# Wireless Technology Battlefield in the 21st Century - Can Radio Survive?

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## Abstract

As the broadcast and telecom industries adopt more advanced digital technology, the roles of these entities begin to intertwine. In fact with the emphasis of convergence since the mid-90s, telecom operators could now offer media rich services previously restricted to broadcasters. The advent of 3G technology promises the ability to deliver multifarious contents to the mobile phone subscribers beyond voice and text message services. Would radio remain relevant especially in the realm of wireless mobile media technology in the 21st century? This paper looks into digital radio technology and discusses how radio could evolve into a sophisticated gadget with the synergy from telco and other technologies.

## 1.0 INTRODUCTION

Perhaps the digital revolution actually begins after the introduction of music CDs in the consumer industry in the early 80s. This was soon followed by a myriad of DSP (Digital Signal Processing) based technologies in the pro-audio industry [1]. In 1986, the Eureka-147 digital radio project was launched with the objective to replace analogue FM radio. Originally developed in Europe, the Eureka-147 digital radio [2][3] is now being deployed in many countries around the world since the mid-90s and can carry multimedia services at up to 1.5Mbits/s in the VHF Band III and L-Band region. Although more commonly known as Digital Audio Broadcasting or DAB, this can also apply to other digital radio technologies such as the HD Radio (High Definition Radio). Developed by iBiquity Digital [4], it is based on the IBOC (In-Band On-Channel) technique and was primarily designed to operate in the VHF Band II spectrum by coexisting with the analogue FM radio. Commercial rollout for HD Radio commenced in the USA in 2003. In Japan, the ISDB-T (Integrated Services Digital Broadcast-Terrestrial) was designed to deliver both radio and television programmes [5]. For AM broadcasting in the short-wave (SW) and medium-wave (MW) bands, there is the Digital Radio Mondiale (DRM) system [6].

Similarly, the telecom technology has emerged from the humble analogue POTS (Plain Old Telephone Service) to the third-generation or 3G digital cellular systems based on the Universal Mobile Telecommunications System (UMTS). 3G promises the ability to deliver multimedia content at up to 2Mbits/s. Future generations include IP-based 4G and 5G systems with data rate of up to 100Mbits/s [7].

As the broadcast and telecom industries adopt more advanced digital technology, the roles of these entities slowly begin to intertwine. The telecom operators could now offer multimedia entertainment services, once restricted to the broadcasters only. In other words, it is theoretically feasible for a telecom operator to offer its cellular phone subscribers, digital radio via the 3G network. Can radio survive in the wireless technology battlefield and remain relevant in the 21st century?

This paper looks into digital radio technology by comparing its strength and weaknesses against the other wireless mobile technologies and attempts to answer this question by visualising how radio would evolve in the realm of mobile technology of the future.

## 2.0 AN OVERVIEW OF THE BROADCAST AND TELCO TECHNOLOGIES

This section presents the strength and weaknesses of some of the digital technologies in the broadcast and telecom industries.

### 2.1 Digital Radio Broadcasting

Digital radio broadcasting offers listeners services beyond audio such as text, graphic [8][9] and even streaming video. The digital sound quality appeals both to the younger generations of listeners as well as audiophiles who have been influenced by CD sound quality since the early 80s. The perception of radio is no longer just an audio receiver but rather a multimedia entertainment gadget that can display data such as song title, artiste's name, and traffic report on the LCD screen. A typical broadcast system is a one-way transmission process and does not have a back channel return path. Despite the strength in digital radio, it is primarily a passive medium. It has been proven though that DAB can be integrated with the telco technology such as GPRS or 3G to provide a return path. This has many interesting applications beyond radio [10][11][12][13][14].

### 2.2 Internet Radio

Once perceived as a threat to traditional radio broadcasting [15], the reliability and sound quality due to limited bandwidth and frequent traffic congestion has remained a major drawback for streaming audio over the Internet. Moreover, copyright policy governing the online availability of pre-recorded materials has remained a complex and tricky issue to grapple with. Although the WAP (Wireless Application Protocol) was introduced to enable the access of Internet content on wireless devices such as the mobile phone, it failed to live up to its hype due to cost and slow bandwidth [16]. These are some of the setbacks that have hindered growth in Internet Radio. However, incumbent radio broadcasters can stand to benefit with the re-broadcast of their off-the-air content online by attracting new audiences and advertisers. It also serves as an alternative transmission platform, targeting radio listeners who are not within the area of terrestrial coverage.

### 2.3 Visual Radio[1]

The number of mobile phone models with integrated FM radio receiver has grown over the past couple of years. Visual Radio enables radio broadcasters to offer visual and interactive user experience for its radio listeners. The visual content displayed on the terminal screen such as song title, artiste's name and slideshow are delivered via the telco network that is synchronised with the FM radio broadcast. Although similar to what a DAB receiver could do with the PAD (Programme Associated Data) and NPAD (Non-Programme Associated Data) services, the sound and mobile reception qualities are still basically analogue FM. Unlike DAB, listeners would have to bear the cost for accessing the visual service.

### 2.4 Software-Defined Radio

As technologies continue its rapid transition from analog to digital, it was realized that more functions of traditional radio systems could be implemented in software. Instead of using discrete hardware components, software-defined radio [17] comprises of downloadable software on DSP processors. This increases the flexibility and simplicity of the receiver design. Software-defined radio technology seeks to balance standards compatibility, upgradeability and cost. Upgrading can be accomplished very easily by downloading the latest software from the web via USB (Universal Serial Bus) connection. In principle, this makes vital business sense since the nature of the consumer electronic market is such that competition would only get more intense each year. The price of digital radios would have to remain very affordable.

[1] Trademark of Nokia Corporation. More info at http://www.visualradio.com/

### 2.5 Digital Cellular Communications

The introduction of digital cellular phones in the 1990s has helped enabled individuals to be contactable anytime, anywhere. The proliferation of mobile phone subscribers worldwide over the last decade indicates consumers' preference for convenience at their fingertips. The telecom technology has emerged since the humble analogue POTS to the current third-generation or 3G digital cellular systems. 3G has the added advantage of a full-duplex system and has the potential to provide data rates at up to 2Mbits/s. This is beyond the specifications of what the current digital radio broadcasting technologies could provide. Theoretically, this means that 3G can also carry radio content plus the added advantage that it has a return path for interactive services. However, the 2Mbits/s applies only to stationary reception and the data rate for 3G would fall to below 300 bits/s for mobile application [7][18]. This is a critical factor for mobile radio reception application. Furthermore, consumers would be billed for listening to radio or in fact accessing any services that are delivered through the telco network much like talking on their mobile phone which can be a rather costly entertainment.

### 2.6 Digital Video Broadcasting

The earlier thoughts that the Digital Video Broadcasting-Terrestrial (DVB-T) system could substitute DAB (since it can also deliver radio programme) was a major fallacy [19]. DVB-T was originally designed for fixed TV reception using rooftop antenna whereas DAB was designed, right at the very beginning, for mobile radio reception. Therefore, DAB does have an extra edge when it comes to reception in moving vehicles as compared to DVB-T because of an extra layer of error protection [20]. The DVB-H (DVB-Handhelds) standard was later developed to further enhance the mobile reception quality of the DVB-T standard. DVB-H can offer higher data-rates but at the expense of higher cost, transmitter power and lower flexibility [21]. While the DAB system can also be extended for video streaming as was demonstrated using the Digital Multimedia Broadcasting (DMB) technology [22], it is certainly not meant for TV-centric or high-definition television (HDTV) services.

## 3.0 RADIO OF THE 21st CENTURY

Radio has evolved over the last decade and is no longer confined to a standalone device nor must it be transmitted over a radio broadcast network. We have seen how mobile phones have evolved over the past few years and that it is very common to find models with digital camera, MP3 player and PDA (Personal Digital Assistant) besides FM radio. In fact from a survey conducted by Nokia on their first mobile phone model with FM, radio was the second most liked features and that almost 80% of these owners use the radio at least once a week. According to The Yankee Group report, the penetration of mobile phones was projected to reach 27.4% of the world's population by 2007 [23] with the highest growth rate at 13.6% coming from the Asia-Pacific region. We believe the demand from outdoor radio listeners relying on their mobile phones would outpace those using other personal radio devices over the next couple of years.

It is clear that the future trend for mobile entertainment and wireless communication technologies have to satisfy the demands for higher data rate and robust mobile reception quality without sacrificing affordability [24]. By taking into account the technical challenges inherent in the different technologies described in the previous section, it is difficult to envisage a mobile device that can deliver a multifarious service based solely on a single platform. For point-to-point communication, cellular phone network is a better option but for point-to-multi-point transmission, radio broadcast remains the more efficient solution. Moreover, broadcasters can leverage on the strength of DAB to handle large data files delivery [25][26] without any download charges. It can

also be easily integrated with the telco technology to facilitate interactive services. We foresee that radio will evolve into a hybrid system and will be an essential feature on many devices as shown in Figure 1. This is already happening as can be seen from the Visual Radio, cellular phone-enabled PDA, and Internet Radio micro-system, among others. With software-defined radio technology, receivers will be future-proof and upgrading should remain very affordable.

## 4.0 CONCLUSIONS

No doubt the sound and mobile reception qualities of digital radio broadcasting are superior to that of traditional analogue radio, it is a one-way transmission system without a return path. On the other hand although digital cellular communication technology is a full-duplex system, it is more suitable for point-to-point type of service. The reliability and sound quality of Internet Radio have remained a major drawback and could not be easily accessed through WAP on mobile phones nor taken seriously as a replacement for traditional radio broadcast. Visual Radio is basically a mobile phone with FM receiver and therefore the mobile reception and sound qualities are still at best analogue. Listeners would likely have to bear the cost for any visual data service access since these are delivered via the telco network. DVB-H can offer a more robust mobile reception quality as compared to DVB-T and higher data-rates than DAB but at the expense of higher cost, transmitter power and lower flexibility. The idea of using digital television system as a substitute to DAB was a fallacy and did not materialise.

Radio has stood the test of time despite the rise in popularity of television in the 1960s and the appeal of the print media such as the newspapers and magazines. It remains attractive to advertisers in recognition that there is something in radio that the other media could not offer. As an example, one is able listen to radio while driving or performing other chores at the same time. We have no doubt that radio will survive in the 21st century amidst the battlefield of more advanced wireless technologies such as Internet Radio and 3G. Digital radio broadcasting will continue to dominate as a more efficient and cost-effective means of reaching its audiences. It will evolve into a hybrid system by integrating DAB with telco technology for interactive mobile receivers, and with the Internet for interactive home receivers. Digital radio will be an essential feature on many devices. With software-defined radio technology, it will be future-proof and upgrading would remain very affordable. We envisage growth in DAB cell phones will also outpace that of a standalone pocket digital radio device in the future. Digital radio will continue to serve radio listeners who enjoy higher sound quality. It will provide an efficient, robust and cost effective wireless delivery platform for mobile multimedia applications beyond radio.

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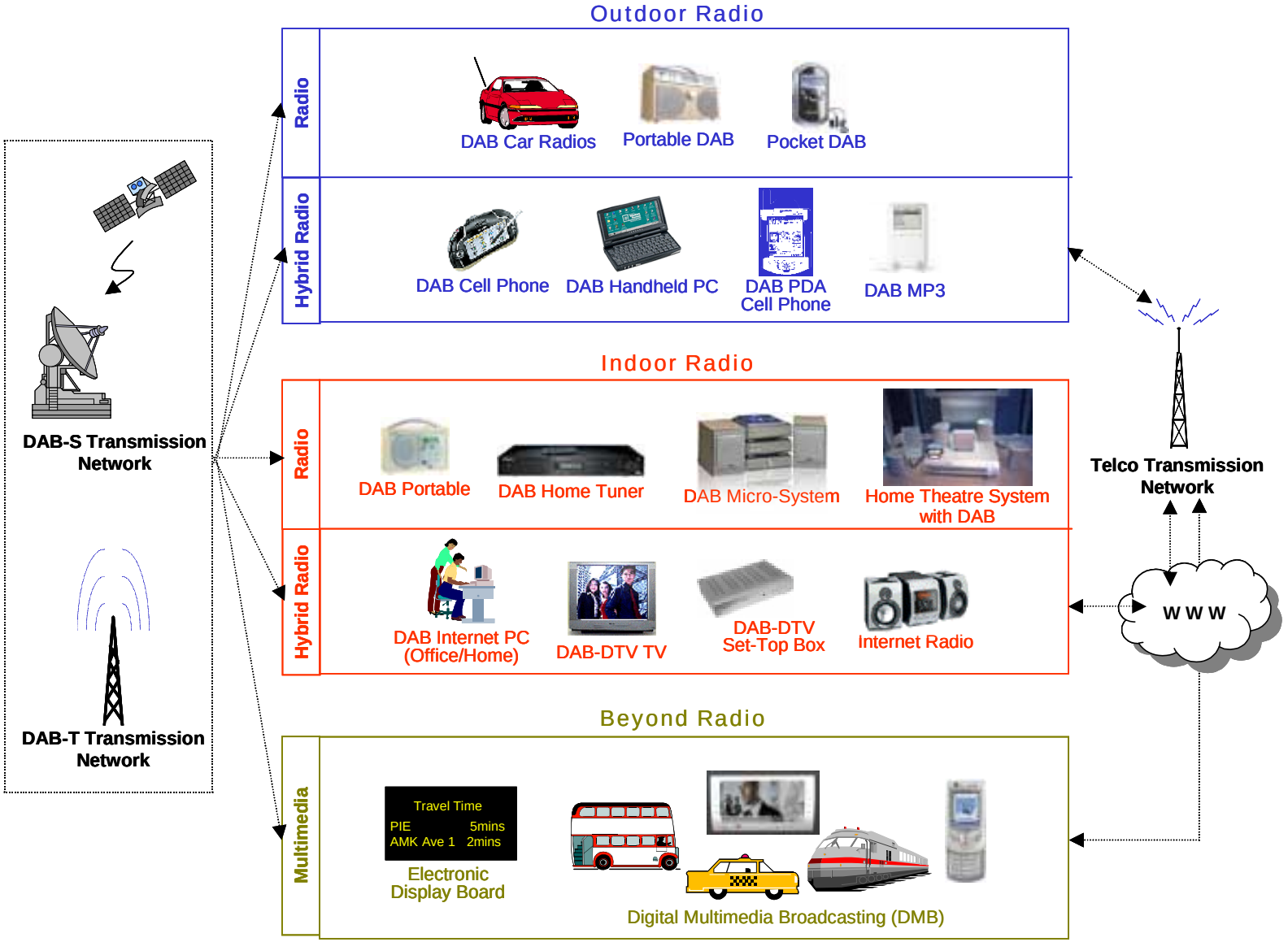


***Figure 1*** *– Diagram showing the future of radio in the 21st century.*