WHITE PAPER


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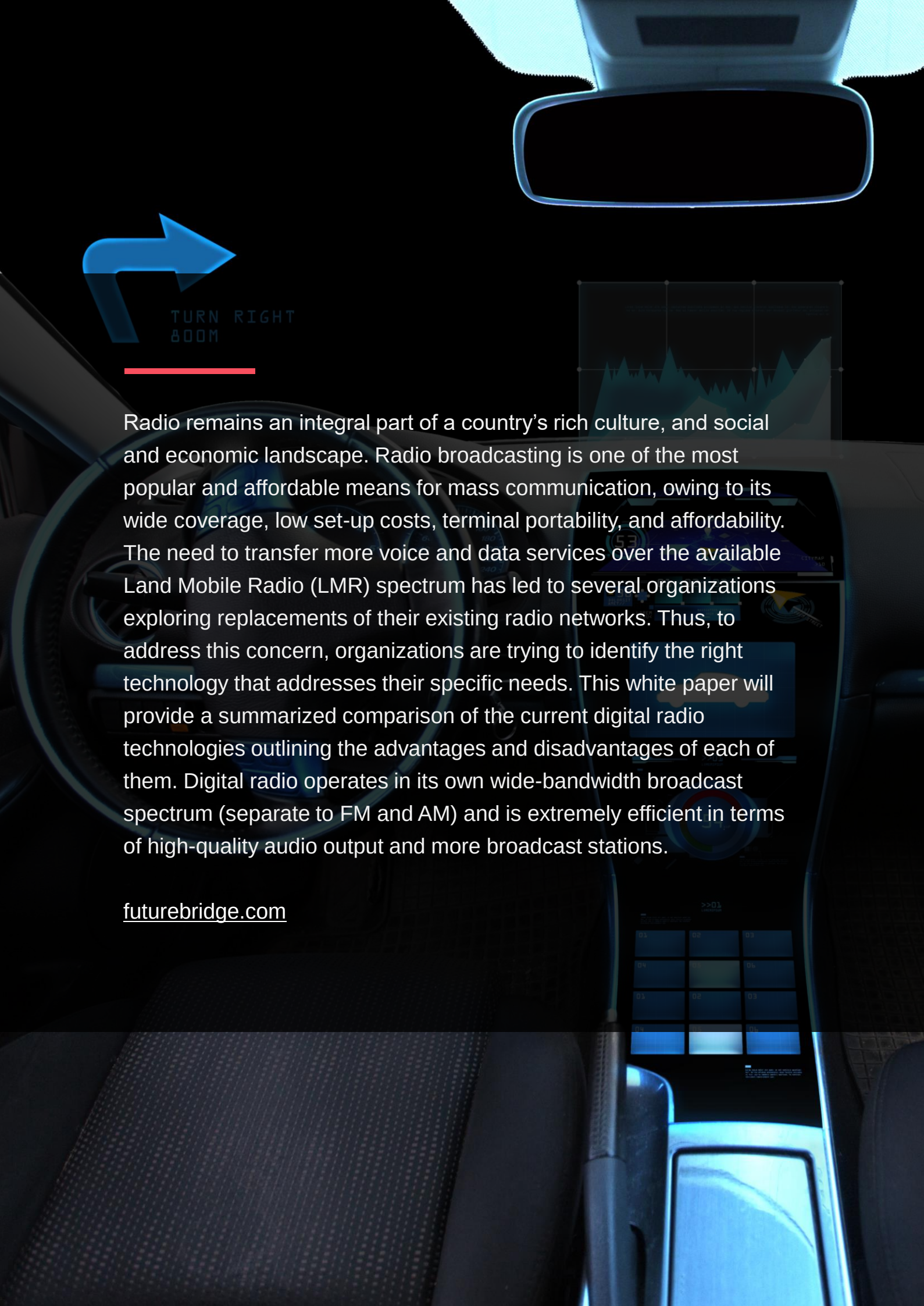
# Digital Radio Systems – Technology Benchmarking and Regional Adoption

FutureBridge




Radio remains an integral part of a country's rich culture, and social and economic landscape. Radio broadcasting is one of the most popular and affordable means for mass communication, owing to its wide coverage, low set-up costs, terminal portability, and affordability. The need to transfer more voice and data services over the available Land Mobile Radio (LMR) spectrum has led to several organizations exploring replacements of their existing radio networks. Thus, to address this concern, organizations are trying to identify the right technology that addresses their specific needs. This white paper will provide a summarized comparison of the current digital radio technologies outlining the advantages and disadvantages of each of them. Digital radio operates in its own wide-bandwidth broadcast spectrum (separate to FM and AM) and is extremely efficient in terms of high-quality audio output and more broadcast stations.

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# Introduction

The evolution and adoption of digital radio broadcasting standards by various countries have been influenced by the existing transmission technologies used and the infrastructure available in those countries. Countries worldwide have chosen different standards through rigorous trials and examining the suitability of the new technology for various popular applications and ease of implementation. Digital switchover plans have been formulated, keeping in view the technological options. Digital radio standards differ in terms of audio formats, in addition to the modulation and transmission techniques used. The following digital terrestrial radio broadcasting standards have been recognized by the International Telecommunication Union (ITU): DAB/DAB+, ISDB-TSB, HD Radio (IBOC), CDR, and DRM/DRM+.

# Digital Audio Broadcasting (DAB/DAB+)

During the 1980s, DAB was introduced as a research project in Europe and was gradually adopted by different standardization bodies, such as International Telecommunication Union (ITU) and the European Telecommunications Standards Institute (ETSI). In February 2007, DAB+ standard was introduced as an upgraded version of DAB. The forward compatibility of DAB receivers was not in line with DAB+ receivers. DAB/DAB+ is a popular radio technology that is gaining momentum across the Asia Pacific, Europe, Arab nations, and South Africa. Presently, DAB services reach out to approximately 418 million people. There are around 2,090 on-air DAB services across 38 countries. Norway is the first country that has completed the digital switchover and has shut down the analog FM from December 2017.

# Digital Radio Mondiale (DRM/DRM+)

Digital Radio Mondiale (DRM) standard for digital terrestrial radio broadcasting is specially designed for the switchover to digital radio broadcasting from the current analog radio broadcasting. It is used across all the radio frequency bands, which include AM (SW and MW) and FM/VHF bands. DRM system provides the ability to switch depending on the strength of reception and perceived audio quality. It provides three kinds of audio codecs, namely, Advanced Audio Codec (AAC), Code Excited Linear Prediction (CELP), and Harmonic Vector Excitation Coding (HVXC), which vary in quality, bit rate requirement, and application. Several European countries have experimented with DRM. Successful DRM+ trials in frequency band I, II, and III have

been supported in Germany, the UK, Vatican, Sri Lanka, and France. Currently, DRM+ trials are being held in Sweden.

## HD Radio (IBOC)

HD Radio is a terminology used for iBiquity's In-band On-channel (IBOC) Digital Radio technology. Through a single radio station, HD radio format offers a simultaneous broadcast of one or more programs, coupled with programs being transmitted over the analog channel of radio stations. In the United States, HD Radio, also known as IBOC, a trademarked system owned by a consortium of private companies named iBiquity, has been implemented for digital radio broadcasting on medium wave and VHF band II. In North American countries, iBiquity has successfully achieved high penetration of HD radio technology via the automotive Original Equipment Manufacturer (OEM) market.

## Integrated Services Digital Broadcasting for Terrestrial Sound Broadcasting (ISDB-Tsb)

Integrated Services Digital Broadcasting for Terrestrial Sound Broadcasting (ISDB-Tsb) is a standard for digital radio broadcasting developed in Japan to deliver high-quality sound and data broadcasting with high consistency and improved flexibility, expandability, and commonality for multimedia broadcasting using terrestrial networks. It uses OFDM modulation (particularly Band Segmented Transmission (BST) - OFDM), which is used for encoding digital data on multiple carrier frequencies. Japan has adopted a standard known as ISDB-Tsb for digital radio. This is related to the ISDB-T television standard and is similar to DAB in operation. However, it has yet to progress beyond test transmissions.

## CDR

China's digital radio broadcasting in FM band, commonly referred to as CDR, is a digital radio broadcasting standard that operates in the FM band (87 MHz to 108 MHz). CDR is a type of In-Band On-Channel system that works in the FM band. The CDR standard, operational since November 2013, has been labeled as GY/T 268.1-2013 and was published by the State Administration of Press, Publication, Radio, Film, and Television of the People's Republic of China (SAPPRFT).

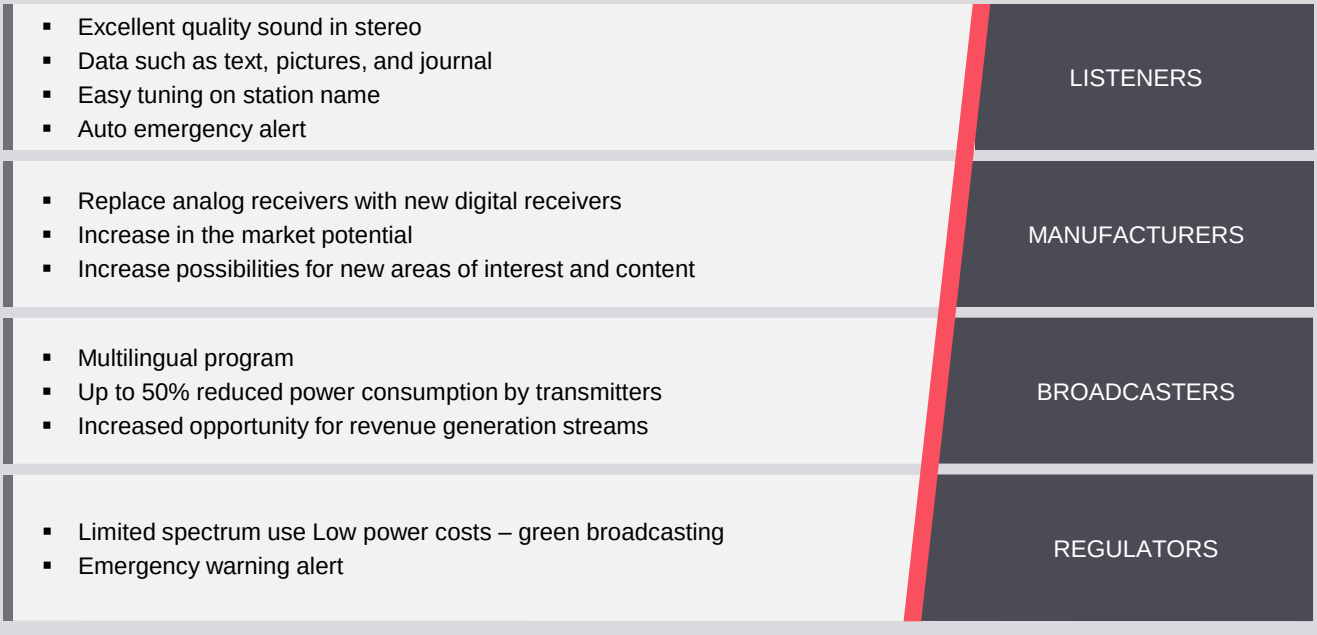
# Landscape of Digital Radio

The table below showcases the comparison between different digital radio standards with the bandwidths allocated, frequency bands, and audio compression.[1]

| Standard | Audio Compression | Transmission Technology | RF Bandwidth | Frequency Range |
|---|---|---|---|---|
| **DAB/DAB+** | MPEG-layer II/ HE-AAC | Multi-carrier (1536) OFDM, type DQPSK | 1.5 MHz | VHF Band III 1.5 GHz |
| **DRM/DRM+** | HE-AAC | Multi-carrier (106) OFDM, 4 or 16 QAM | 96 kHz | VHF Band I Band II Band III |
| **HD Radio** | HD-codec/ HE-AAC | Multi-carrier (up to 524) OFDM, 4 QAM | 400 kHz | VHF Band II/MF |
| **ISDB-Tsb** | MPEG Layer II Dolby AC-3 and HE-AAC | Multi-carrier (segmented OFDM) | 0.5/1.5 MHz | VHF Band III 2.6 GHz |
| **CDR** | DRA+ codec | Multi-carrier (up to 524), 4-64 QAM | 400 kHz | VHF II |

The figure below offers detailed information on the benefits for various entities within the digital radio ecosystem:

**EXHIBIT 1: Benefits for various entities within the digital radio ecosystem**



Digital radio is as an efficient replacement for analog AM transmissions. The scarcity of spectrum for new uses has led to the appreciation of the characteristics of radio broadcast bands. It also brings in tremendous properties with which broadcasters may deliver programs over vast distances and in difficult terrain areas. Digitizing bands with a system offers several benefits to both the audience and the broadcaster.

DRM's support for Emergency Warning Functionality allows digital radio sets to automatically switch from the current service to the emergency program when needed, in addition to automatically switching on the emergency program when on standby.

## Benefits with Big Data

Big Data offers extensive information about the target audience, which, in turn, helps advertisers tap their audience in the digital ecosystem by providing improved services. Earlier, limited information was made available about listeners. With Big Data, advertisers are able to acquire in-depth information on various aspects, such as age, gender, education, taste in music, favorite brands, sports, etc. Advertisers can use this data to craft their messages, with the end result of maximizing a campaign's effectiveness.

## Limitations

With digital radio the bandwidth compression is fantastic, but if there are too many stations in a particular spectrum, the quality of sound drops. Unlike AM/FM radio wave transmission, which gets weaker as you move away, digital radio is either on or off. However, if the transmission from the digital radio is perceived as too weak, it will stop completely, and this is a bit of a problem in fringe suburbs.

Moreover, objects such as buildings can block the radio signal. When in these areas, signals from the digital radio will tend to continually drop in and out, and may also become weak in car parks and tunnels. Currently, tunnel operator range extends with AM and FM broadcasts but not with digital radio. Several administrations have discovered that digitizing radio is not simple, as there is no clear digital dividend at the end of the process. Unlike digital TV, where there is a standard consensus, in radio, there are different options and models. Digital radio over IP or even OTT, are in certain instances touted as possible replacements for terrestrial broadcasting.

# Regulations

The European Parliament has voted to adopt the European Electronic Communications Code, which requires that all new car radios in the European Union are able to receive digital terrestrial signals. In addition, the Directive formalizes EU consent for the Member States introducing rules that require the consumer to be able to receive digital transmissions. In Italy, all new radios shall have digital capability from January 01, 2020, and France is expected to trigger a similar law once DAB+ coverage exceeds 20% of the population. The EU directive states that digital radio reception must be included in-car infotainment systems in addition to FM reception, which the automakers may want to provide.

Several car brands have started to offer digital radio as standard in their new cars in key countries. According to World DAB, 90% of new cars in the UK and 85% in Switzerland come with DAB+ as standard. In 2017, a total of new cars sold with DAB reached 5.9 million units, close to a 20% increase.[2]

# Conclusion

Digital radio system is a revolutionary technology providing the following benefits:

- Efficient spectrum space usage
- Transfer of a considerable amount of information through a single channel
- Better audio quality with high clarity output at low receiver signals that are approaching sensitivity

Thus, owing to the above-mentioned benefits, the adoption of digital radio systems across is expected to increase in the near future.

[1] https://www.gatesair.com/documents/slides/2015-09-Anderson-Advanced-Digital-Radio-HD-Radio-DRM-DAB-CDR.pdf

[2] https://www.automotiveit.com/european-parliament-agrees-digital-radio-must-be-in-new-cars/5706.article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