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# Radio Broadcasting Chips for Smartphones: A Status Report

**name redacted**

Specialist in Telecommunications Policy

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## Summary

The concurrent developments of digital radio broadcasting and digital cellular networks have enabled hybrid products that incorporate over-the-air broadcasting into cellphones. A recent introduction (2013) is a hybrid radio/smartphone with Internet connectivity, marketed in the United States as NextRadio. NextRadio uses a chip that receives analog FM and digital radio, with enhancements such as customized radio listening; the primary radio connection is over-the-air, not through Internet streaming.

On the assumption that radio broadcasting is more accessible and reliable than communications over wireless networks with Internet connectivity, some broadcasting industry leaders have proposed that FM radio chips be required—or at least encouraged—for smartphones as part of the nation's emergency communications preparedness.

To give perspective on the proposal for widespread deployment of FM radio chips in smartphones as an emergency preparedness measure, this report provides information on consumer and industry trends in radio and wireless network communications. It also provides a brief overview of the role of technology in disseminating emergency alerts and information.

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## Background

Digital radio broadcasting was introduced in the 1980s as a European research project, leading to the adoption of a European standard called Digital Audio Broadcasting (DAB), updated in 2006 to DAB+. DAB/DAB+ standards are compatible with many digital cellphone standards, notably digital GSM,<sup>1</sup> massively deployed as the European standard beginning in the early 1990's. Digital radio broadcasts over cell phones became available in Europe in the late 1990's. By 2000, the DAB radio standard and GSM had converged and DAB radio chips were incorporated into some handsets to provide radio listening as a feature. For example, a digital phone from Nokia, with a tuner installed could, be converted into a radio by downloading software onto the phone, and adding an antenna (connected to the charger connection) and headphones (connected to the audio jack). With the introduction of smartphones, the conversion from phone to radio became more straightforward for the consumer, as discussed in the following paragraphs.

In the United States, digital broadcast radio was authorized by the Federal Communications Commission (FCC) in 2002 as HD Radio, a trademark of iBiquity Digital Corporation.<sup>2</sup> HD Radio is iBiquity's core business. Radio stations that broadcast HD Radio pay fees to iBiquity. In 2011, an analysis by Pew Research identified 2,103 HD Radio stations, approximately 13% of all radio stations, noting that the number appeared to have plateaued.<sup>3</sup> For 2012, Pew reported that the number of radio stations dropping HD Radio was greater than the number of stations adopting it.<sup>4</sup> iBiquity reported "close to 2,100" HD Radio stations as of September 2014.<sup>5</sup> The FCC reported 15,433 licensed radio stations (AM, FM, or HD channels) as of September 2014.

iBiquity also markets digital radios and radio chips; the primary consumer market is for car radios. As the chips it developed for digital car radios became smaller, iBiquity began to explore the possibility of including them in iPods or smartphones, promoting the radio chips to the wireless industry at a 2010 conference of the CTIA, a major wireless industry association.<sup>6</sup> A dongle<sup>7</sup> for iPod or iPhone (iOS operating system) had been introduced in 2009 by at least one manufacturer to provide an external HD Radio connection.<sup>8</sup> HD Radio dongles for wireless mobile devices using iOS or Android operating systems are available from several manufacturers through sources such as Amazon.com or BestBuy and similar retailers. They are activated by downloading and accepting an HD Radio app.

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<sup>1</sup> Global System for Mobile communications; background at <http://www.gsma.com/aboutus/history>.

<sup>2</sup> iBiquity HD Radio, "What Is HD Radio Broadcasting?" [http://www.ibiquity.com/hd\\_radio](http://www.ibiquity.com/hd_radio). The standard used for HD Radio is referred to as NRSC-5-C, the current American standard approved by the National Radio Systems Committee, <http://www.nrsstandards.org/SG.asp>.

<sup>3</sup> Pew Research Center's Project for Excellence in Journalism, "The State of the News Media 2012," <http://www.stateofthemediamedia.org/2012/audio-how-far-will-digital-go/?src=prc-section>.

<sup>4</sup> Pew Research Center's Project for Excellence in Journalism, "The State of the News Media 2013; Audio by the Numbers," <http://www.stateofthemediamedia.org/2013/audio-digital-drives-listener-experience/audio-by-the-numbers/>.

<sup>5</sup> iBiquity Press Room, "HD Radio Broadcast Momentum Continues," September 10, 2014, [http://ibiquity.com/press\\_room/news\\_releases/2014/1656](http://ibiquity.com/press_room/news_releases/2014/1656).

<sup>6</sup> Radio World, "HD Radio Could Be in Cellphones by 2021, iBiquity Says," March 24, 2010, <http://www.radioworld.com/article/hd-radio-could-be-in-cellphones-by-2012-ibiquity-says/2964>.

<sup>7</sup> A dongle is a small piece of hardware that attaches to an electronic device to provide additional services.

<sup>8</sup> Engadget "Gigaware Adapter Brings HD Radio to iPod Touch and iPhone for \$80," by Darren Murph, November 9, 2009, <http://www.engadget.com/2009/11/09/gigaware-dongle-brings-hd-radio-to-ipod-touch-and-iphone-for-80/>.

## Radio Chips in Smartphones: A New Initiative

In 2014, the BBC launched a campaign, the “Universal Smartphone Radio Project,” to expand the market for digital radio listeners by adding an FM/DAB/Internet chip to smartphones. The BBC reportedly is leading an industry coalition that includes the National Association of Broadcasters (NAB) and Commercial Radio Australia.<sup>9</sup> In the United States the FM/DAB/Internet chip for smartphones is marketed as NextRadio. It was introduced in the United States by Emmis Communications in 2013.<sup>10</sup> NextRadio is enhanced through cloud services provided by TagStation.<sup>11</sup> NextRadio requires a smartphone with the customized chip and radio tuner and uses an app that makes it possible to listen to over-the-air radio while connected to the Internet, providing a number of interactive features. There are approximately 32 devices currently available in the United States with NextRadio pre-installed.<sup>12</sup>

### Business Case: Radio Industry

The business case for marketing radio/phone combinations is straightforward for the radio industry: increase radio listeners—and advertising revenue—by reaching potential new audiences through their cellphones.<sup>13</sup> Radio reached 92% of all Americans over age 12 in 2012 (roughly 250 million people), a market penetration virtually unchanged in a decade.<sup>14</sup> At the end of 2013, there were 175 million active smartphones in the United States.<sup>15</sup> Among adults (18+), 56% had smartphones. Demographically, smartphone owners tend to be younger, with higher income and education levels than other cell phone owners.<sup>16</sup> A study projecting smartphone use in the United States shows the number of users rising from 62.6 million in 2010 to 220 million in 2018.<sup>17</sup>

Research conducted with the support of NAB<sup>18</sup> indicated significant interest in NextRadio among survey participants: smartphone users 18 to 49 years old. The corresponding market demand has not yet materialized, however. About 6.5 million NextRadio-enabled smartphones were in

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<sup>9</sup> BBC Media Centre, “Radio Industry Moves to Meet Demand for ‘Hybrid’ Radio,” October 14, 2014, <http://www.bbc.co.uk/mediacentre/latestnews/2014/hybrid-radio>.

<sup>10</sup> Emmis Press Room, “What’s Next? Emmis Preparing NextRadio for Smartphone Introduction in 2013,” November 7, 2012, <http://www.emmis.com/whats-next-emmis-preparing-nextradio-for-smartphone-introduction-in-2013/>.

<sup>11</sup> NextRadio + TagStation, <http://tagstation.com/>.

<sup>12</sup> See <http://nextradioapp.com/supported-devices/>; visited December 2, 2014.

<sup>13</sup> For the United Kingdom, see, for example, The Telegraph, “BBC aims to boost flagging DAB sales with smartphone push,” October 14, 2014. For the United States, see, for example, NAB News Release, “Prepared Remarks for NAB President and CEO Gordon Smith at 2014 Radio Show,” September 10, 2014, <http://www.nab.org/documents/newsroom/pressRelease.asp?id=3504>.

<sup>14</sup> Pew Research Center’s Project for Excellence in Journalism, “The State of the News Media 2013; Audio by the Numbers,” <http://www.stateofthemediamedia.org/2013/audio-digital-drives-listener-experience/audio-by-the-numbers/>.

<sup>15</sup> CTIA Wireless Industry Survey, [http://www.ctia.org/docs/default-source/Facts-Stats/ctia\\_survey\\_ye\\_2013\\_graphics-final.pdf?sfvrsn=2](http://www.ctia.org/docs/default-source/Facts-Stats/ctia_survey_ye_2013_graphics-final.pdf?sfvrsn=2).

<sup>16</sup> Pew Research Internet Project, “Smartphone Ownership 2013,” <http://www.pewinternet.org/2013/06/05/smartphone-ownership-2013/>.

<sup>17</sup> Statista, “Number of Smartphone Users in the U S from 2010 to 2018 (in Millions),” <http://www.statista.com/statistics/201182/forecast-of-smartphone-users-in-the-us/>.

<sup>18</sup> Coleman Insights Media Research, “NextRadio; National Quantitative Study Summary,” July 2014, available at <http://www.colemaninsights.com/news/new-research-from-coleman-insights-and-knowdigital-finds-strong-demand-for-nextradio>.

circulation by late 2014, most of them purchased with a Sprint subscription. Of these phones, 1.25 million had been activated for NextRadio, that is, either the pre-loaded app was activated by a Sprint subscriber, or a separately purchased app was downloaded and activated after the purchase of the smartphone. Emmis Communications, which provided the market data, forecast that the number of activated NextRadio smartphones would rise to 14.5 million by mid-2015, based on the number of new smartphones coming to market that will be compatible with NextRadio.<sup>19</sup> Emmis has a three-year agreement (extending into 2016) with Sprint that requires the carrier to preload the NextRadio application on at least 30 million smartphones sold through its network. In return, Emmis contracted to pay Sprint \$15 million per year over the life of the contract, plus certain revenue sharing.<sup>20</sup>

#### The agreement between Emmis and Sprint

does not limit the ability of NextRadio LLC to place the NextRadio application on FM-enabled devices on other wireless networks. Through August 31, 2014, the NextRadio application had not generated a material amount of revenue. The radio industry continues to work with other leading United States network providers, device manufacturers, regulators and legislators to cause FM tuners to be enabled in all smartphones.

Emmis granted the U.S. radio industry (as defined in the funding agreements) a call option on substantially all of the assets used in the NextRadio and TagStation businesses in the United States. The call option may be exercised in August 2017 or August 2019 by paying Emmis a purchase price equal to the greater of (i) the appraised fair market value of the NextRadio and TagStation businesses, or (ii) two times Emmis' cumulative investments in the development of the businesses.<sup>21</sup>

## **Business Case: Wireless Service Providers**

The business case for wireless carriers to include FM radio is more complex. As subscribers switch to smartphones, wireless service providers have the opportunity to include NextRadio as a product enhancement. Although the radio access is free to listeners, the interactive services delivered over the Internet may be billable by the wireless service as data traffic. Decisions may be influenced by broader strategies for building customer bases and adding new features. From the perspective of its customers, Sprint views the broadcast radio feature as providing another entertainment choice for its subscribers.<sup>22</sup> T-Mobile, however, is expanding its offer of free music streaming (no data charges) as a means of attracting new subscribers for its mobile services.<sup>23</sup> Other carriers may consider music streaming as a source of income and may not wish to install a

<sup>19</sup> Inside Radio, "Forecast: 14.5 Million NextRadio-Enabled Phones by Mid-2015," December 3, 2014, [http://www.insideradio.com/Article.asp?id=2868611&spid=32061#\\_VH3LTIeRk3g](http://www.insideradio.com/Article.asp?id=2868611&spid=32061#_VH3LTIeRk3g).

<sup>20</sup> Emmis Communications Corporation, Form 10-Q filed with the Securities and Exchange Commission for the quarter ended August 31, 2014, "Item 2: Management's Discussion and Analysis of Financial Condition and Results of Operations," <http://www.sec.gov/Archives/edgar/data/783005/000078300514000063/emms2015q210-q.htm#s33623B482854DB331C3F49BA1F93C7D9>.

<sup>21</sup> Ibid.

<sup>22</sup> Sprint Newsroom, "Sprint Customers to Enjoy Local FM radio on Smartphones via FM Radio Chip," January 8, 2013, <http://newsroom.sprint.com/news-releases/sprint-customers-to-enjoy-local-fm-radio-on-smartphones-via-fm-radio-chip.htm>.

<sup>23</sup> T-Mobile, "T-Mobile Doubles Down on Music Freedom with the Addition of 14 New Services," company release, November 24, 2014, <http://investor.t-mobile.com/file.aspx?IID=4091145&FID=26286964>.

radio-based competitor. Reportedly, Apple will pre-install the app for its music streaming service, Beats, in iPhones and iPads beginning in 2015, possibly boosting interest in streaming music.<sup>24</sup> Some research shows that trends favor Internet streaming over radio, although radio remains an important source for information and entertainment.<sup>25</sup>

Additionally, carriers may need to consider whether a market commitment to provide over-the-air radio could constrain development of other chip-based services in the future. The smartphones arriving on the market today rely on fourth-generation standards but, by 2020, many industry leaders are predicting a transition to fifth-generation technologies. 5G devices may be substantially re-engineered to take advantage of new wireless network capabilities.<sup>26</sup>

## Emergency Alerts and Warnings

As Emmis noted in the above-quoted filing with the Securities and Exchange Commission, the broadcasting industry is lobbying regulators and legislators in support of including NextRadio chips in smartphones. The basis of the industry campaign, as expressed by NAB, is the value of radio information in times of disaster.<sup>27</sup>

The topic of using radio-enabled cellphones for emergency alerts in the United States has periodically been considered by policy makers in the field of emergency communications, but no specific actions have been taken to include this technology in emergency planning. Instead, emergency planning at the federal level has focused on improving the communications capabilities for wireless messages based on the Internet Protocol (IP).

As discussed in the 2014 National Emergency Communications Plan (NECP),<sup>28</sup> IP-enabled networks permit the interconnection and management of emergency alerts and information across a wide choice of devices, including smartphones, electronic signs, Next Generation 9-1-1 services, and the Emergency Alert System (EAS).

A goal of the NECP and emergency planners at all levels is to provide important information to as many people as possible, in a timely manner. To that purpose, federal, state, local, and tribal agencies are using communications technologies to connect to many types of devices. The reasoning, discussed in the 2014 NECP,<sup>29</sup> is that if people are most readily reached by, for example, social media, then alerts must be delivered by social media. The number of active smartphone social network users in the United States was estimated at 97.9 million users in 2013 and is projected to grow to 160.5 million by 2017.<sup>30</sup>

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<sup>24</sup> Financial Times, "Apple Plans to Push Beats to Every iPhone," November 19, 2014, <http://www.ft.com/intl/cms/s/0/068c2212-700b-11e4-bc6a-00144feabdc0.html#slide0>.

<sup>25</sup> Pew Research Center, Journalism Project, "Key Indicators in Media and News," March 26, 2014, <http://www.journalism.org/2014/03/26/state-of-the-news-media-2014-key-indicators-in-media-and-news/>.

<sup>26</sup> See CRS Report IN10191, *What Is 5G? Implications for Spectrum and Technology Policy*, by (name redacted).

<sup>27</sup> NAB Newsroom, "FEMA Administrator Praises FM Chips, Radio's Role During Emergency," October 20, 2014, <http://www.nab.org/documents/newsroom/pressRelease.asp?id=3523>.

<sup>28</sup> *National Emergency Communications Plan*, 2014, Department of Homeland Security, <http://www.dhs.gov/necp>.

<sup>29</sup> *Ibid.*, "Message from the Secretary," Jeh Charles Johnson, Secretary of Homeland Security.

<sup>30</sup> Statista, "Number of Smartphone Social Network Users in the United States from 2011 to 2017," <http://www.statista.com/statistics/297504/number-of-us-smartphone-social-network-users/>.

The backbone of the United States' Emergency Alert System (EAS) is a network of high-power AM radio broadcast stations that broadcast alerts across wide areas. These stations are referred to as Primary Entry Point stations because they are the point of entry for emergency alerts and warnings.<sup>31</sup> These alerts are in turn picked up and distributed across the country by additional radio stations, television, most cable systems, and other media, as required by the FCC.<sup>32</sup> Since 2009, the Federal Emergency Management Administration (FEMA) has been enhancing the PEP backbone to reach 90% of the country's population.<sup>33</sup>

The Federal Emergency Management Agency (FEMA) jointly administers EAS with the FCC, in cooperation with the National Weather Service (NWS), an organization within the National Oceanic and Atmospheric Administration (NOAA). The NOAA/NWS weather radio system—referred to as National Weather Radio—is the primary source for alerts and warnings over EAS. Measures to improve NWR and related networks are ongoing. For example, FEMA is developing the Integrated Public Alert and Warning System (IPAWS) to meet requirements for an alert system as specified by an Executive Order issued by President George W. Bush.<sup>34</sup> When completed, IPAWS should be able to accept any legitimate alert or action announcement, verify it, and relay it to wide variety of communications devices.

Legislation<sup>35</sup> passed in 2006 set in motion requirements for delivering alerts to cellphones, now known as Wireless Emergency Alerts (WEA).<sup>36</sup> WEA uses the IPAWS network to deliver geographically targeted messages to cellphones over commercial wireless networks. Radio-enabled cellphones are able to receive WEA messages as well as radio broadcast alerts. Similarly, over-the-air TV broadcasts might be delivered to mobile devices (typically tablets) that have been enabled through the addition of a dongle.

## Wireless Network Reliability

With an increasing number of people relying on mobile devices connected to the Internet as their primary source of information, the reliability of these networks has become a concern for policy makers. At the federal level, for example, the FCC has undertaken a number of actions intended to improve wireless network reliability.<sup>37</sup>

Rapid advancements in wireless technologies are resolving many of the network vulnerabilities identified by the FCC and other federal agencies. For example, the industry is stepping up the installation of small-scale networks<sup>38</sup> that reduce reliance on vulnerable high-site towers, and is

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<sup>31</sup> FEMA, National Weather Service Systems (NOAA HazCollect), <https://www.fema.gov/national-weather-service-systems-noaa-hazcollect>.

<sup>32</sup> FCC, Emergency Alert System, <http://transition.fcc.gov/pshs/services/eas/>.

<sup>33</sup> FEMA, Primary Entry Point Stations, <https://www.fema.gov/primary-entry-point-stations>.

<sup>34</sup> Executive Order 13407 "Public Alert and Warning System," released June 26, 2006, <http://www.whitehouse.gov/news/releases/2006/06/20060626.html>.

<sup>35</sup> The Warning, Alert, and Response Network Act (WARN Act), signed into law as Title VI of P.L. 109-347.

<sup>36</sup> FEMA, Wireless Emergency Alerts, <https://www.fema.gov/wireless-emergency-alerts>.

<sup>37</sup> For example, through the Communications Security, Reliability and Interoperability Council, which recommends best practices for the industry, among other functions, <http://transition.fcc.gov/pshs/advisory/csric/>.

<sup>38</sup> For example, Juniper Networks, "Delivering Scalable and Cost-Effective HetNet Backhaul," <http://www.juniper.net/us/en/local/pdf/solutionbriefs/3510499-en.pdf>. See also CRS Report R43595, *Mobile Technology and Spectrum Policy*: (continued...)



investing in new standards that allow networks to use each other's capacity.<sup>39</sup> A new chip that may be introduced in 2015 has numerous applications that will not rely on cell towers.<sup>40</sup> For example, one application being developed for this chip is planned to handle wireless connections for 1 million people congregated at Times Square on New Year's Eve.

Continued improvements in emergency communications infrastructure and management are key goals of the NECP. For example, policies need to be developed that will accelerate the transition from analog to digital technologies for 9-1-1 calls. How responses are managed is also under study. Immediately after the Boston Marathon bomb attack in April 2013, for example, fearful that a cellphone signal might trigger another bomb, authorities ordered that wireless phone networks be turned off. This practice is being reconsidered given the ubiquity of cellphones for communications and their use for WEA.<sup>41</sup>

## **Author Contact Information**

(name redacted)  
Specialist in Telecommunications Policy  
#redacted#@crs.loc.gov, 7-....

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(...continued)

*Innovation and Competition*, by (name redacted).

<sup>39</sup> 3GPP, LTE-Advanced, <http://www.3gpp.org/technologies/keywords-acronyms/97-lte-advanced>.

<sup>40</sup> Qualcomm, LTE Direct, <https://www.qualcomm.com/products/lte/direct>.

<sup>41</sup> House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Response, and Communications, Hearing, "Interoperable Communications: Assessing Progress Since 9/11." November 18, 2014, oral testimony of Rear Admiral Ronald Hewitt, USCG (Ret.), Director, Office of Emergency Communications, Department of Homeland Security.

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