



DIGITAL DASHBOARD
Best Practices Report
October 2023

Executive Summary

Radio broadcasters have done much to improve the appearance of radio on the digital dashboard since this report was first released in 2017. It's a moving target, to be sure, as receiver manufacturers have also improved infotainment systems significantly since 2017, with today's systems having larger displays and improved connectivity. And while radio's dashboard appearance in large markets (as well as in vehicles with advanced hybrid radio technologies) may look good or great, there is significant work required in this regard in the many thousands of small and medium size radio markets across the U.S.

A number of recent developments are discussed in this updated recommended practices document, including:

- **Developments in hybrid radio systems**, which allow broadcasters to combine over-the-air (OTA) and internet-delivered content, primarily in automotive receivers. Examples of how hybrid radio technology looks on the digital dash and how it differs among vehicles are provided;
- **Information obtained in "station audits"** on how broadcasters are making use of the enhanced displays in connected cars has been augmented to include audits conducted in mid-2023 in the Detroit, Mich., and Little Rock, Ark., markets, but unfortunately only reinforce the conclusion from earlier audits that much work still needs to be done to realize a consistently good appearance for broadcast radio on the dash; and
- **A new section**, resulting from work done by NAB's Auto Initiative, Digital Officer and Radio Technology Committees, that enumerates the important "rich content" information that broadcasters and automotive original equipment manufacturers (OEMs) need to support, as well as a number of security and privacy issues which arise in the connected car.

Nearly all of the content from prior editions of this best practices document has been kept in this latest version as it describes an informative and highly relevant study on how broadcast radio looks on the dashboard and what broadcasters can do to improve that look. Information is included on how broadcasters can support hybrid radio technology and an update on service providers currently available for assisting broadcasters in managing metadata and offering an enhanced digital dashboard radio experience to listeners. In summary:

- **Metadata support is more important than ever.** Automakers are expending significant resources to improve in-vehicle infotainment (IVI) systems and are supporting multiple sources of content including AM and FM radio, satellite radio, online streaming audio and podcasts. This is a highly competitive environment and a lack of metadata support by radio broadcasters becomes glaringly obvious, in particular when stacked up against satellite radio and online audio streaming services which provide very complete and consistent metadata.
- **Many automakers are using in-vehicle databases.** The presence of an in-vehicle database (from Gracenote and others), which uses "audio fingerprinting" to generate song title and artist and album art metadata, has raised consumer expectations for audio service metadata in the vehicle. This in-vehicle database technology can serve to level the playing field across services but it is completely outside of the broadcaster's control and has the potential to interfere with the information broadcasters elect to provide to listeners. It is also the case that many automakers are *not* using in-vehicle databases so a broadcaster relying on this technology may be underserving a significant portion of their listenership.
- **Using RadioDNS is a good start to enhance a station's image.** RadioDNS is a not-for-profit organization dedicated to the support and proliferation of hybrid radio. Broadcasters can register with RadioDNS for free and can easily create a service information (SI) file that can enhance the appearance of their station on hybrid radio receivers with station information and logos.
- **Broadcasters should sign up for DTS AutoStage.** Xperi, developer of the HD Radio digital radio system used in the U.S., has developed and is deploying DTS AutoStage, a hybrid radio platform included (as of August 2023) in select Mercedes-Benz, Tesla, Hyundai, Kia and Genesis vehicles and expected to appear in other brands in 2023. Broadcasters can enroll in DTS AutoStage service for free, and those that do will be well-positioned to offer their listeners a premium metadata experience and can obtain invaluable analytical information on listener behavior that is available from the DTS AutoStage system.

- **Broadcasters must develop strategies for supporting non-linear content and interactivity.** With the advent of hybrid radio, broadcasters will increasingly be able to deliver non-linear content (such as podcasts or timely weather and traffic info) and expand their brand beyond simply being a provider of linear audio content. Interactivity with listeners, supported by internet-connected hybrid radios, is also an area ripe for innovation and new creative opportunities.

The foundation of the original best practices document was an NAB project undertaken by Jacobs Media and engineering consultant E. Glynn Walden, in collaboration with NAB staff and the NAB Auto Initiative Committee, to help radio broadcasters better understand the way broadcast radio stations are displayed on automobile dashboards. Jacobs Media conducted three in-market audits in Grand Rapids, Mich. (5/19/17), Philadelphia, Pa. (6/1/17) and Charlotte, N.C. (6/2/17), spending one day in each metro area monitoring commercial FM radio stations in vehicles equipped with RDS and HD Radio with Artist Experience receivers. The audits were conducted during three dayparts - morning drive, midday and evening drive - and the information on the receiver displays was captured on video. Jacobs Media, in conjunction with NAB, developed a scoring system to tabulate the results.

Concurrently, Walden interviewed multiple system providers and engineering specialists. In the process, he developed additional best practices from an engineering perspective. Key findings from the audits include:

There is room for improvement. The display of radio station text and image information is generally inconsistent, creating a sub-optimal user experience. Standards for formatting and composing information for dashboard display need to be developed and adhered to by broadcasters. While some broadcasters provide a quality in-car display experience, there are too many situations where information is spotty or inaccurate, content is redundant, there are typos and superfluous information and other elements that are impediments to a positive display look for broadcast radio operators.

The radio industry needs a standardized approach. The audit spawned a series of improvements broadcasters can make on both RDS and HD Radio systems:

- **Dynamic vs. static information.** Some stations provide a static environment for their content, while others use a dynamic approach and “scroll” or “chunk” information, creating a sub-optimal experience that can be harder to read. Overall, static is preferred over dynamic, but since many vehicle displays (typically character-based displays) rely on dynamic text, this practice is likely to continue. When using dynamic text, chunking is preferred over scrolling.
- **Album art for FM-band HD Radio stations.** There is a lack of consistency in the use of display pictures and illustrations when music is playing. Some stations don’t provide any album art, and in some vehicles (including the ones used for this audit) this can result in display of an artist photo or generic format slide originating from the car receiver, which is sometimes incorrect (in these receivers, a broadcaster-supplied image such as a station logo or album art will always be used in place of the receiver-based images). Spoken word stations are often poorly depicted in the Artist Experience format, infrequently displaying station formats and personality shows.
- **Case consistency.** Some stations use all caps, while others blend in all caps for some items and title case for others.

There is a lack of consistency during commercial breaks. There is no industry standard for showcasing advertisers during commercial breaks. Some stations continue to scroll or chunk station information, such as call letters or slogans, on RDS systems during commercials. In HD Radio receivers with Artist Experience, some receivers display a generic format slide in the absence of any broadcaster-supplied images, while others present a station logo, missing a valuable and sellable advertising opportunity.

Inconsistent use of available fields. RDS systems have two available fields for content display. The Program Service (PS) field has both static and dynamic capabilities and is comprised of just eight characters. It typically resides at the top section of the dashboard display. The RadioText (RT) field is comprised of up to 64 characters and is typically on the lower portion of the dashboard display.

The audits found there is no standard use of content displayed in these two fields. Some stations show title and artist along with the station’s slogan and call letters in the eight-character PS field. Others show the station’s slogan in the RT field only. Still others display the same information in both fields.

There are missed opportunities to showcase HD1 (main channel) stations, especially in the spoken word formats. Many stations miss the opportunity to brand their stations, high-profile personalities, morning shows and talk show hosts. This includes the name of programs, personality pictures or show or program logos. While music stations rely heavily on album art, talk radio stations are grossly under-identified on dashboard displays.

HD multicast channels generally lack branding of any kind. Rarely is there clear branding and identification of HD2, HD3 and HD4 stations that set them apart from their HD1 parent. Multicast channels are almost uniformly referred to as “WXXX HD2,” despite the fact they often feature vastly different programming from their HD1 originating station.

Format designations need to be reviewed and expanded. Too often, the name of the format of the station is incorrect or is simply listed as “Other.” Classic Rock stations are often designated as “Rock.” Hip-hop stations are listed as “R&B.” Upon investigation, it became clear that not all popular radio formats are included in the system directory and modifying them is an arduous process.

As part of this NAB project, this best-practices document was developed for programmers and engineers that provides basic recommendations for broadcasters to upgrade their in-car dashboard appearance.

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APPENDIX A - CONNECTED CAR RADIO TECHNOLOGIES - RICH CONTENT FEATURES TABLES

The National Association of Broadcasters is the voice for the nation’s local radio and television stations and their network partners. NAB advocates the interests of our members through advocacy, education and innovation.

Overview

Since 2017, NAB has been conducting investigations into how radio looks on automobile dashboards. NAB's initial effort was a project focusing on "station audit" data obtained from three radio markets (Grand Rapids, Philadelphia and Charlotte). This original data is still highly relevant and is included in this 2023 update to the Digital Dash Best Practices. The focus of these station audits is the use of "metadata," information sent by the broadcaster to describe the radio station and the audio content on the station, for example, song title and artist or an album art image of a song being played.

Since that initial project, NAB has studied and done test drives on the new digital dashboard capabilities supported by hybrid radio systems which allow broadcasters to deliver content to receivers using both over-the-air (OTA) broadcast and mobile broadband-delivered internet signals. Advanced features such as service following (receiver switching from OTA to internet-delivered audio streaming signals when the OTA signal fades) and rich station guides are supported by these receivers, and broadcasters need to understand how these new features work. Knowing this information also helps NAB to interact with auto manufacturers and equipment suppliers with the goal of helping to maintain radio's prominence in the vehicle.

NAB has also recently conducted some additional station audits in two markets, Detroit and Little Rock, and the results are included here. These results demonstrate that there are still many broadcasters not delivering good metadata content and also that not all modern receivers are optimized for a good radio display experience. This is troubling, as today it's not uncommon for a consumer to access audio content in their vehicle from various sources including satellite radio, mobile streaming audio apps (built into the vehicle or from a smartphone through Apple CarPlay or Android Auto) and AM and FM radio stations. Newer hybrid radios offer even more choices for content including podcasts. Yet, for the most part, each source is displayed differently on the dash. Most of the time, platforms like SiriusXM and Pandora are consistent in their approach, offering clean, professional displays. When a listener switches channels within those platforms, they know what to expect.

This is not the case with broadcast radio, as was demonstrated by our first set of tests in 2017 and more recently in Detroit and Little Rock. There is a lack of standardization among radio broadcasters in the ways content is displayed on the dash across the two main OTA metadata delivery systems currently in use, Radio Data System (RDS, a digital subcarrier for analog FM signals) and HD Radio (in both AM and FM bands), as well as with audio streaming versions of broadcast programs. When a listener scans the dial, it is likely they will encounter a wide array of content display formats, often significantly inconsistent. In many cases, the quality of a broadcast radio station's content display is subpar or isn't taking advantage of the available technology, failing to equal the consistent levels from the aforementioned mobile streaming and satellite radio competitors.

This is a critically important issue for radio broadcasters because the automobile is the number one listening location for radio station content. Gone are the days when the radio industry had this real estate to itself. The bar has been raised by new competitors, the auto industry continues to invest in new dashboard displays and technology and there is a much lower barrier to entry for content providers. Broadcasters need to strengthen their hold on this turf by improving the user experience on auto dashboards.

Based upon knowledge of radio metadata capabilities, auto industry investigations and station audits, NAB presents in this document some recommended best practices. There are two significant benefits for the radio industry in adopting these best practices. First, content in vehicles would be displayed in a more consistent way that makes it easier to understand and more enjoyable for listeners, who now have many different audio options in cars. Broadcasters need to ensure that at minimum, they present a quality visual experience equivalent to satellite radio and pure-play streaming services.

Second, the radio industry can demonstrate to the automotive industry that radio provides a quality in-dash experience. The way radio is presented in the car makes a statement to the automotive industry at all levels. For example, at the local level, when an auto dealership salesperson or trainer is showcasing a new car to a potential customer, the entertainment system is always demonstrated, usually to show off the best-looking content. By enhancing the way that radio is displayed, the likelihood of being a part of that demonstration will increase. Automakers invest considerable effort and resources into developing state-of-the-art in-

vehicle infotainment systems and it's important for broadcasters to recognize this and make sure they take advantage of these supported features.

NAB has long-term goals relating to radio's future in the car and the radio industry's relationship with the auto industry. In the short term, an industry-wide effort to improve the ways in which radio is displayed in fully-equipped recent model-year and new vehicles, as well as in older cars and trucks, is an important initiative that can benefit broadcasters in myriad ways.

Thus, the goals of this project are to improve the consistency and quality of the textual metadata - information such as song title and artist or format type - fed into in-car radio receivers and establish best practices for the way it is displayed to achieve the most positive impact. It is noted that given the extraordinary number of radio receivers and displays in automobiles, some which have been in service for a few decades, the goal of reaching a 100% solution is unlikely. When developing best practices, our intent is not to disenfranchise listeners with older vehicles.

Quality, image-based metadata such as station logos and album art should similarly be consistently available across the broadcast radio dial. Non-hybrid radio receivers obtain these images over HD Radio digital radio signals while hybrid radios can use both OTA and internet sources. Information on how this is accomplished is provided below. Broadcasters need to make sure they are licensed to use the images they transmit. This is typically accomplished through a service provider like RAPID or Quu Interactive; note that when broadcasters obtain rights for companion images to their internet-based audio streams, these images may not be licensed for over-the-air transmission.

It is important to note that the three markets tested in 2017 do not constitute a definitive sample of radio markets throughout the U.S. However, the results of the audits produced a level of consistency in observing how all the commercial stations in each market are supporting auto radio displays. These audits were not designed to yield definite, statistically significant display grades for the radio industry. Rather, the goal was to get a sense for what most stations are displaying in vehicles across a range of different markets and developing solutions and best practices to improve the situation from there.

The focus of this report is on analyzing and synthesizing this data, as well as the overall experience of observing radio in these vehicles in real time. Provided herein are recommendations on how broadcasters can improve the way the radio industry is presented on automotive displays, from both an engineering and marketing point of view. For the engineering perspective, consultant and former Vice President of Radio Engineering for CBS E. Glynn Walden interviewed multiple system providers and engineering specialists and developed engineering best practices, which are provided at the end of this report.

The combination of these two approaches provides radio broadcasters with a solid roadmap designed to quickly and efficiently enhance the in-car user experience.

Metadata Usage by Broadcasters and Manufacturers

AM and FM radio broadcasters need to be making use of rich content metadata as part of their normal operations, as modern automotive receivers advance to take full advantage of these multimedia offerings. Presented in this section are examples of auto infotainment system user interfaces which support rich content metadata from broadcasters, delivered both over-the-air and via broadband as part of a hybrid radio service. These are a guide for broadcasters who are interested in seeing how the metadata they prepare and transmit appears for listeners. Examples from Mercedes and Hyundai (using DTS AutoStage), as well as Audi (using RadioDNS-formatted information), are provided.¹

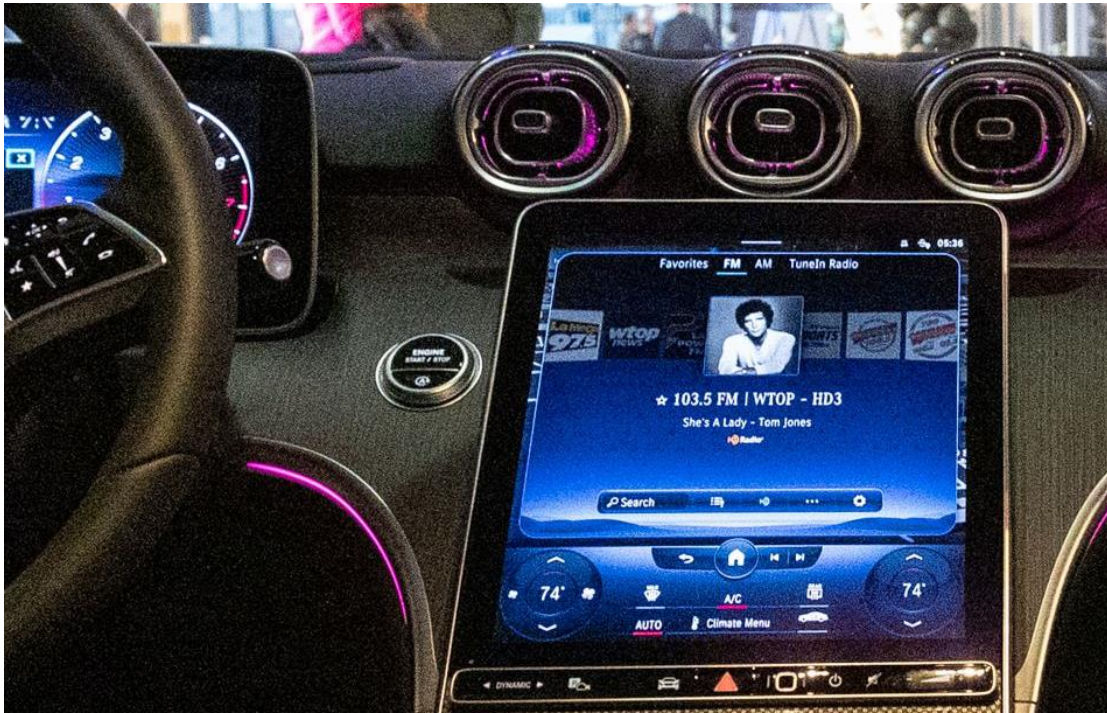
In addition, research on broadcaster behavior supporting metadata transmission is included, first presented in 2017 but highly relevant today as well, providing a glimpse into metadata usage in the Philadelphia and Charlotte markets. This research highlights the fact that broadcasters need to improve their metadata content usage and deliver the best possible product to listeners, similar to or an improvement over other audio services, in particular those delivered over the internet. Updated (but more limited) information obtained from station audits conducted in 2023 in the Detroit and Little Rock markets is also included, confirming and reinforcing the lessons from the earlier audits.

DTS AutoStage in Mercedes and Hyundai - 2023

Xperi's hybrid radio system, DTS AutoStage, first premiered in Mercedes S-class vehicles in November 2020, bringing enhanced station lists and service following (where the receiver can switch from an over-the-air signal to a streaming audio signal) to a large-screen console display. Two years later in November 2022, DTS AutoStage became available for Hyundai, Kia and Genesis vehicles, both in new vehicles and as a software update for certain older vehicles. In early 2023, Mercedes offered DTS AutoStage in C-class vehicles, and is supporting the on-demand delivery of song lyrics through this hybrid platform. Provided below are screenshots and descriptions of the metadata content from these various hybrid radio platforms.²

The first three images are from the 2023 Mercedes C-class implementation, a significant rollout as there will likely be more of these less expensive cars in the marketplace compared to the earlier S-class deployment. In the first image, a "Now Playing" screen is shown with both foreground (featured artist) and background (logos of nearby stations) images, all delivered to the receiver over the internet. Note that many AM and FM-band HD Radio stations deliver the metadata seen here OTA as well, meaning that in many cases a hybrid radio receiver is supplied with redundant information. Non-hybrid digital radios, of course, rely solely on the OTA metadata as these radios do not have a direct connection to the internet.

The "Favorites" screen for the C-class is shown in the second photo and serves to illustrate a DTS AutoStage system feature, the ability to save a station as favorite when receiving OTA and still accessible when you drive to another market, using the station's simulcast audio stream. This particular vehicle was used in Detroit and then driven to Washington, D.C., for the 2023 NAB State Leadership Conference, and a number of Detroit stations were saved as favorites before the drive, including Audacy station 99.5 WYCD (second icon from the left). This screenshot was captured in Washington, D.C., and at the very top of the screen it says "Internet Radio Active: 99.5 WYCD," reflecting the fact that the audio streaming version available from the vehicle's broadband connection is currently active.



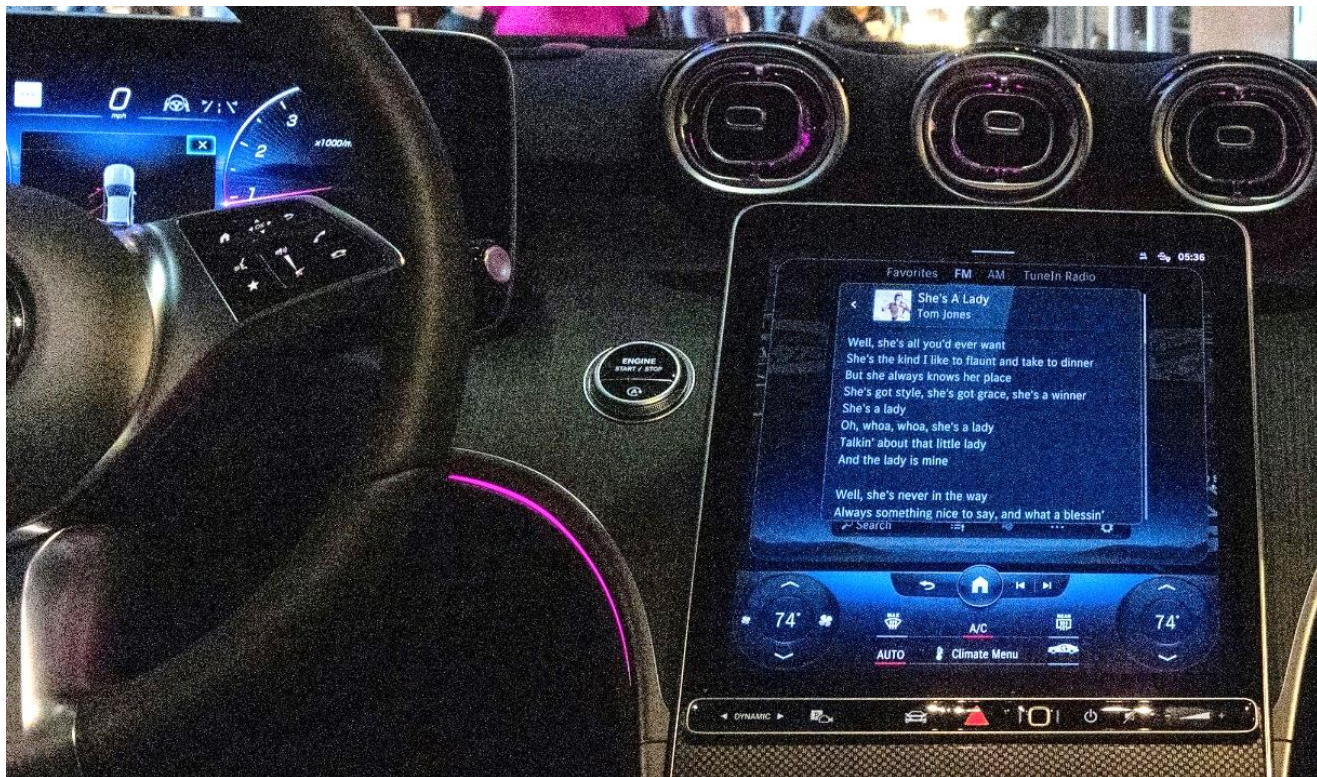
“Now Playing” screen in the Mercedes C-300 sedan. Behind the image of the featured artist are darkened images of logos of stations nearby on the band.



“Favorites” screen in the Mercedes C-300 sedan. These favorites can include a streaming version of stations that were at one time receivable over-the-air in the vehicle but are now out-of-market.

In the third C-300 photo, a new feature is displayed that provides song lyrics in real time, delivered via the internet to the receiver. The new DTS AutoStage lyrics feature, which is available in 28 languages, is fully integrated and immediately available to OEMs within

the DTS AutoStage platform. Among the new features are lyrics display and search, synchronized lyrics (for in-cabin sing-along), translation of song lyrics, lyrics for “Now Playing” music on all sources and more.



DTS AutoStage lyrics feature.

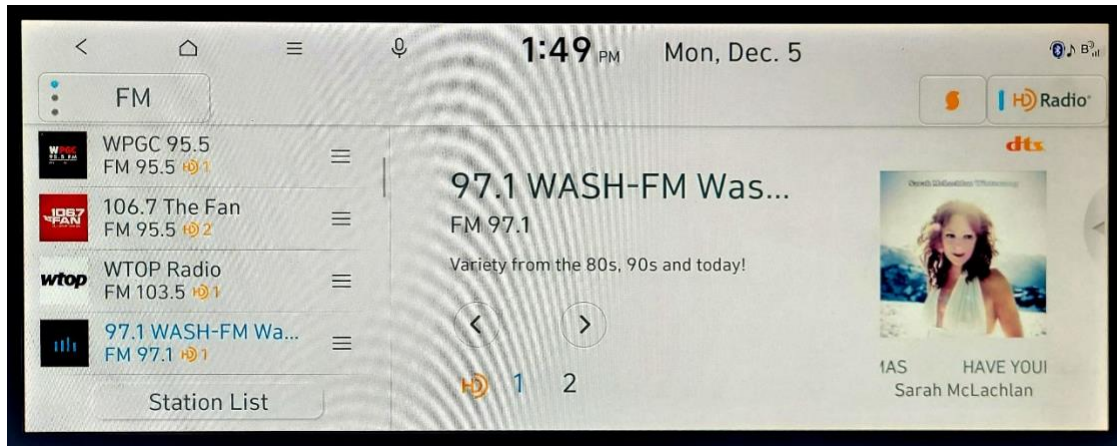
Note that new features, like song lyrics just mentioned, can be added with software updates so functionality of the infotainment system can change over time. This was evident in the 2022 DTS AutoStage rollout of the Hyundai group, the second such group after Mercedes to deploy DTS AutoStage technology. One of the vehicles eligible for the AutoStage update was the 2022 Hyundai Ioniq 5 EV, the first vehicle built on Hyundai’s new Electric-Global Modular Platform (E-GMP).³

Shown in the first of a series of images of the Ioniq 5 is the dashboard, thoroughly modern and consisting of two flat-panel displays. The right-hand dash display is a touch screen used to control many of the car’s features. Subsequent Ioniq 5 photos below show this right-hand screen with the radio selected for display and illustrate some of the features of this radio, as well as the careful thought that went into its design. This receiver was first tested by NAB in February 2022 and at that time, this brand-new vehicle had a non-hybrid digital radio, that is, the radio was only connected to OTA and not internet.



Dashboard of the 2022 Hyundai Ioniq 5 electric vehicle. Screen on the right is a touch screen used in conjunction with hardware buttons below to access vehicle functions.

In October 2022, Hyundai released an update to the infotainment software that when installed, transformed the receiver in the Ioniq 5 into a DTS AutoStage hybrid radio with both OTA and internet connectivity.⁴ The Ioniq 5 photos below were taken after the upgrade of the receiver. This next photo shows the FM band “Now Playing” screen with metadata (station information, song information, artist image) provided over the internet. On the left-hand side is the presets list which scrolls vertically. Note that each station has a logo and station information that was delivered to the receiver over the internet using the DTS AutoStage system.



Ioniq 5 FM “Now Playing” screen using DTS AutoStage, with favorites list at left.

Next shown is the DTS AutoStage AM band “Now Playing” screen, truly revolutionary in that the AM stations (both analog and digital) have logos and station ID information associated with them, again delivered to the receiver over the internet. Using AutoStage, analog AM stations can now provide rich metadata to listeners for the first time.

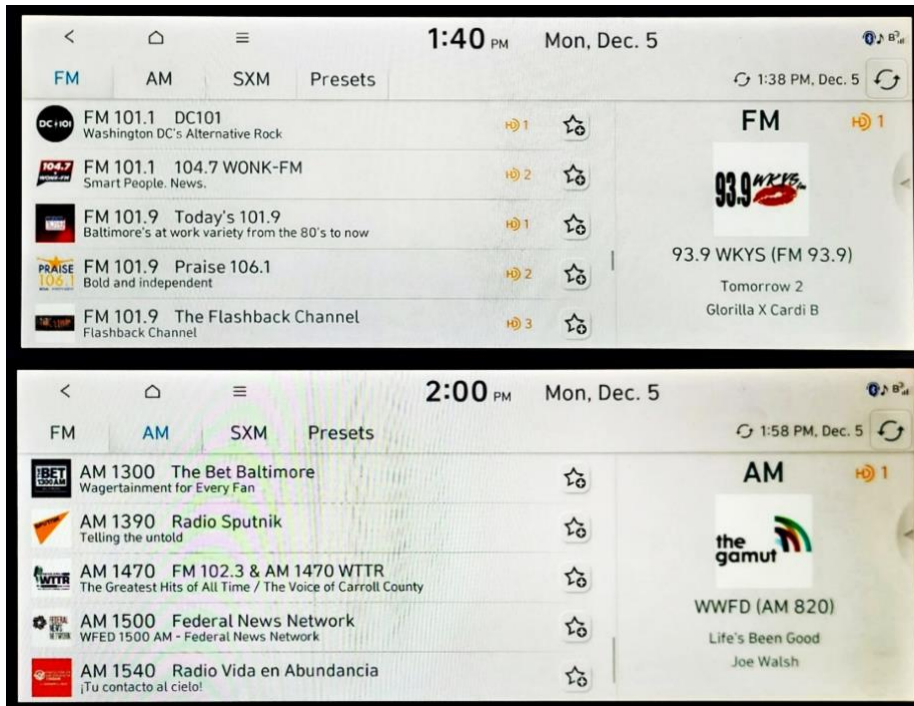


Ioniq 5 AM “Now Playing” screen using DTS AutoStage, with favorites list at left.

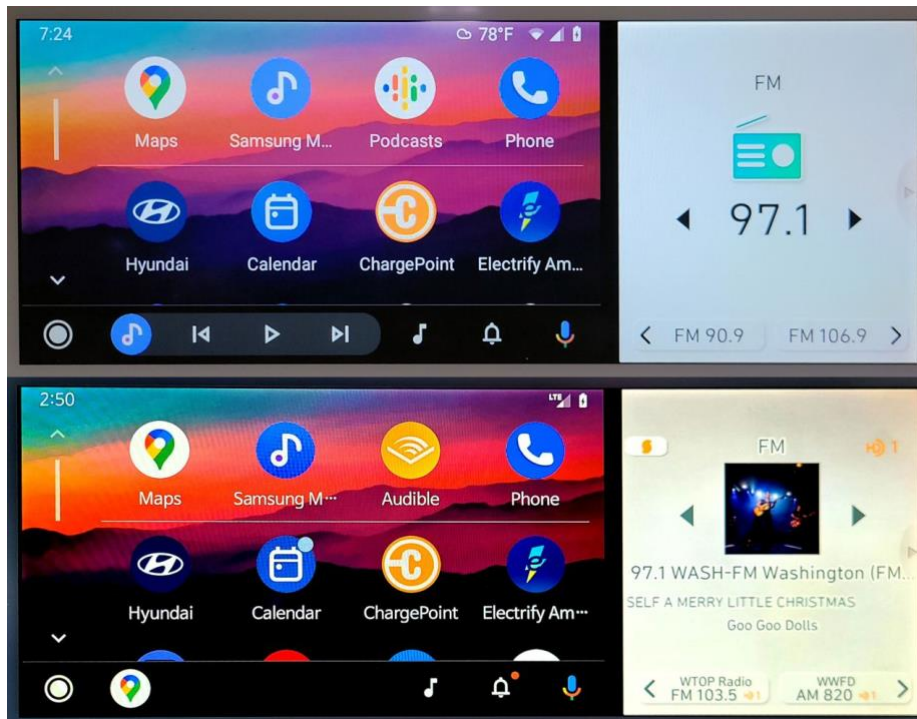
This next pair of screenshots show the FM and AM station lists and serve to further highlight the rich metadata delivered to the receiver over the internet for both FM (top image) and AM (bottom image) stations. These station lists are based on the location of the receiver which is then sent to the AutoStage servers. Notice in the FM station list how HD Radio multicast channels are integrated into the list (look for the HD 2 and HD 3 indications just to the left of the “favorite stars.”) Also notice for both lists that a Now Playing screen is on the right and includes logos and metadata for the current station.

This last pair of screenshots compares the Ioniq 5 radio display when Android Auto is running. Early Android Auto implementations were hampered by non-intuitive and sometimes challenging switching between the Android Auto and radio displays, but in the Ioniq 5 these technologies co-exist nicely. The top screen shows Android Auto and the radio co-existing prior to the upgrade to DTS AutoStage. The lower screen is after the upgrade; note how DTS AutoStage has updated the radio Now Playing screen at right, including the rich metadata for the current station as well as information about the adjacent preset stations in the buttons at bottom right.

Broadcasters are encouraged to become content partners with DTS AutoStage and connect their station and “Now Playing” information directly into the DTS AutoStage system. This also provides broadcasters with the ability to obtain listening information about their station derived directly from listener interactions in DTS AutoStage-equipped vehicles. For more information visit the DTS AutoStage website at onboarding.connectedrad.io.



FM and AM station lists compiled with DTS AutoStage metadata downloaded over the internet.
Smaller “Now Playing” area visible on the right.



Android Auto (left side of screen) and FM radio Now Playing information (right side of screen) shown before (upper screenshot) and after (lower screenshot) DTS AutoStage update.

NAB Test Drive of Audi A4 - 2021

NAB's 2021 test of the Audi A4 hybrid radio focused on the differences between station guides for some of the available audio sources (which include AM, FM, SiriusXM, online and podcasts). One of the nice features of automotive hybrid radios is the ability to display accurate station guides based upon the vehicle's location, including a logo and text identifier (typically a call sign for AM and FM). Typically, the way this works for AM and FM sources is that the hybrid radio receiver communicates its location to the automaker's hybrid radio servers and in return receives a complete station list for that location based upon estimated station coverage areas.

The first photo below is an example of the FM band station guide and in this example, each station has provided a logo for display either by using HD Radio image delivery or by specifying logos in the station's RadioDNS Service Information (SI) file. You can also see that for the current station (in this example, 97.1), the Now Playing information also appears in the guide.



2021 Audi A4 hybrid radio showing FM band station guide with logos present.

When the receiver was tuned across the FM dial, 42 signals were found (a mix of analog, HD Radio main channel and HD Radio multicast channel signals) and of those 42, 21 had logos (50%). This was actually an encouraging result and more than expected (likely due to the close proximity to Washington, D.C., a major market), however as the dial is scanned the missing logos are glaringly obvious, as illustrated in this next photo.



2021 Audi A4 hybrid radio showing FM band station guide with logos absent.

By contrast, in these next two photos the station guides are shown for two other radio sources, SiriusXM and online radio. In each case a consistent, uniform guide is presented where every station has a logo and a description. This is the visual presentation that AM and FM radio broadcasters should aim to achieve.

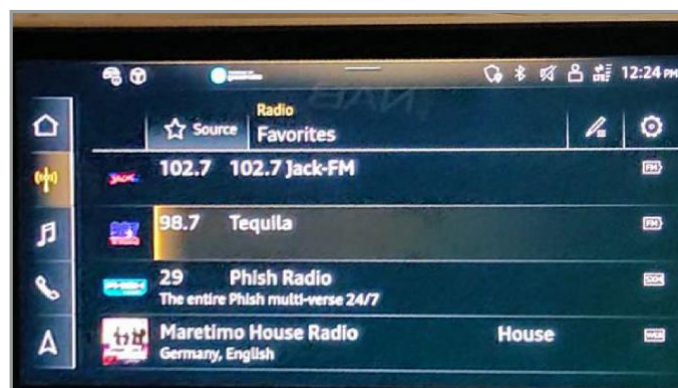


2021 Audi A4 hybrid radio showing SiriusXM station guide. Note that every station has a logo and a description.



2021 Audi A4 hybrid radio showing online station guide. Note that every station has a logo and a description.

One final photo is provided showing the A4's "Favorites" screen, where a listener stores their presets. In the world of hybrid radio, content from a variety of sources can be combined and displayed on a single favorites screen, as shown here. There are two local FM stations (102.7 and 98.7), a SiriusXM station (29) and an online station. The SiriusXM and online stations will always have logos on this favorites screen but as just seen, many local broadcasters are not yet supporting logos. While in this example both local stations do have logos, you can imagine how poorly it reflects on broadcast radio when they don't have logos here, but the other sources do.



2021 Audi A4 hybrid radio showing "Favorites" screen, which in this example includes two local FM stations, a SiriusXM station and an online station.

Jacobs Media Audit – 2017

Jacobs Media and engineering consultant E. Glynn Walden collaborated with NAB staff and the NAB Auto Initiative Committee to conduct three in-market audits in May and June 2017 in Grand Rapids, Mich., Philadelphia, Pa., and Charlotte, N.C., spending one day in each metro area monitoring commercial FM radio stations in vehicles equipped with RDS and HD Radio with Artist Experience receivers.

Three audits per market were conducted in morning drive, midday and afternoon drive dayparts. Radio displays were captured on video as the radios were scanned across the FM dial from 88 to 108 MHz, focusing on the commercial band radio stations. The results were transcribed into an Excel spreadsheet form, noting how each receivable radio station presented itself on the dashboard display. In each market, two cars were utilized for the audit – one with an RDS receiver and one with an HD Radio receiver with Artist Experience to observe performance across the full range of modern displays.

The specific results of the 2017 audit are provided in a separate report,⁵ but the results are clear – the presentation of FM radio in the car needs to be properly evaluated by broadcasters on a continuing basis and in many cases significantly improved. This was also evident in the station guide observations made in 2021 in the Washington, D.C., area using the Audi A4's hybrid radio where half of the radio stations did not provide a station logo, and that is actually better than expected. The 2023 audits in Detroit and Little Rock (discussed below) likewise show a need for improvement.

While some broadcasters provide a quality HD Radio experience that includes album art, strong station branding and consistently good displays, for too many stations there is little to no information, content redundancy (an artist name and song title appearing in two places on the display), advertiser information on the display during a music or talk segment, typos, a confusing array of upper and lower cases and other signs of display chaos that detract from the overall consistency of the user experience, especially when switching from station to station or platform to platform.

When a driver listens to satellite radio, there is a consistent look and feel across each channel. Channels are branded and there is uniformity from channel to channel. Obviously, this is possible because the SiriusXM array of stations are all controlled by a single broadcaster.

In broadcast radio, scores of different broadcasters offer stations in a given market, thus leading to a lack of consistency and a hodgepodge experience. On a car equipped with an HD Radio receiver, part of this is due to the fact that not all stations broadcast the HD Radio digital signal and offer station information only using RDS. To make matters even more complex, there are essentially two levels of RDS information support – basic, using the Program Service (PS) field and advanced, using the RadioText (RT) field – providing different levels of content displays.

But the biggest problem, regardless of whether or not a driver is in a vehicle with an RDS or an HD Radio receiver, is the lack of a defined look and approach by radio broadcasters to create a standard, pleasing in-car experience. Oftentimes, there's a sense that the metadata is not checked or properly edited before broadcasting and no one is monitoring the station or market to look for mistakes. It also appears that different people at stations are responsible for this job (engineers, program directors, etc.), and that the system goes unchecked.

To provide a level of consistency for the audit, a scoring system was created. Every receivable FM station, regardless of the city of license, was observed and rated against several different criteria and then assigned a grade based on how that station's information was displayed. At the end of each audit, a color grade was assigned to each station as follows:

Green	The station utilized the full display functionality of the system (RDS or HD Radio) and information was displayed properly
Yellow	The station did not properly utilize all of the display functionality
Orange	The station's display functionality was poor or there were errors
Red	There was no display functionality

Below is a summary of how FM radio performs during the afternoon drive daypart in Philadelphia, the best market of the three, in the HD Radio-equipped automobile:

Philadelphia Audit: HD Radio Vehicle, Afternoon Drive		
Score	Number of stations	Percent of total
Green	7	14%
Yellow	25	49%
Orange	8	16%
Red	11	22%

During this daypart, only one in seven (14%) stations used the full functionality of HD Radio receiver display systems, while nearly half (49%) are under-utilizing these displays in some way.

In most cases, radio appears presented somewhat better in the simpler RDS display than it is on the HD Radio units in the test vehicles. Below is a summary of how FM radio performs during the midday daypart in Charlotte in the RDS-equipped automobile:

Charlotte Audit: RDS Radio Vehicle, Midday		
Score	Number of stations	Percent of total
Green	9	33%
Yellow	5	18%
Orange	8	30%
Red	5	18%

During this daypart, only one-third (33%) of the stations monitored are utilizing the full functionality of the RDS system display in a pleasing way. Overall, a qualified conclusion about the three markets observed is that, especially for HD Radio-equipped vehicles, the bigger the market, the better the user experience.

All that said, there is a considerable level of subjectivity involved in the recording and scoring of this data. Broadcasters would be wise not to micro-focus on the specific results of particular stations in these markets, but to read this report in a more general way, taking note of the observations and recommendations and then applying these to their own stations.

As noted, there are uncontrollable factors that impacted these test results, including different HD Radio and RDS displays from vehicle to vehicle, location of the audits themselves, weather conditions, time spent on each FM frequency before returning to the “Scan” feature and inadvertent errors on the part of the auditors.

Detroit and Little Rock Audits – 2023

NAB staff conducted radio station audits in Detroit, Mich., and Little Rock, Ark., using rental vehicles in mid-2023, similar to the audits conducted by Jacobs Media in 2017. For these 2023 audits, the vehicles used had modern, touch screen display infotainment systems, but neither had HD Radio capabilities so the only metadata service observed was RDS and there were no images (like station logo or album art) shown on the receiver displays when the radio was in use. The results obtained from these audits serve to reinforce the message that more broadcasters need to be paying attention to their metadata.

In Detroit, a 2023 Chevy Bolt EUV, a plug-in electric vehicle, was used for the audit. The dash of the Chevy Bolt is seen in the photo below including the large, 10.2 inch color touch screen infotainment display showing Google Maps using Android Auto. In the second photo, there are two infotainment screenshots which show the Bolt’s FM radio station list (on left) and FM radio “Now

Playing” screen (on right). A 2023 Dodge Charger was used in Little Rock and a picture of its infotainment display is also shown below. The Charger did not have a station list feature.

Note that the RDS capabilities of these receivers is different - in the Bolt, the display shows a long text string using the RDS RadioText feature, while the Charger is displaying the RDS Program Type feature above the station frequency and a scrolling, eight-character RDS Program Service (PS) field below the station frequency. It also appears that the Bolt is including the RDS PS field on the station guide screen. If nothing else, these new audits serve to highlight the tremendous variability of in-vehicle infotainment features, something broadcasters need to be aware of as they plan their metadata strategy.



Chevy Bolt EV with 10.2 inch touch screen infotainment display at right.



Chevy Bolt EV infotainment screen when displaying the FM radio station list (left) and a typical FM station “Now Playing” screen (right). As this is an RDS-only radio (no HD Radio), only text is displayed when the radio is in use.



Dodge Charger infotainment screen when displaying a typical FM station “Now Playing” screen. As this is an RDS-only radio (no HD Radio), only text is displayed when the radio is in use.

In Detroit, 34 radio stations were receivable for this test and in Little Rock there were 36 stations, all selected by using the “seek” feature of the radios. Here is the summary of these stations’ performances with respect to transmission of RDS metadata:

Detroit 2023 Audit: RDS Radio Vehicle, Midday		
Score	Number of stations	Percent of total
Green	3	9%
Yellow	9	26%
Orange	19	56%
Red	3	9%

Little Rock 2023 Audit: RDS Radio Vehicle, Midday		
Score	Number of stations	Percent of total
Green	1	3%
Yellow	14	39%
Orange	1	3%
Red	20	56%

The previously described color code is included here again, along with information on how these codes were interpreted for the more limited display capabilities in the Chevy Bolt and the Dodge Charger:

	Color code definition	Specific interpretation for 2023 Detroit audit (Bolt)	Specific interpretation for 2023 Little Rock audit (Charger)
Green	The station utilized the full display functionality of the system (RDS or HD Radio) and information was displayed properly	The station was displaying a call sign, a station slogan and some program information (song title, artist, etc.)	The station was displaying a call sign, a station slogan and some program information (song title, artist, etc.)
Yellow	The station did not properly utilize all of the display functionality	The station displayed two out of three (call sign, station slogan, program information)	The station displayed two out of three (call sign, station slogan, program information)
Orange	The station’s display functionality was poor or there were errors	The station did not appear correctly in the receiver’s radio station list	The station displayed a call sign but nothing else
Red	There was no display functionality	No RDS functionality at all	No RDS functionality at all

Perhaps the most striking result from these 2023 audits is that in Little Rock over half of the FM stations received did not have any RDS information transmitted at all. Also, these RDS-only vehicles highlight the fact that for digital radio broadcasters (those transmitting HD Radio signals), the RDS data stream cannot be neglected as it may be, and in fact is likely to be, the only metadata service available to broadcasters in most vehicles.

Metadata and Terms of Use Agreements

Radio broadcasters, as content developers, are sensitive to intellectual property rights and work hard to protect how their content is used and to protect against unauthorized use. Historically these efforts have been centered on audio programming, but these same sensitivities and issues also exist for metadata, in particular with respect to the use of artist images and album art.

It is important for broadcasters to confirm that they have the necessary permission and rights to broadcast metadata content. Clearly broadcasters have the rights to use their own locally-obtained metadata, for example, station logos and slogans or the song title and artist information generated by their playout systems. For metadata not created by the broadcaster, such as artist images and album art, many broadcasters obtain rights from service providers in addition to obtaining the necessary rights for broadcast.

Likewise, manufacturers need to be assured that they have the rights to use the metadata sent to their devices by broadcasters. RadioDNS, the nonprofit association which develops open standards for hybrid radio services, has developed a “standard terms” template which seeks to codify the terms under which broadcasters make their metadata content available.⁶

Additional Insights from 2017 Jacobs Media Audit

The 2017 Jacobs Media Audit, as well as the 2023 Detroit and Little Rock audits, demonstrate there is much room for improvement in how radio broadcasters are using metadata.

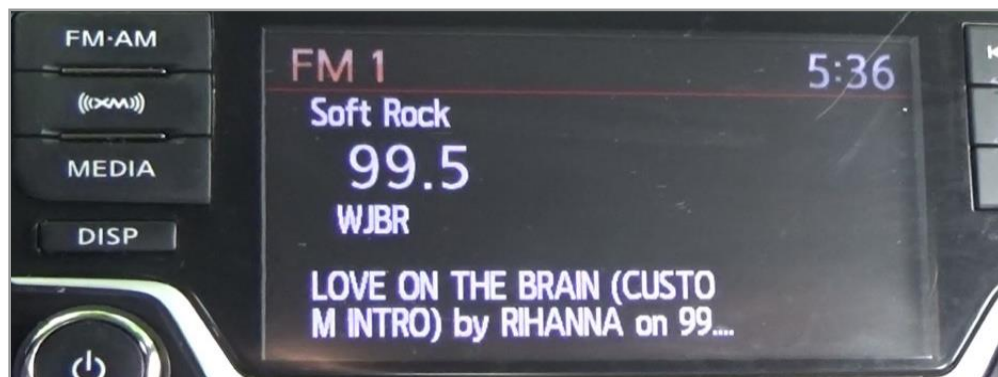
Realizing the given number of uncontrollable variables – numerous auto manufacturers that don't have their own industry standards, multiple display configurations, different system utilization across broadcast groups, lack of access to HD Radio (or even RDS) systems by some broadcasters and other factors – perfection is not achievable. But by recognizing there are attainable areas for improvement by following the best practices outlined in this report, the radio industry has the opportunity to greatly enhance the in-car user experience for both the audience and the auto industry.

Here are suggested areas of improvement identified by this project:

Lack of Standardization

There are multiple ways in which radio stations are displayed in RDS, HD Radio and hybrid radio systems. Examples include:

- **Movement:** Dynamic vs. static information. Static is preferable because the display is more legible, user-friendly and less distracting. While it is more time-consuming to code information to conform with display character limits, in particular the eight-character limit of the RDS PS field, the end result is better and cleaner. It should be noted that there are a lot of older automobiles with receivers that can only display textual information using the eight-character RDS PS field and the only way to show song title and artist information on these displays is by using dynamic PS. Note that in 2021, most new vehicles no longer support dynamic PS. Consequently, at least for the near-term, broadcasters are likely to want to use dynamic PS even though it does not look as good as static PS on more modern displays. When using dynamic PS, there are two options, scrolling and chunking, and of these two, chunking is preferable.
- **Album art:** There is a lack of consistency of using album art when music is playing, or displaying album art when other programming is on the air that does not correspond to the album art. Some HD Radio stations don't broadcast any album art or station logo images, while some vehicles actually provide artwork based upon audio recognition and an in-vehicle or cloud-based database of images (for example, the Gracenote smart radio solution).
- **Case consistency for text:** Some stations utilize all caps for all fields, others blend all caps for some items and lowercase for others. All caps has become synonymous with shouting on text and social media platforms. Using uppercase and lowercase is preferred, with uppercase used just to capitalize words.



RDS: Case Inconsistency

- **Commercial breaks:** There is no standardized approach for metadata when a station is in a commercial break. Some stations continue to scroll information using RDS, such as slogan or call letters. In HD Radio receivers with Artist Experience, some receivers show a generic format slide in the absence of any broadcaster-supplied images. It is recommended that

sponsor information be displayed during commercial breaks, such as SiriusXM’s display of a phone number. In the case of HD Radio, a sponsor logo should be shown in Artist Experience, which could benefit a station’s sales efforts.



Poor execution during a commercial break.

■ **Music stations versus spoken word stations:** Generally speaking, music-formatted stations are showcased better on receiver displays than spoken word stations, especially on HD Radio receiver displays. Because of the available metadata, it is relatively easy for music stations to have art (usually album art) displayed on a consistent basis concurrent with the content heard on the air. Spoken word stations have very few graphics displayed, thus leading to a suboptimal user experience and poor in-car marketing and identification.

Branding

Many radio stations are missing the opportunity to effectively brand their stations, shows and personalities on in-dash displays. In both RDS and HD Radio systems, there are great inconsistencies in how station slogans and branding are shown on receiver displays. And as shown above, for a hybrid radio with an internet-derived station guide, the absence of station logos reflects very poorly on local radio. During morning shows, it is rare to see any branding on RDS displays with the names of talent or shows. On HD Radio displays, graphics featuring a morning show’s logo or a photo are virtually nonexistent. As noted, spoken word stations – news and sports – are rarely well branded. Most do not feature a host, show name or topic displayed, especially on HD Radio receiver displays.

Given that radio talent is often the cornerstone of a brand, even the biggest stations in the largest markets fail to include program names, much less pictures of talent or program/host logos – a missed opportunity to not only showcase a big program or personality but to offer a difference from competitors such as Pandora, Spotify and SiriusXM.

As also noted, it is rare to see branding for HD2, HD3 and HD4 multicast channels. These channels are almost uniformly referred to as “WXXX HD2,” despite the fact they often feature very different programming from their HD1 parent. If the multicast channel provides a simulcast of another station in the cluster, often an AM station, branding is rare. Sometimes in the case where the simulcast station is identified, it is featured along with the call letters of the HD1 parent station, thus creating branding confusion.

Overall Consumer Experience

The user experience for radio in the car is lacking in many cases and while this is often attributable to the technology used in the vehicle - for example, a text-only display - drivers aren’t usually aware of these technical limitations, nor do they care. As users move from station to station or platform to platform, they expect a level of consistency and quality. Clearly, automakers are upgrading their dashboard display technology to achieve these goals. Many newer vehicles have receivers with pre-stored images that will be selected for display usually based upon audio fingerprinting technology. When broadcasters do not provide their own images, these receiver-based images may be used and the broadcaster has lost an opportunity to be in control of the consumer experience.

The load time of certain display elements on both RDS and HD Radio displays can be painfully slow. On HD Radio receivers, there can be gaps of 30 seconds or more on music stations while waiting for album art to load (sometimes these gaps are unavoidable, for example, when a listener tunes to a station mid-song and hence the station was not able to pre-load the image into the receiver as is normally done).

On RDS receivers, textual information is often difficult to read because of inconsistent scrolling or chunking of the information. On some stations, content appears one word at a time and on others it is fed letter by letter. Too often, the listener has to attempt to figure out the message. The net effect is that these data loading issues are annoying and can be embarrassing when only parts of words are displayed and are difficult to comprehend. And of course, from station to station, the displayed information is inconsistent.

Developing a standard approach in the near term is complicated by the fact that broadcasters are trying to support different types of receiver displays simultaneously. In many older vehicles, the displays are character based and rely on dynamic PS exclusively for textual information. On more modern displays, large LCD color displays offer richer content and support RDS RadioText and HD Radio Artist Experience. To provide support for character-based displays, broadcasters may want to provide more information than just static call letters and the station slogan in the RDS PS field and instead use a dynamic PS approach. As previously noted, for dynamic PS the chunking approach is preferred over the scrolling approach.

In the long term, the broadcasting industry should consider phasing out or “sunsetting” the support of character-based displays (i.e., the use of dynamic PS), as the penetration of full-featured displays increases in the market. Many automakers have phased out support for dynamic PS as there is no need for that service on a large display.

Format Designations

Too often, the name of the station format shown on the display is incorrect or is simply designated as “Other.” For example, “Classic Rock” stations are often designated as “Rock,” and “Hip-Hop” stations are listed as “R&B.” This is due in part because not all popular radio format names are included in the receiver, particularly RDS receivers, and these designations are not easy to modify. This is an issue worthy of further discussion within the broadcasting industry.

Inconsistent Use of Available RDS Fields

RDS systems have two principal fields for displaying metadata content. The PS field is comprised of just eight characters. For the receivers used in the audit, the PS field typically resides in the top section of the display, and as discussed, the text shown here is often dynamic in nature. The RT field is comprised of up to 64 characters and is usually, but not always, static on the display.

The audit found there is no standard use of the content displayed in these two fields. Some stations show title and artist along with the station’s slogan and call letters in the eight-character PS field. Others show the station’s slogan in the RT field only. Still others have the same information in both fields, with the RT field scrolling and the PS field static.

Recommended Best Practices: General

These are the general areas that radio stations should focus on in order to enhance the way radio is showcased in automobiles. A separate section focusing on specific engineering recommendations follows this section.

Review Your Station's Use of The Radio Display

It appears that many stations' poor use of the display may result from a lack of continuous review. Many of the errors found could easily be caught by stations if there were a review system in place. It is recommended that each radio station take the following actions:

- Both the engineering and programming departments need to collaborate on a thorough monitoring of each station's use of auto displays. A video recording of how the station appears on RDS and HD Radio receiver displays, including other competing stations in the market, would be a plus. This might require renting a vehicle that has the proper in-car entertainment system, although chances are that most stations have employees who own a wide array of equipped vehicles. This exercise should include reviewing each element that is visible on the display (music, artwork and other information like the station slogan, personalities, etc.) at the point in the station where the information resides, for example, the production system.
- On a quarterly basis, designate two station employees – one with a vehicle equipped with an RDS receiver and one with a vehicle with an HD Radio receiver with Artist Experience – to conduct a comprehensive monitoring of the station using the recommended web form (below) to ensure that all standards are met. If possible, it would also be good to include a vehicle with a hybrid radio receiver, noting that each manufacturer's hybrid radio platform will behave differently. As of August 2023, the vehicle manufacturers with hybrid radios in the U.S. include Audi, BMW, Mercedes, Hyundai, Kia, Genesis and Tesla.

Optimize Branding

Broadcasters need to view the dashboard as an opportunity to market and brand their stations, personalities and programs in the most important listening location – the car. In short, this is a branding exercise and opportunity. While having engineering involved is essential, this also requires the vision of a programmer and a strategic sales manager. The recommended best practices to enhance and optimize branding are:

a. Develop standard content practices for music stations.

- Capitalization of proper nouns, not entire words – nothing should be in all caps.
- Consistent use of title and artist when music is played with first name followed by last name (“Bruce Springsteen”).
- Removal of metadata notes and codes (Ex: “edited version,” “clean version”).
- Display name of host and/or show during talk segments.
- Review the static format designation/Program ID.
- During commercial breaks on hybrid and/or HD Radio displays, display a logo of the advertiser with phone number or URL, the host or the station if an advertiser logo isn't available. On RDS systems, display the advertiser name and a phone number or URL.



Recommended HD Radio layout.

b. Develop standard content practices for spoken word stations.

- Capitalization of proper nouns, not whole words.
- Display the name of the host or program either via text or graphically.
- Review the static format designation or Program ID.
- During commercial breaks on hybrid radio and HD Radio displays, display a logo of the program, the host or the station if an advertiser logo isn't available.

c. Create program identification/logos for HD2, HD3 and HD4 channels.

- Replace the call letters of the HD1 station as the name of these secondary channels (WXXX HD2) and create a brand name that identifies the type of station for the listener.
- Develop a unique logo for each multicast channel to enhance brand identification and listenership.



Well-executed HD2 branding radio layout.

Standardize Use of the RT and PS Fields

Broadcasters need to define the proper use of these two fields in RDS systems. Currently, both fields are used for a multitude of content, creating inconsistency and confusion. As previously discussed, use of the PS field in particular is complicated by the fact that there are many older automobiles with receivers that can only display textual information using the eight-character RDS PS field, and the only way to show song title and artist information on these displays is to use dynamic PS. It is recommended that each of these fields be utilized in the following ways:

- **PS field – static** – Because of the eight-character limit, it is recommended that the PS field be limited to station-specific identifiers only, such as call letters, dial position or brief format or slogan information. The limit will require stations to economically use this field to clarify its identification rather than create unnecessary data distractions that go beyond eight characters. Note that some receivers populate station lists using a station’s PS field. This feature is best supported by broadcasters when static PS data is transmitted.
- **PS field – dynamic** – For broadcasters who elect to use dynamic PS, chunking of the text is recommended over scrolling of the text. By adopting a more economical approach and appreciating the fact that most listeners are driving, this encourages stations to select the most important word or words to maximize this limited branding real estate. Again, for receivers using the PS field for station lists, when dynamic PS is received it can result in a poor station list experience as shown in the photo below (from a 2023 Chevy Bolt EV).



Example of station list which utilizes PS field information. Note confusing information for stations 90.9 and 92.3 as a result of the use of dynamic PS.

- **RT field** – It is recommended that RT be utilized to showcase what is currently broadcasting on the air. With up to 64 characters, there is ample room for title and artist, a station slogan and the name of the program or personalities and hosts. Stations should also scrub the text to ensure that digital debris isn’t included in the RT display. Examples of scrubbed text include “clean version,” “short version” and other notes that may have been inserted into a station’s system when the song was first added but were never meant to be displayed on a receiver.

Review All Artwork in the System

FM and all-digital AM HD Radio stations need to broadcast artwork.⁷ Many newer Artist Experience-capable receivers in vehicles will display generic format artwork in place of broadcaster-supplied artwork, and the graphic is often incorrect or odd. It is

recommended that each station review the artwork in their system and/or meet with their artwork provider to ensure the proper art is broadcast at all times. HD Radio broadcasters can take advantage of a web-based tool from Xperi, [HDLogoVerify.com/](https://www.xperi.com/hdlogoverify), to check and see if their artwork (logos and/or artist images) will appear properly on HD Radio receivers with Artist Experience. It is also important for broadcasters to make sure the images they are broadcasting are properly licensed. Usually, the broadcaster's service provider(s) for images have taken care of licensing; note that images licensed for delivery with internet-based audio streams may not be licensed for over-the-air transmissions.

Provide Enhanced Information about Advertisers

The dashboard affords an opportunity to increase service to advertisers by providing enhanced information on the display while an ad is running. HD Radio's Artist Experience system is capable of displaying an advertiser's logo concurrent with the commercial currently playing, while the text fields can provide additional information about that advertiser (phone number, URL, etc). Hybrid radio systems offer similar capabilities whether HD Radio is used or not. However, advertiser information should not be displayed during program content (music, talk, etc.).

Provide Enhanced Content to Increase Listening

The dashboard display provides opportunities to set listening occasions and increase listening. For example, during a sports broadcast, a radio station could display the current score of the game and at the end of an inning during a baseball broadcast could display which hitters are coming up in the next inning. Talk programs could display the name of a guest and current topic of discussion. Music stations could display what's coming up next, including songs as well as contests. That said, it is recommended that occasion-setting information be brief and further recommended that stations do not promote programs or features that are hours into the future.

Develop Non-linear Content and Interactive Strategies

Hybrid radio technology provides broadcasters with new opportunities to deliver content and interact with listeners, and broadcasters need to develop strategies to take full advantage of this situation. The specific strategies used will be platform-dependent as different automakers support a different set of capabilities in their hybrid radio designs. Typical possibilities include support for station podcasts and other non-linear content and the possibility of interacting with listeners over the hybrid radio platform since the internet connectivity provides for two-way communication.

Recommended Best Practices: Engineering

Background

Listener expectations have changed and audio entertainment content must be immersive in its engagement and offer a consistent feel across the various platforms upon which it is consumed. The improvements in digital dashboard displays offer radio broadcasters the opportunity to add visual engagement to audio broadcasts. Other audio services like personal music delivered by a smartphone to the car display and internet (streaming) audio can deliver additional program-associated data, such as the name of the song, the artist and a visual display of the album art. Drivers routinely enjoy a consistent visual experience as they move among competing audio services such as Pandora, Spotify, SiriusXM and personal music collections.⁸

Free, over-the-air radio is capable of displaying the same information, however, it is not consistently transmitted and displayed. This section offers a collection of engineering best practices that will lead to a better understanding of how to transmit this information and encourage radio stations to pay greater attention to accurately presenting these items on digital dashboard displays.

The key to this enhanced experience is metadata (both textual and images), the information associated with a station's audio events – primarily songs, spots and promos – and other related program information like on-air personality names, program names and station program schedules. When utilized effectively, this metadata becomes enhanced content for receiving devices and greatly enhances the listener experience.

To be most effective, metadata should be accurate to, and presented simultaneously with, the audio content currently consumed and be transmitted by all stations in a market so listeners have a consistent user experience as they scan across the band. To achieve this level of effectiveness, broadcasters must standardize their approach to metadata management and implement services that use metadata to enhance the consumer experience.

Radio broadcasters, particularly the major groups, need to make displaying visual metadata a high priority for the radio industry. The accurate and consistent delivery of this data involves a joint effort by a station's engineering and programming departments. The engineering department is responsible for the setup and maintenance of equipment that a station likely already has installed, and the programming department is responsible for correctly entering the metadata and keeping it up to date.

As simple and elementary as it may seem, a quality and consistent visual display of information on today's dashboard has not received the industry-wide focus it should. While the time and energy invested in this project will pay immediate dividends in a better listener experience, the required labor and technical investments will also prepare radio for a smoother and more rapid deployment of future technologies.

Metadata Essentials

There are two types of metadata that can be displayed on receiver displays in automobiles – text-based and image-based. The most prevalent image-based metadata is found on HD Radio receivers that support the Artist Experience service and at present, the Artist Experience service is only supported by FM-band HD Radio services. However, all-digital AM service (authorized by the FCC in 2020) will eventually support Artist Experience as well. Hybrid radio receivers typically receive images in three ways: using HD Radio, using an IP lookup or in-car database like Gracenote or over the internet.

As previously mentioned, many newer vehicles that support Artist Experience have receivers with pre-stored images that will be selected for display based upon audio fingerprinting. When broadcasters do not provide their own images, these receiver-based images may be used and the broadcaster has lost an opportunity to be in control of the user experience.

Text-based metadata is available for analog FM radio services that utilize the RDS digital FM subcarrier, as well as for both AM- and FM-band HD Radio services. There are four principal RDS text-based metadata services supported by most current automotive receivers:

- 1. Program Identification (PI).** Used to uniquely identify a station's audio program and is used by hybrid radios to link the over-the-air signal to a station's internet content.
- 2. Program Service (PS).** The label of the program service consisting of no more than eight alphanumeric characters coded in accordance with the NRSC-4-B Standard.⁹ PS is displayed on RDS receivers in order to inform the listener what program service is currently broadcast by the station to which the receiver is tuned. An example for a PS name is "Hot 99.1," which is exactly eight characters long. Broadcasters have been using "scrolling" or "chunking" PS as described above to convey song title and artist information on older receivers.
- 3. Program Type (PTY).** There are 31 program format genres that can be viewed in this field.
- 4. RadioText (RT).** A 64-character string that can be displayed eight characters at a time in older RDS receivers and as a 64-character field on newer receivers.¹⁰

Metadata Delivery Equipment

The implementation of RDS data is accomplished by broadcasters using a variety of methods to deliver metadata to transmission hardware. Most stations already have installed some, if not all, of the equipment needed to support metadata. Some may need additional support services and software, while others may only need to configure the equipment they have to properly deliver the data to radio receivers.

In the simplest implementation, a station will have the automation system delivering the song title and artist information directly to the station's RDS encoder. This is not a recommended implementation, as the data available for the radio to display is limited and is subject to errors in the station's automation system database.

Additionally, all FM radio broadcast facilities should have a middleware system, either hardware or software based, a data cleanup and image insertion service and an RDS encoder.¹¹ HD Radio stations (AM and FM) should have their HD Radio importers and exporters updated to the latest fielded software revision, which at the time of publication of this document (August 2023) is v5.3.2.¹² The minimal equipment needed by a station for metadata support over just RDS is:

- 1. The station's automation system,** which stores the songs used by the radio station and is the source of the song title and artist information.¹³
- 2. An RDS encoder.**

Additionally, to improve the dashboard experience stations should employ middleware, such as Broadcast Electronics TRE or Xperi's Artic Palm.¹⁴ The middleware system can be in the form of hardware or software as implemented on a PC. Middleware delivers the metadata from the station's automation system to the RDS and HD radio equipment. These middleware systems provide for additional functionality, including scheduling of information by show daypart, scheduling of advertising campaigns and synchronizing of commercial information with commercial audio, such as the sponsor's web address, slogan, phone number and display logos.¹⁵

The middleware can and should be connected to a data correction and image insertion service such as the Jump2Go/QUU Interactive collaboration (called Quu2Go), which can provide album cover art and advertising images, or the Arctic Palm/DTS Connected Radio image service (using CenterStageLive), which can provide artist images, not album cover art.¹⁶ These services take raw data from the station's automation or middleware and sends it into the cloud for clean up and to provide additional information with consistent data quality to the RDS and HD Radio equipment.¹⁷ There are several other systems in use outside of the U.S. that offer this functionality. Radioplayer has a proprietary metadata aggregation system which is tightly integrated with broadcasters' playout infrastructure and allows Radioplayer to make broadcast metadata available on a wide range of its consumer and automotive platforms and applications. For FM-band HD Radio systems, album art with the Artist Experience feature is an example of the additional information that can be transmitted.

HD Radio importers and exporters process metadata for broadcast by the HD Radio system. The program service data (PSD) for the main channel audio service HD1 (title, artist, album, etc.) are sent to the HD Radio exporter along with the HD1 audio stream. The

corresponding PSD and audio for multicast programs (HD2, HD3, etc.) are managed in the HD Radio importer. Additionally, the HD Radio importer also manages the Advanced Application Services (AAS) metadata including station logo, Artist Experience and traffic data services.

Commitment to Displaying Metadata Accurately and Consistently

Radio stations should commit to providing the following information, at minimum, to radio receivers to establish a consistent listener experience as radio competes directly with streaming pure-plays, satellite radio and music collections:

- 1. Station brand name or station call letters**
- 2. Station PI code (FM stations only)**
- 3. Station program type (PTY) identification (“Rock,” “Country,” “Sports,” “Pop,” etc.)**
- 4. Title of song playing or talk program airing**
- 5. Name of artist performing or talk program host or guest**
- 6. Album, commercial art or station logos, when available, for hybrid radios and AM and FM HD Radio signals**
- 7. Data for the RT field**

Typically, items 1 through 3 are accomplished by a one-time setup which occurs when the RDS encoder or HD Radio transmitters are initially deployed. For some stations, the program type may change according to daypart and in those instances this information would be expected to change accordingly. Note that the National Radio Systems Committee (NRSC) curates PI codes for all full-service and translator FM stations, see picodes.nrsstandards.org.

Items 4 and 5 are typically delivered as an output from a radio station’s automation or digital playback system. Item 5 can either come from the station’s automation system or a software- or hardware-based data service like Quu2Go or Arctic Palm/DTS Connected Radio.

For item 7 there is a function that requires an initial setup when installed. The engineer in conjunction with the programming department needs to set up in the middleware precisely which text from the automation system will be sent to the RT field. The middleware assembles the data, some fixed and others as inputs from the automation and metadata/image services. The RT field can contain song, artist, station slogans, web address, etc. In HD Radio, this field is called PSD. As for RT, PSD is set up in the middleware and is assembled from information from the station’s automation system and metadata/image services.

Information residing in the station’s automation service is most vulnerable to errors and omissions that could result in a poor visual experience in the automotive dash. To create the highest level of standardization, a broadcaster will need to involve the programming department to review the active on-air library, as this function is not typically handled by the engineering department at most stations. Additionally, it is recommended that the station employ a software data service to correct errors in the data contained in the automation system and to provide a consistent data presentation.

Metadata Best Practices: Get it Right, Right from the Start

The most effective way to manage metadata for the purpose of providing enhanced content to the listener on dashboard displays requires cooperation and effort from multiple departments within the radio station.

Engineering resources are best suited to complete technical setup, ensuring that data flows to and from a centralized metadata management system to all appropriate inputs and outputs to support a variety of services, such as HD Radio, RDS, digital dashboards, hybrid radio services (over the air plus broadband) and website Now Playing information.

Content curators from a number of departments (programming, marketing, digital, sales, etc.) are best suited for the day-to-day management of metadata to ensure brand and product consistency. For example, using a centralized management system, someone in programming is likely best suited for song and artist title input whereas a member of the digital team may be best suited to work with station programming and traffic to establish and maintain the station schedule. Subsequently, a member of the sales team may be best suited for gathering the enhanced content for commercials. These responsibilities will vary by station personnel, staff sizes and departmental structure.

To ensure the highest level of accuracy, it will be necessary for someone at the station who is familiar with the content to review the song title and artist information for:

1. **Spelling errors.**
2. **Use of upper and lowercase spelling and not all capital or all lowercase spelling.**
3. **Consistent entry of artist names, i.e., first then last name rather than mixing first and last with last and first throughout the database.**
4. **Removal of cryptic notes, primarily directed at the on-air talent, from the song title and artist fields as this may confuse the audience if seen on a receiver display. These notes may be visible to the audience and could be embarrassing.**

Simple System RDS Encoder Only

The simplest metadata delivery system uses a direct connection from the automation system to the RDS encoder.¹⁸ Older systems may use a serial port connection, but most contemporary RDS systems employ TCP connections over ethernet cable. See Figure 1, which depicts the simple RDS system. This is not a recommended setup.

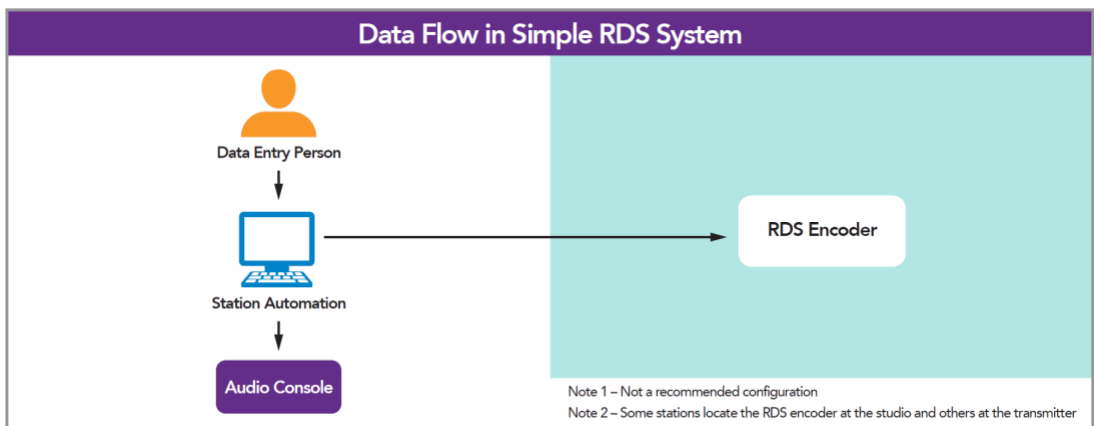


Figure 1 – The simplest system employing a direct connection from automation system to RDS encoder.

System with Middleware

More sophisticated station metadata delivery setups use a middleware device, either hardware- or software-based, residing on a computer to deliver the metadata to the RDS and HD Radio equipment. These same devices can also supply data to the station’s internet streams, websites and Now Playing destinations such as billboards and hybrid (over the air plus internet) radio receivers, see Figure 2 below. The system components are typically connected via TCP connections.

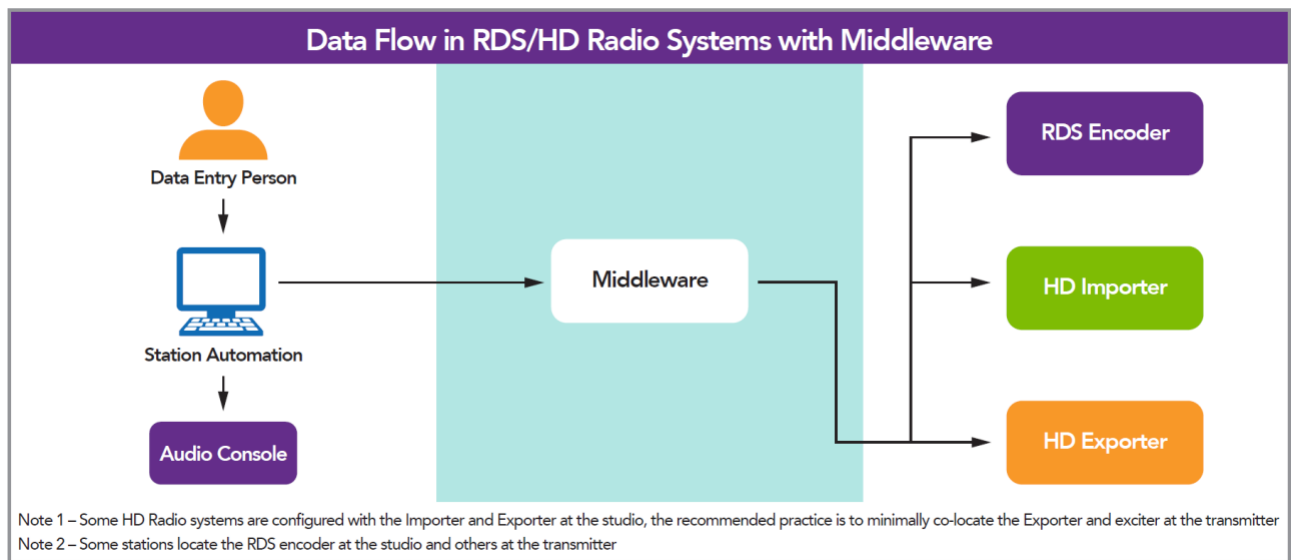


Figure 2 – Metadata delivery system utilizing middleware.

System with Middleware and Web-based Cleanup and Data Acquisition Services

Figure 3, shown below, is a further enhancement of the system shown in Figure 2 that includes the middleware system sending raw data from the automation system, via the web, to a data cleanup and image insertion software service like Quu2Go, Arctic Palm/DTS Connected Radio or Pluxbox. Once data cleanup and image insertion services are performed, the service returns the data to the middleware for distribution to the RDS and HD Radio equipment. Additionally, the software service can add album art, advertisement art and station logos for stations using HD Radio Artist Experience technology.

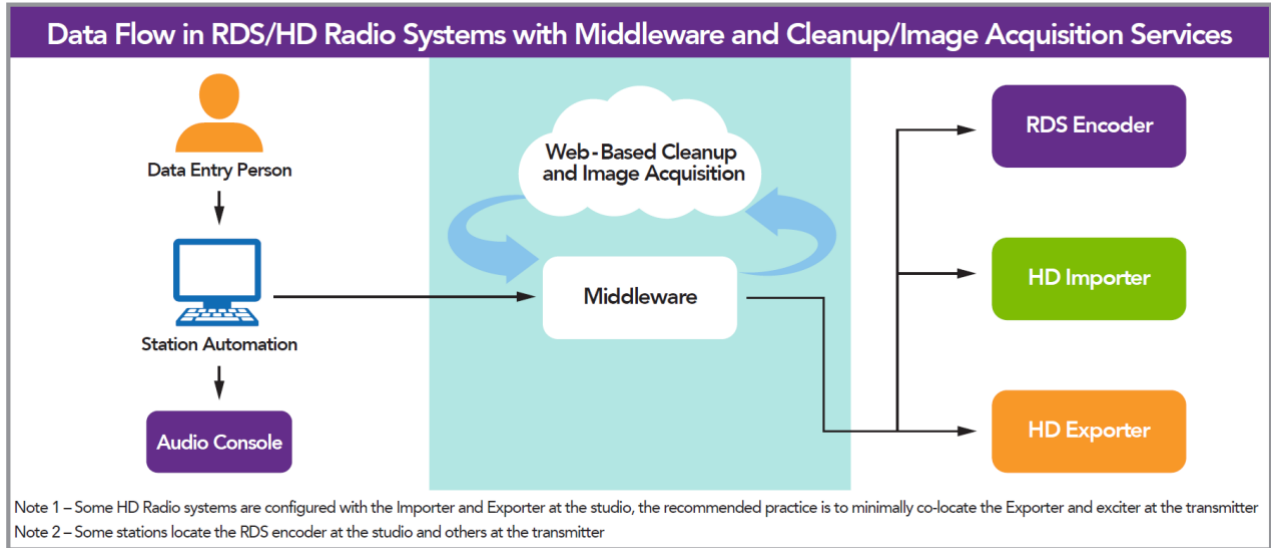


Figure 3 – Metadata delivery system utilizing middleware and cloud-based cleanup and image insertion service.

Loading Images in HD Radio

The normal data transmission rate of the FM-band HD Radio system is 96 kilobits per second (kbps) with an additional 24 kbps of data provided in the extended hybrid mode, which must be divided up among the main audio channel, multicast audio channels, data delivery services such as traffic services, the logo service and Artist Experience artwork. The 24 kbps of data in the extended hybrid carriers is not shared with the 96 kbps of data in the normal data carriers. Thus, the 24 kbps delivered by the extended hybrid carriers can only be used in total for data services or a low bit rate multicast audio channel. The bandwidth required for Artist Experience images must come from the 96 kbps of the normal data carriers.¹⁹ The truth is that many stations are using all of their available bandwidth for audio and data services, so in order to support enhanced metadata services like Logo Service and Artist Experience the stations must make compromises when utilizing their bandwidth.

Xperi recommends that a station set aside four to five kbps to accommodate visual services. This allocated bandwidth is sufficient to convey logos and any commercial or album artwork needed to support the main and multicast channels. The frequency of transmission of the station logos is established in the setup of the middleware and is typically set to every five minutes. The more bandwidth that is set aside for these services, the faster the images will load. The load time of an image to a receiver is dependent on the content of the image and ranges from five to 10 seconds. If a listener tunes in during the middle part of a song, the image display will have to wait for a resend of the album art.

As the current song is approaching completion, generally at three-fourths of the way through, the metadata system will start the processing for the artwork image for the next song. The image is pre-sent and stored locally in the radio and will be displayed when the song plays and the song title and artist information for the new song is transmitted. The image is typically refreshed two times while the song is playing. Commercial events with artwork are treated in a similar manner.

The system defaults to the previously stored station logo when it is not called on to play album or advertiser artwork. Systems such as Quu2Go or Arctic Palm/DTS Connected Radio can have templates set up to display talk show hosts or other program-associated artwork in lieu of the station logo.

Loading Images in Automotive Hybrid Radios

Automotive hybrid radio platforms may receive images both over the air (assuming an HD Radio signal is in use) and over the internet. Before internet-based images can be delivered, however, the receiver needs to know where the station’s internet content is located. This will depend upon the hybrid radio manufacturer and also where static logo images are obtained and where dynamic images (like images for songs or specific advertisements) are obtained.

For static logo images, many hybrid radio platforms can utilize the method standardized by RadioDNS for linking logo images to over-the-air signals. A broadcaster can accomplish this by doing two things: 1) registering stations with RadioDNS (free of charge) and 2) creating a System Information (SI) file for identifying the location of station logos and other static station information, including a streaming audio URL for program audio.

Delivery of dynamic images such as album art to hybrid radios is accomplished in one of three ways:

- **Using HD Radio Artist Experience** - FM-band HD Radio and AM-band all-digital HD Radio. This has been covered in detail above.
- **Using an in-vehicle database** – automakers use this method because they can guarantee a consistent user experience for local radio with respect to song title and artist and album art metadata. These systems are not perfect (sometimes mismatched album art, for example), but for the thousands of radio stations that are not supporting metadata these systems serve to level the playing field. On the other hand, stations that *are* providing metadata may be disadvantaged by these systems because receivers with in-vehicle database systems tend to favor the in-vehicle data and the broadcaster-provided metadata may not be displayed.
- **Using a service provider which delivers images over the internet** – typically an automaker will select a service provider for dynamic metadata delivery for a hybrid radio platform. The table below shows the metadata source/service providers for the three automakers currently supporting hybrid radio.

Metadata source/provider by auto manufacturer (August 2023)

Metadata Source/Provider		
Manufacturer	Static	Dynamic
Audi	RadioDNS	Radioplayer
BMW	RadioDNS	n/a
Mercedes	Various (including RadioDNS, direct integration with Xperi is recommended)	Various (direct integration with Xperi is recommended)
Hyundai/Kia/Genesis	Various (including RadioDNS, direct integration with Xperi is recommended)	Various (direct integration with Xperi is recommended)

Tesla	Direct integration with Xperi is recommended	n/a
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How Receivers Display RDS Metadata

Receivers differ greatly in how they display the transmitted metadata, so it's important that broadcasters understand how receiver displays function.

Basic RDS receivers will display the PS static eight-character station ID or dynamic PS data. The 64-character RT message field is automatically displayed in displays of less than 64 characters by scrolling or chunking the text. Basic RDS receivers will have only an eight-character display. With older RDS radios, the listener must press a button to see the 64-character RT information. Be aware that some receivers will block this display if the car is traveling at more than a pre-determined speed. Newer receivers will display both the PS/dynamic PS and the full 64-character RT message automatically, however in the newest receivers the dynamic PS function is likely disabled.

Connected Car - Additional Recommendations

NAB, working with its members through the NAB Auto Initiative, Digital Officer and Radio Technology Committees, has compiled a list of hybrid radio and supporting services features summarized in the sections below.²⁰ This information may prove vital in helping service providers and manufacturers understand what radio broadcasters need to meet consumer expectations regarding audio programs with rich content.

Rich Content

The examples of hybrid radio devices already discussed from commercially-deployed services and the lessons of the Jacobs Media audit are largely about how broadcasters and receiver manufacturers handle rich content, the textual and image-based components of their program offerings. NAB has considered connected car technologies and compiled a list of rich content features (below and in Appendix A in more detail), which are important for meeting consumer expectations for audio services in a connected car and should be supported by broadcasters and manufacturers:

Textual metadata – station information: static metadata such as station geographic coordinates, slogan and call sign.

Textual metadata – program-related information: dynamic metadata such as song title and artist (music formats), host/program name (news and talk formats), advertiser or sponsor information, etc.

Textual metadata - display: textual metadata shown on receiver display should be uniform in appearance according to particular text field being displayed. Connected car radio systems need to:

- Normalize the appearance of text according to text field being displayed.
- Normalize the appearance of text regardless of how metadata was transmitted. The user experience should be consistent regardless of the metadata delivery method.

Image metadata: station logos, artist or album art images (music formats), talk show/news program logos (news and talk formats), advertiser or sponsor images. Connected car radio systems need to prioritize highest-quality broadcaster-supplied images. IP-delivered images will typically have higher quality than those OTA-delivered.

Metadata synchronization: textual and image metadata must be properly synchronized with audio program; also, OTA- and IP-delivered content, both metadata and audio, must be properly synchronized with one another. Connected car radio systems need to:

- Compensate for system-specific processing delays in order to provide properly synchronized metadata at the receiver.
- As necessary, enable coordination between cloud services and OTA transmission/reception equipment.

Metadata checking: review of dynamic metadata contents for accuracy prior to broadcasting (for example, correct misspelled words).

Support for multiple platforms: broadcasters should have the ability to deliver rich content to multiple destinations. Connected car radio systems need to:

- Accept metadata in any broadcast industry-standard formats.

Advertising support: text and image metadata to be displayed when audio program consists of advertising or sponsorship information. Connected car radio systems need to:

- Properly recognize advertiser-related metadata, which may undergo different review processes than program-related metadata.
- Support consumer actions on advertisers.

Geofencing: define geographical boundaries for authorized and/or restricted use of streaming metadata. Connected car radio systems need to:

- Support use of geofencing using industry-standard methods for controlling usage of streaming audio in receivers. Note that

broadcasters set geofencing boundaries with station coverage area in mind.

- Ensure that the streaming audio is not buffered for long periods of time in the background when it is not in use. The internet stream should only be prepared when the vehicle has reached the boundaries of the geofencing. The internet stream should not be pre-fetched in conditions where regular OTA reception is satisfactory.

Audio source: Order of preference for audio source selection should be controlled by broadcaster. Connected car radio systems need to:

- Ensure that default audio source order of preference should be OTA digital, OTA analog, IP-delivered streaming audio.
- Utilize IP-delivered streaming audio source specified by the broadcaster in the receiver from dynamic information sources.
- Minimize use of streaming audio in order to minimize audio streaming delivery costs incurred both by consumers and broadcasters.
- Utilize “blend” algorithms that are not too aggressive, that is, do not blend too soon (should favor OTA audio for as long as possible).

Security and Privacy

For all automakers, connected car radio systems will be subject to cybersecurity issues and risks by virtue of their internet connectivity and the various digital communications channels involved. NAB has identified four specific items pertaining to privacy and security of data associated with connected car platforms that are of interest and listed here:

Privacy – broadcasters: data collected for a station is not shared with other parties with the exception when station data is aggregated in order to become individually unrecognizable.

Protecting streaming URLs: streaming URLs are protected from unauthorized usage. Receiver should utilize IP-delivered dynamic streaming audio source specified by the broadcaster and should verify streaming URLs are not past their expiration date.

Protection of data delivery: rich content delivered to receivers and any data or analytics from receivers should be protected from malicious interference. All communication links in all signal paths should be secured with use of https and public/private encryption certificates.

Data integrity: prevent unauthorized data from being distributed to stations or to listeners either OTA or via IP.

Station Recommendations - Summary

Rich Content

Broadcasters, equipment and service providers and receiver manufacturers should consult the information above and in Appendix A on rich content. NAB has considered connected car technologies and compiled this list of rich content features that is important for meeting consumer expectations for audio services in a connected car and should be supported.

Programming

1. Making sure the song title and artist fields of an automation system are correct is the first step. To do so, every song in the station's automation system must be reviewed to ensure the accuracy of the data.
2. As new songs are entered, be sure that the data is in the same format as the existing tunes in the database.
3. When entering data in the song title and artist fields, adding any more information other than the actual artist name and song title will make someone else's job more complicated down the line.
4. Program-associated data is not just for music, it is also important for spoken word stations. These stations can increase audience engagement by sending the name of the program, the host name and picture for FM-band HD Radio stations or hybrid (over the air plus internet) radio services, topic of discussion, guest and call-in telephone number.
5. AM-band HD Radio stations should not forget that program-associated data is available and can transmit, as discussed above, show information, sports scores, weather, traffic bulletins, stock prices and synced advertiser's slogans, phone numbers and web addresses. In the future, all-digital AM HD Radio receivers will support Artist Experience, as well.
6. The station's programming management and engineering staff should all own or rent a car with an HD Radio that can display Artist Experience so they can see what listeners are experiencing.
7. Be sure that the station PI code is correct, this is vital for stations that are supporting RadioDNS for delivery of static metadata to hybrid radio receivers.
8. Be sure that the station slogan or ID is correct.
9. If a station is merely sending text from an automation system to an RDS encoder, a middleware system such as Quu2Go, TRE or Artic Palm should be added.
10. Every station should be using a software service like Quu2Go or Arctic Palm/DTS Connected Radio to clean up the data for an accurate and consistent user experience. You can get information on Quu2Go at myquu.net and for Arctic Palm/DTS Connected Radio at arcticpalmapps.com.
11. Make use of the RT field in RDS systems.
12. Provide station logos and station information using a RadioDNS SI file to support hybrid radio receivers.

Engineering

1. Correctly enter the RDS PI code by going to picodes.nrsstandards.org/fs_pi_codes_allocated.html and finding the PI code for your station. It is very important to not leave the default PI code in an RDS encoder. When the same PI code ends up on multiple, unrelated stations, advanced receivers can then execute seemingly random jumping from station to station.
2. Consult with the station programming department to identify the RDS PTY code that the station wishes to use to identify its format on the radio display. Refer to Table F.2 in the NRSC's [NRSC-4-B Standard](#) and enter the appropriate PTY code into the RDS and HD Radio equipment.
3. Set the RDS injection level. While there is no specified level, four to five percent injection levels are common and provide reliable RDS encoding throughout the station's service level.

4. The RDS PS data can be displayed either as static or dynamic, and in the case of dynamic as scrolling text or chunking PS scroll (dynamic PS or DPS). This function is controlled by the RDS encoder and requires a configuration setting or DPS command to use this feature.²¹
5. Set up middleware to display desired information in the RT field in RDS systems.
6. Set up middleware for displaying the PSD information in HD Radio systems.
7. For stations employing HD Radio systems, consult with the station’s programming department to set up the Station Information Services (SIS): station call, PTY, station slogan and station message.
8. In HD Radio systems, be sure the exporter and importer software versions are up to date. The current fielded version number (exporter and importer, August 2023) is v5.3.2. This is what manufacturers are shipping and this will support all current features.
9. The station’s engineering team should have full-time access to an HD Radio receiver in order to observe the metadata, album art and commercial art.
10. Work with the station or group IT department to ensure the correct information is included in the RadioDNS SI file, to allow for proper reception of static metadata over the internet for hybrid radios.
11. Verify that the station’s dynamic metadata is properly received by the DTS AutoStage system to support hybrid radio receivers in vehicles that use DTS AutoStage.

Metadata Service Providers

This information is provided for informational purposes only. Please contact NAB’s David Layer at dlayer@nab.org if you want your company’s services to be included.

Service Provider	List of services	Comments
Aiir aiir.com	<ul style="list-style-type: none"> • Free RadioDNS registration, SI file creation 	
Arctic Palm arcticpalmapps.com	<ul style="list-style-type: none"> • Radio station production software for metadata management 	Legacy system, has devolved into the Rapid Xperi platform (see below)
Pluxbox pluxbox.com	<ul style="list-style-type: none"> • Free RadioDNS registration, SI file creation (metadata.radio) • Full-service dynamic metadata including song title and artist, artist images and synchronized ad display messages 	Supports RadioDNS, DAB+, DTS AutoStage
Quu Interactive myquu.net	<ul style="list-style-type: none"> • Full-service dynamic metadata including song title and artist, artist images and synchronized ad display messages 	Acquired Jump2Go in 2019
Radioline business.radioline.co	<ul style="list-style-type: none"> • Full-service dynamic metadata including song title and artist, album art 	Have developed a hybrid radio platform for Android Automotive OS
Radioplayer radioplayer.org	<ul style="list-style-type: none"> • RadioDNS registration, SI file creation • Full-service dynamic metadata including song title and artist, album art • Exclusive dynamic metadata service provider for Audi and BMW hybrid radio solutions 	Not currently available in the U.S.
Rapid aimrapid.com	<ul style="list-style-type: none"> • Radio station production software for metadata management 	Predecessor system is Arctic Palm

<p>TRE bdcast.com/products/studio-products/tre-the-radio-experience/</p>	<ul style="list-style-type: none"> • Radio station production software for metadata management • Full-service dynamic metadata including song title and artist, artist images 	
<p>Xperi (DTS AutoStage) dts.com/autostage</p>	<ul style="list-style-type: none"> • Acquire SI using RadioDNS standards (some stations only) • Full-service dynamic metadata including song title and artist, artist images and synchronized ad display messages • Analytical information on listener behavior shared with the broadcaster • Exclusive service provider of broadcast metadata for Mercedes, Hyundai/Kia/Genesis, Tesla hybrid radio solutions 	<p>AutoStage is an amalgam of TiVo metadata services and the DTS Connected Radio platform</p>

Abbreviations

Abbreviation	Definition	Notes
AM	Amplitude Modulation	Modulation system used in the U.S. AM band.
AAS	Advanced Application Services	Advanced Application Services.
BBC	British Broadcasting Corporation	
DAB/DAB+	Digital Audio Broadcast	A digital radio service developed by Eureka consortium used throughout Europe and in other parts of the world. DAB+ is an advanced version of DAB utilizing more efficient audio coding to support more audio channels per signal.
FM	Frequency Modulation	Modulation system used in the FM band (87.8 – 108 MHz).
kbps	Kilobits per second	
NAB	National Association of Broadcasters	
NRSC	National Radio Systems Committee	A standards setting committee co-sponsored by the Consumer Electronics Association and the National Association of Broadcasters. nrsstandards.org
PAD	Program Associated Data	Text or graphics that are synchronized with the associated program audio.
PI	Program Identification	A field defined in the RDS standard to uniquely identify an audio program, also used by the RadioDNS standard to identify an over-the-air signal in a hybrid radio.
PS	Program Service	An eight-character field defined in the RDS standard containing a label of the program service or station slogan. Originally intended to be displayed as a static text field, the PS is widely used in the U.S. in a dynamic fashion to provide song title and artist to receivers with simple eight-character displays.
PTY	Program Type Code	A six-bit field defined in the RDS standard, included in the RDS system to identify one of 31 program types to be displayed on the radio receiver.
RDS	Radio Data System	A digital FM subcarrier that is used to add digital data to analog FM transmissions.
RT	RadioText	This is an RDS field intended to display a 64-character text field.
SIS	Station Information Services	Two kbps of data reserved for station information in HD Radio systems. ²²
STL	Studio Transmitter Link	Device or system used to convey audio and data from the studio to the transmitter.
TCP/IP	Transmission Control Protocol/Internet Protocol	A protocol for delivery of a data stream between applications running on hosts communicating by an IP network.

Definitions

Term	Definition
Album cover art (or just album art)	This is the cover art of the album from which a song originates, and is usually the preferred artwork to use for songs airing on a radio display (for example, when using HD Radio The Artist Experience service) or on a streaming website or mobile app. Use of album cover art by broadcasters typically involves a license fee charge.
Artist Experience	The image delivery feature employed by HD Radio systems to insert station logos, advertising logos, program associated logos and album art into FM-band HD Radio transmissions.
Artist image art	Typically refers to a non-album cover art image used when a song is playing, these are usually promotional images used by the record label for the song's artist. Use of artist image art by broadcasters typically does not involve a license fee charge.
Connected car	The connected car generally refers to a vehicle that is connected to a mobile broadband service. It can be connected with a built-in cellular modem that can support a plethora of visual information functions, essentially supporting a hybrid radio functionality. Or it can be connected using a mobile phone's cellular modem and reflects certain phone features onto the car display system and allows interaction with the phone features via the car's driver controls.
DTS AutoStage	An automotive hybrid radio platform developed by Xperi and currently (as of August 2023) in use by Mercedes-Benz, Hyundai/Kia/Genesis and Tesla as the technology behind their respective hybrid radio implementations.
HD Radio	A digital radio service developed by iBiquity Digital Corporation, now Xperi. The system is used to add a digital broadcast component to AM and FM transmissions and has been adopted primarily in North America.
Hybrid radio	A system where internet data is used to augment over-the-air audio broadcast with additional visual data and to allow call-to-action responses from the listener. In mobile applications, the internet connectivity will typically come from the user's smartphone or a cellular modem installed in the vehicle.
Logo service (logo)	The HD Radio system supports a logo service to display station logos for the main HD1 and, for FM-band HD Radio, any associated multicast channels (HD2, HD3 and HD4). For hybrid radio, the RadioDNS SI file can be used to identify the internet locations of a station's logo.
Metadata	Data simultaneously transmitted to support other services. In the case of radio this data supports the audio program segment of the over-the-air transmissions. Radio station metadata can contain information associated with a station's audio events - primarily songs, spots and promos - and other related program information like on-air personality names, program names and station program schedules.
Middleware	A hardware or software service that is used to route data from a radio station's automation system that should be augmented by a data cleanup and image insertion service, to the station's RDS and HD Radio equipment.
RadioDNS	A nonprofit international standards-setting organization which supports hybrid radio. Broadcasters register for free with RadioDNS and create a SI file which identifies the internet location of a station's logos, streaming audio URL and other station information.

Radioplayer	Radioplayer is a radio technology platform owned by U.K. radio broadcasters and operated under license in some other countries. It operates an internet radio web tuner, a set of mobile phone apps, an in-car adapter and a growing range of integrations with other connected devices and platforms.
QUU Interactive	A service for cleaning up raw data as supplied by the radio station's automation system, adding additional program associated data, inserting logos and advertising and album art.

Endnotes

- ¹ RadioDNS is a nonprofit organization which develops open standards for hybrid radio systems.
- ² Additional information and screenshots are available in the Radio World eBook “A Call to Action: DTS AutoStage and Radio’s Existential Battle for the Dash,” available for download [here](#).
- ³ The Ioniq 5’s infotainment system has been the subject of NAB PILOT blogs, one focusing on the [availability of AM radio](#) in this new electric vehicle and the other on how Hyundai has nicely [integrated Apple CarPlay and Android Auto](#) to work seamlessly with the radio.
- ⁴ For more information on the October 2022 Hyundai group update, including which vehicles are eligible, visit <https://update.hyundai.com/US/EN/updateNoticeView/930> for Hyundai, <https://update.kia.com/US/EN/updateNoticeView/931> for Kia, or <https://update.genesis.com/US/EN/updateNoticeView/932> for Genesis. Note that the exact capabilities of the updated receiver will depend upon the generation of the Navigation System and that some older models will not experience a “full hybrid radio” upgrade.
- ⁵ A separate report, Dash Committee Audit Report, August 2017, is available from NAB which describes the audits in greater detail.
- ⁶ The RadioDNS Metadata Terms of Use are available at <https://radiodns.org/terms/metadata/>.
- ⁷ Artist Experience support for all-digital AM is expected to be available for newer HD Radio receivers starting sometime in 2023.
- ⁸ SiriusXM receivers will either display album art or a logo representing the channel being received, depending upon the particular implementation.
- ⁹ As previously discussed, many broadcasters are using PS in a “dynamic” fashion to send song title and artist information, intended for use on receivers that only have character-based displays.
- ¹⁰ Some receivers with only 32-character displays display the total data field sequentially. Additionally, some receivers will block this display if the car is traveling more than a speed determined by the manufacturer.
- ¹¹ While the image insertion is only for HD stations, the data cleanup service is essential to the reliable and consistent delivery of data to analog and HD Radio receivers.
- ¹² Many AM stations have a single box HD Radio exciter with an integrated importer and exporter function.
- ¹³ The automation software needs to be configured to output the data.
- ¹⁴ For information on Broadcast Electronics TRE see <https://www.bdcast.com/products/studio-products/tre-the-radio-experience/> and for information on Xperi’s Arctic Palm see <https://arcticpalmapps.com/>.
- ¹⁵ Additionally, middleware systems can supply metadata to support streaming players, hybrid radio applications like NextRadio, the connected car and “Now Playing” systems.
- ¹⁶ The Arctic Palm system was evolving into the “Rapid” platform, <https://www.aimrapid.com/>, at the time this document was updated (June 2021).
- ¹⁷ Jump2Go/Quu Interactive is a service that communicates with the station’s middleware to clean up entries from the automation system and add album art as is supported by Xperi’s Artist Experience.
- ¹⁸ The automation software needs to be configured to output the metadata.
- ¹⁹ As an example, 48 kbps assigned to the main audio channel (HD1), 32 kbps assigned to the HD2 multicast audio channel, 12 kbps assigned for a traffic service and four kbps assigned for Artist Experience artwork results in all of the data capacity within the normal carriers used. An additional 24 kbps is available when operating with the additional extended hybrid carriers which could be used for a third multicast audio channel, HD3.
- ²⁰ This committee work took place in late 2022/early 2023.
- ²¹ In the PS scroll mode, there is an eight-character scroll which moves one character at a time. This is not recommended as full words are rarely displayed, making the display hard to read and creating greater driver distraction. In the PS block mode, the message is a word scroll so full words are shown making the display easier to read. For words of more than eight characters, most encoders perform some justification for a better display.
- ²² An additional two kbps of data not included in the 96 kbps of the main HD radio carriers. Thus, the total bandwidth of the HD radio main carriers is 98 kbps.

APPENDIX A

Connected Car Radio Technology - Rich Content Features Table

No.	Item	Description	Important connected radio-related features
1	Textual metadata – station information	Static metadata such as station geographic coordinates, slogan, call sign	<ul style="list-style-type: none"> • Prioritize broadcaster-supplied metadata (OTA- or IP-delivered) over metadata from other sources by default • Stored in the receiver for rapid display when tuning, etc. • Updated regularly and subject to an automatic expiration date • Some data (e.g., geographic coordinates) only used internally in the receiver and not visible to users
2	Textual metadata – program-related information	Dynamic metadata such as song title and artist (music formats), host/program name (news and talk formats), advertiser or sponsor information	<ul style="list-style-type: none"> • Prioritize broadcaster-supplied metadata (OTA- or IP-delivered) over metadata from other sources by default • Typically displayed to the user only for the duration of the corresponding audio content, may be stored for future retrieval (e.g., “tagging”)
3	Textual metadata – display	Textual metadata shown on receiver display should be uniform in appearance according to particular text field being displayed	<ul style="list-style-type: none"> • Support core field set (song title, artist, host/program name, station name/slogan, advertising-related information) • Appearance of text should be normalized according to text field being displayed (e.g., all caps versus upper lower case, etc.) • Appearance of text should be consistent from platform to platform (FM RDS, HD Radio, internet streaming)
4	Image metadata	Station logos, artist or album art images (music formats), talk show/news program logos (news and talk formats), advertiser or sponsor images	<ul style="list-style-type: none"> • Prioritize broadcaster-supplied metadata (OTA- or IP-delivered) over metadata from other sources by default • Prioritize highest-quality broadcaster-supplied images (IP-delivered images will typically have higher quality than those OTA-delivered) • Display to the user only for the duration of the corresponding audio content, may be stored for future retrieval (e.g., “coupon radio”) • Station logos should be updated regularly and subject to an automatic expiration date • Avoid using stale, pre-stored station logos that are pre-loaded or stored on disk and not updated

No.	Item	Description	Important connected radio-related features
5	Metadata synchronization	Textual and image metadata must be properly synchronized with audio program; also, OTA- and IP-delivered content, both metadata and audio, must be properly synchronized with one another	<ul style="list-style-type: none"> • Compensate for system-specific processing delays so as to provide properly synchronized metadata at the receiver • May involve coordination between cloud services and OTA transmission/reception equipment
6	Metadata checking	Review of dynamic metadata contents for accuracy and prior to broadcasting	<ul style="list-style-type: none"> • For example, correct misspelled words
7	Support for multiple platforms	Broadcasters should have the ability to deliver rich content to multiple destinations (e.g., different service providers) using a common format	<ul style="list-style-type: none"> • Accept metadata in industry-standard formats (e.g., RadioDNS)
8	Advertising support	Text and image metadata to be displayed when audio program consists of advertising or sponsorship information	<ul style="list-style-type: none"> • Properly recognize advertiser-related metadata which may undergo different review processes than program-related metadata • Support for advertiser action (e.g., coupon radio, “take me there” using location-aware receiver)
9	Geofencing	Define geographical boundaries for authorized and/or restricted use of streaming metadata (e.g., RadioDNS)	<ul style="list-style-type: none"> • Support use of geofencing using industry-standard methods for controlling usage of streaming audio in receivers • Geofencing data only used internally and not visible to users • Ensure that the streaming audio is not buffered for long periods of time in the background when it is not in use • Use geofencing guidelines as per 3.10 above and the geofencing specifications of the hybrid platform (e.g., RadioDNS)

No.	Item	Description	Important connected radio-related features
10	Audio source	Order of preference for audio source selection should be under broadcaster control	<ul style="list-style-type: none"> • Default audio source order of preference should be OTA digital, OTA analog, IP-delivered streaming audio • Receiver should utilize IP-delivered streaming audio source specified by the broadcaster • Minimize use of streaming audio in order to minimize audio streaming delivery costs incurred both by consumers and broadcasters • Utilize “blend” algorithms that are not too aggressive, that is, do not blend too quickly (should favor OTA audio for as long as possible)