology*, 22, 199–211. <https://doi.org/doi:10.1504/IJICT.2023.128737>
- Sima, V., Gheorghie, I. G., Subić, J., & Nancu, D. (2020). Influences of the industry 4.0 revolution on the human capital development and consumer behavior: A systematic review. *Sustainability (Switzerland)*, 12(10). <https://doi.org/10.3390/SU12104035>
- Singh, H. (2018). Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python. In *Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition using Python*. Apress Media LLC. <https://doi.org/10.1007/978-1-4842-4149-3>
- Song, Y., Yu, Z., Liu, E., Huang, H., Sun, K., Yin, F., & Xu, K. (2023). Digital radio-over-fiber system based on differential pulse code modulation and space division multiplexing. *Optics Letters*, 48(7). <https://doi.org/10.1364/ol.485856>
- Spence, P. R. (2023). We Interrupt This Program, This Is an Emergency: Revisiting the Role of Radio in a Crisis. *Journal of Radio & Audio Media*, 30(2). <https://doi.org/doi:10.1080/19376529.2021.2023539>
- Stanley Tsarwe & Sibanda, M. N. (2024). Community Radio in the Era of Convergence: A Case of Zimbabwe. *Journal of Radio & Audio Media*. <https://doi.org/doi:10.1080/19376529.2024.2303497>
- Stephen Attuh & Kankam, P. K. (2022). Community radio as Information Dissemination Tool for Sustainable Rural Development in Ghana. *Journal of Radio & Audio Media*. <https://doi.org/doi:10.1080/19376529.2022.2146119>
- Xu, M., Jia, Z., Wang, J., Campos, L. A., & Chang, G. K. (2019). Statistical data compression and differential coding for digital radio-over-fiber-based mobile fronthaul. *Journal of Optical Communications and Networking*, 11(1). <https://doi.org/10.1364/JOCN.11.000A60>
- Zhang, P. (2023). New Media, New Literary Theory, and New Literature from an Interological Horizon. *Signs and Media*, 2(1–2), 1–22. <https://doi.org/10.1163/25900323-12340020>