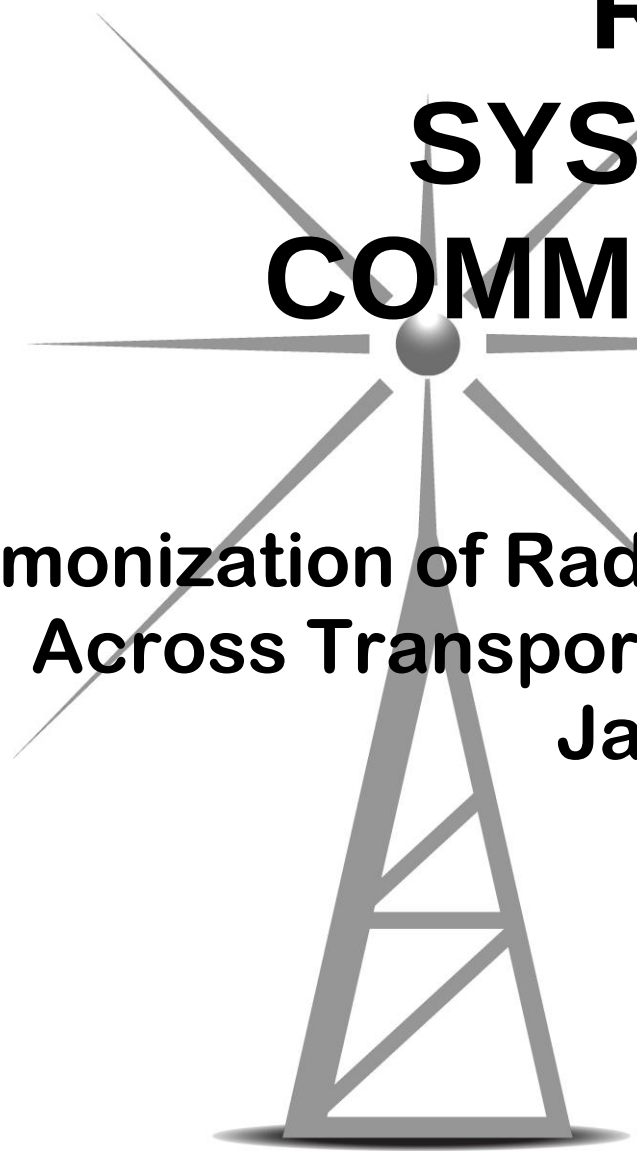
NRSC GUIDELINE

NATIONAL RADIO SYSTEMS COMMITTEE



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Harmonization of Radio Metadata Across Transports Guideline
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FOREWORD

Radio broadcasters use a variety of technologies to deliver content to listeners, both by over-the-air broadcast and delivery using the internet. One common thread among nearly all these technologies is that each has a mechanism for delivering “metadata” associated with the audio content being delivered. While the metadata content being distributed is essentially the same at any given point in time, the protocols and mechanisms used to affect this distribution are different.

The purpose of this NRSC Guideline is to describe the various technologies used to deliver metadata to listeners, comparing and contrasting them, and offering guidance to broadcasters and receiving device manufacturers on how to best harmonize and simplify this process across multiple platforms.

Specifically, this document discusses specific metadata (including text and images) features of the IBOC and RDS Standards, as well as internet streaming audio protocols, and defines an intended usage that will allow the broadcaster to send, and the receiving device to display, common information independent whether the data signal is being received from IBOC or RDS or the internet. Also included is information on hybrid (over-the-air plus internet) radio platforms which seamlessly combine content being delivered to receivers over both paths and in addition offer interactivity and the possibility of enhanced information on listener behavior.

This is a “Guideline” document, and as such is not required for compliance to any standard. However, it is hoped that broadcasters, automation software vendors, transmission equipment manufacturers (both broadcast and streaming), consumer electronics manufacturers and streaming audio player developers will find the clarifications in this document useful. Note that this document is the successor to an earlier NRSC Guideline, NRSC-G200-A, Harmonization of RDS and IBOC Program Service Data (PSD) Guideline, which was retired upon publication of NRSC-G302.

The information contained in this NRSC Guideline is the work of the Metadata Usage Working Group (MUWG) of the Data Services and Metadata (DSM) Subcommittee, Steve Shulits, New York Public Radio, chair. The chair of the MUWG is Alan Jurison, iHeartMedia Corporation.

The NRSC is jointly sponsored by the Consumer Technology Association and the National Association of Broadcasters. It serves as an industry-wide standards-setting body for technical aspects of terrestrial over-the-air radio broadcasting systems in the United States.

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HARMONIZATION OF RADIO METADATA ACROSS TRANSPORTS GUIDELINE

1 SCOPE

This is an informative Guideline document which sets forth the recommendations for harmonization of metadata distribution for radio station audio programs across platforms and technologies, specifically, between RDS data (described by NRSC-4-B and the RT+ Specification V2.1), IBOC Program Service Data (PSD) using MPS, SPS and SIS data (described by NRSC-5-D), and metadata used for internet streaming of radio station audio programs. This document does not cover text sent via NRSC-5-D Advanced Application Services (AAS).

2 REFERENCES

2.1 Normative References

This is an informative specification. There are no normative references.

2.2 Informative References

The following references contain information that may be useful to those implementing this Guideline document. At the time of publication, the edition indicated was valid. All standards are subject to revision, and users of this Guideline document are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

[1]	NRSC-4-B	United States RBDS Standard, April 2011
[2]	NRSC-5-D	In-band/on-channel Digital Radio Broadcasting Standard, April 2017
[3]	SY_IDD_1017s rev. H	HD Radio™ Air Interface Design Description – Audio Transport, iBiquity Digital Corporation, 12/14/16
[4]	SY_IDD_1020s rev. J	HD Radio™ Air Interface Design Description – Station Information Service Protocol, iBiquity Digital Corporation, 12/14/16
[5]	SY_IDD_1028s rev. E	HD Radio™ Air Interface Design Description – Main Program Service Data, iBiquity Digital Corporation, 12/14/16
[6]	ISO 646:1991	Information Processing -- 7-bit Coded Character Set for Information Interchange. Geneva: International Organization for Standardization, 1991
[7]	ISO 8859-1	Information Technology – 8-bit Single-Byte coded Graphic Character Sets – Part 1: Latin Alphabet No. 1
[8]	IEC 62106	Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 to 108,0 MHz
[9]	R06/040_1	RadioText Plus (RT+) Specification V2.1
[10]	ID3V2.3.0	Martin Nilsson, “ID3V2.3.0 Native Frames”, www.id3.org
[11]	ETSI TS 103 270	RadioDNS, Hybrid lookup for radio services

[12]	ETSI TS 102 818	RadioDNS, XML Specification for Service and Programme Information (SPI)
[13]	ETSI TS 101 499	RadioDNS, Visual Slideshow
[14]	ISO/IEC 10646:	"Information technology - Universal Multiple-Octet Coded Character Set (UCS)". (UTF-8)
[15]	NRSC-G300-C	Radio Data System (RDS) Usage Guideline
[16]	NRSC-R300	Program Associated Data (PAD) Field Length Study

2.3 Informative Reference Acquisition

Documents [1]-[5] are distributed free of charge via the NRSC website at: www.nrscstandards.org.

Documents [6]-[8] are international standards and may be obtained for a fee at http://global.ihs.com.

Document [9] is available from the RDS Forum; they may be contacted at www.rds.org.uk.

Document [10] is available as a free download at www.id3.org.

Documents [11]-[13] are international standards available for free download at www.etsi.org

Document [14] is an international standard and may be obtained for a fee from www.iso.org.

Documents [15] and [16] are available free of charge via the NRSC website at: www.nrscstandards.org.

2.4 Symbols and Abbreviations

In this Guideline the following abbreviations are used:

API	Application Programming Interface
Character Set	The displayable images corresponding to the 256 possible values of a one-byte character
DSM	Data Services and Metadata (name of NRSC Subcommittee responsible for this document)
FCC	Federal Communications Commission (U.S.)
FM	Frequency Modulation
IBOC	In-Band/On-Channel
MPS	Main Program Service
MPSD	Main Program Service Data
MUWG	Metadata Usage Working Group (name of Working Group which drafted this document)
N/A	Not Applicable
NRSC	National Radio Systems Committee
PIDS	Primary IBOC Data Service Logical Channel
PSD	Program Service Data
RBDS	Radio Broadcast Data System
RDS	Radio Data System
RF	Radio Frequency
RT	RadioText
RT+	RadioText Plus
SIDS	Secondary IBOC Data Service Logical Channel
SIS	Station Information Service

SPS	Supplemental Program Service
SPSD	Supplemental Program Service Data
TBD	To Be Determined

2.5 Definitions

In this Guideline the following definitions are used:

HD Radio™ — Trademark (of iBiquity Digital Corporation) for the digital AM and digital FM transmission technology authorized by the FCC. Note that the use of the term "HD Radio" in the NRSC-5-A Standard and its normative references shall be interpreted as the generic term "IBOC" for the NRSC-5 compliant system and shall not be construed as a requirement to adhere to undisclosed private specifications that are required to license the HD Radio name from its owner.

msb — Most significant bit

Program Service (PS) — As defined by the RBDS Standard, the PS data field comprises eight characters. It is the primary aid (under RDS) to listeners in program service identification and selection.

RadioText (RT) — As defined by the RBDS Standard, RT is a message type to be used for transmitting up to a 64-character text message.

RadioText Plus (RT+) — As defined by R06/040_1 [9], a facility to extract certain fields from the RT buffer.

RDS — Radio Data System is an industry-standard method for transmitting low bit-rate data (~1187 bps) over an FM subcarrier.

3 OVERVIEW OF AUDIO SERVICE DELIVERY TECHNOLOGIES

3.1 Introduction

The broadcasting landscape changes as rapidly as technology does. Technology allows for different systems to become integrated and offered in one or a small set of devices and software covering the full spectrum of broadcasting needs.

"Advertisement insertion" and other monetizing strategies can influence how technologies are implemented and used at the broadcasting station level. The need to adapt brings forward other needs to render a unified and consistent experience across multiple platforms.

As these technologies evolve, content insertion and personalization are becoming more and more popular, where the programming is defined by both broadcast content and on-demand content combined in a single unique experience.

The delivery of this programming can be divided into a few categories as described below.

3.1.1 Over-the-air (OTA) transmission

In North America, OTA transmission is done using AM and FM analog radio signals and digital radio signals conforming to the NRSC-5 IBOC Standard. Many broadcasters make use of the Radio Data System (RDS) digital FM subcarrier to transmit information about the content over analog FM signals that can be shown as text on receiver displays. The NRSC-5 Standard describes a system which is capable of both analog and digital transmission and integrates a unique workflow for displayable content description data.

The NRSC-5-D Standard is based upon the in-band/on-channel (IBOC) digital radio technology developed by iBiquity Digital Corporation and marketed under the trade name “HD Radio.” The system described by NRSC-5-D is capable of transmitting various services including audio services and data services. Data transmitted in the Main Program Service (MPS) and Supplemental Program Service (SPS) portions of the signal are typically items associated with the corresponding audio program material, including such information as artist name, song title and station information (aka “Program Specific Data or PSD,” or “Program Associated Data or PAD”).

The NRSC-4-B Standard (aka “the RBDS Standard”) is based upon the European RDS Standard and defines a method for text and data transmission over the RDS FM data subcarrier. Like IBOC, RDS information includes items such as artist name, song title, and station information.

The RadioText Plus (RT+) Standard V2.1 is a product of the RDS Forum (www.rds.org.uk), with input from U.S. broadcasters to accommodate North American requirements. RDS RT+ adds a facility for RT text buffer field extraction. For example, a short RT+ message can identify the start and end of the artist and title information in the RT buffer. This mirrors a similar capability supported in NRSC-4-B (see Annex U). However, RT+ is recommended over Annex U as a more universal solution (supported both in Europe and North America).

When a broadcaster uses both IBOC and RDS text transmission methods, and when an IBOC receiver then decodes both IBOC and RDS text messages, the issue of consistency between these messages (which are related to the same audio material) must be considered. A common situation is that of the IBOC mobile receiver moving from the digital coverage area to the analog coverage area; the mobile device stops receiving IBOC text and typically switches to displaying RDS text which it continues to receive while in the analog coverage area of the signal.

Ideally, the listener will not notice that text from two different data systems (i.e. IBOC and RDS) is being displayed, but rather will perceive one seamlessly integrated information service regardless of whether the current text message is derived from RDS or IBOC.

3.1.2 Simulcast streaming

Simulcast streaming consists of taking the exact same programming that is transmitted by OTA transmission and delivering it through the public internet to a variety of devices.

It is characterized by being the simplest form of streaming as there is usually no intervention in the content compared to the OTA signal. Whatever plays OTA will play in the stream.
Display data used over RDS or encoded into IBOC transmission will match exactly on the streaming side. Use of simulcast streaming often reflects limitations in the signal chain in terms of data availability.

3.1.2.1 Total Line Reporting

Radio stations that are a 95% simulcast of their broadcast content over the stream (including commercials) are considered to be Total Line Reporting (TLR) for ratings purposes (i.e. Nielsen). These stations usually still provide “Now Playing Information” and stream all content. They do not substitute or inject any audio to replace the content. The advantage of this is that the broadcast and stream ratings are considered as one station. Listening is only considered TLR if it occurs in the station’s home market. Listening outside of the market is not attributed to TLR.

The metadata can still contain the “Now Playing Information” and any other data information as long as it does not trigger audio substitution inside the station’s home market. There are other conditions where TLR may be eligible; consult your ratings provider for more information.

3.1.3 Streaming with content replacement and/or Advertisement Replacement (Station Side)

Radio stations may have to do some content replacement when re-purposing an OTA signal for internet streaming, for example, “blackout replacement content,” replacing certain ads or segments devoted to local ads. Streaming with content/ad replacement at the station level is usually done by using specialized hardware or software that will detect certain cue tones or metadata events to trigger replacement content. This content is then streamed over an internet connection making the programming slightly different from the original OTA content. This method is often used to replace ad spots that are not cleared for transmission over the internet with alternate ads. In this case, ads are delivered just like an OTA broadcast and are the same for every streaming listener.

In terms of metadata, the system performing the replacement content will inject its own metadata which also replaced the original metadata coming from the automation system. Certain specialized software and/or hardware is also used to route audio and data accordingly to the streaming encoders.

3.1.4 Streaming with content replacement and/or Advertisement Replacement (Server side)

Also known as server-side ad insertion (SSAI), this method involves having the content replacement being done at the server level. What this allow is for the content or ads to be inserted into individual listener streams. This enables impression-based delivery of ads as well as precise measurement of that delivery.

Metadata marking the boundaries of content versus advertisement is, for most solutions available, essential for the proper functioning of ad insertion and replacement.

3.1.5 Streaming on-demand / Podcasting and other file delivery methods

Internet technology makes it possible for broadcasters to provide on-demand content to listeners in addition to the traditional, linear broadcast content. In this scenario, content is delivered by making a request to a server which will then distribute the content “on-demand” to the end user`s device or player. It is essentially delivering files directly to the listener.

With the advancement of technology, the lines between live streaming and on-demand delivery are becoming more blurred. Indeed, one could argue that HTTP live streaming (HLS) is essentially breaking down content into small segments of files, these files could be manipulated in a way that they cover all the other streaming scenarios above.

3.2 Transmission methods

Two basic diagrams are presented here which illustrate the flow of audio and metadata through a broadcast facility to the consumer. Figure 1 is a diagram showing audio and metadata flow for OTA transmission; similarly, Figure 2 shows audio and metadata flow for internet streaming.

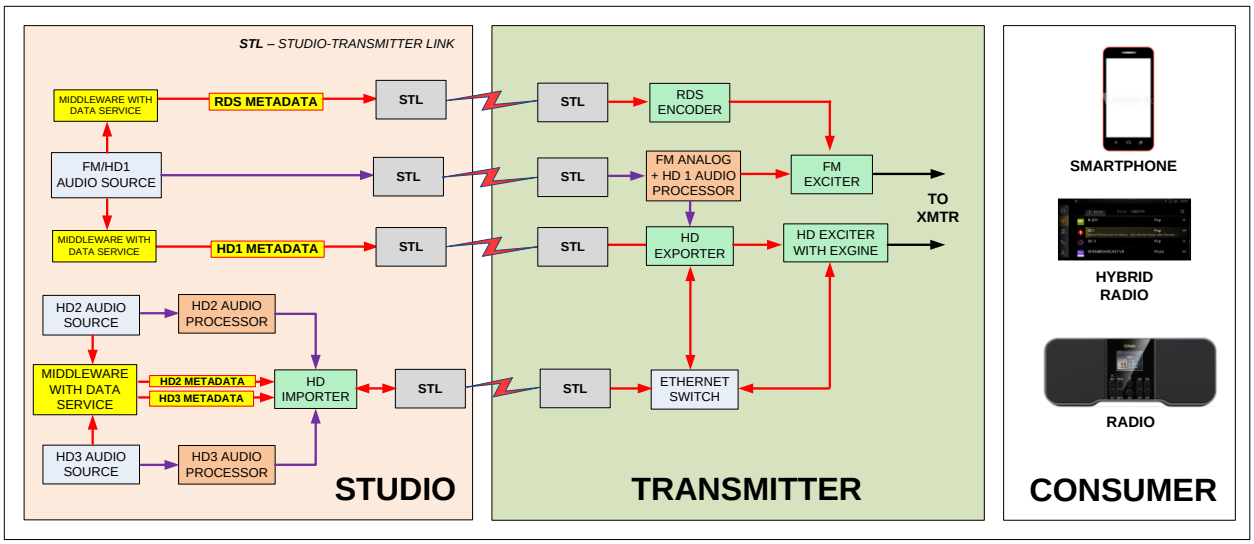

Figure 1. Diagram showing audio and metadata flow for OTA transmission.

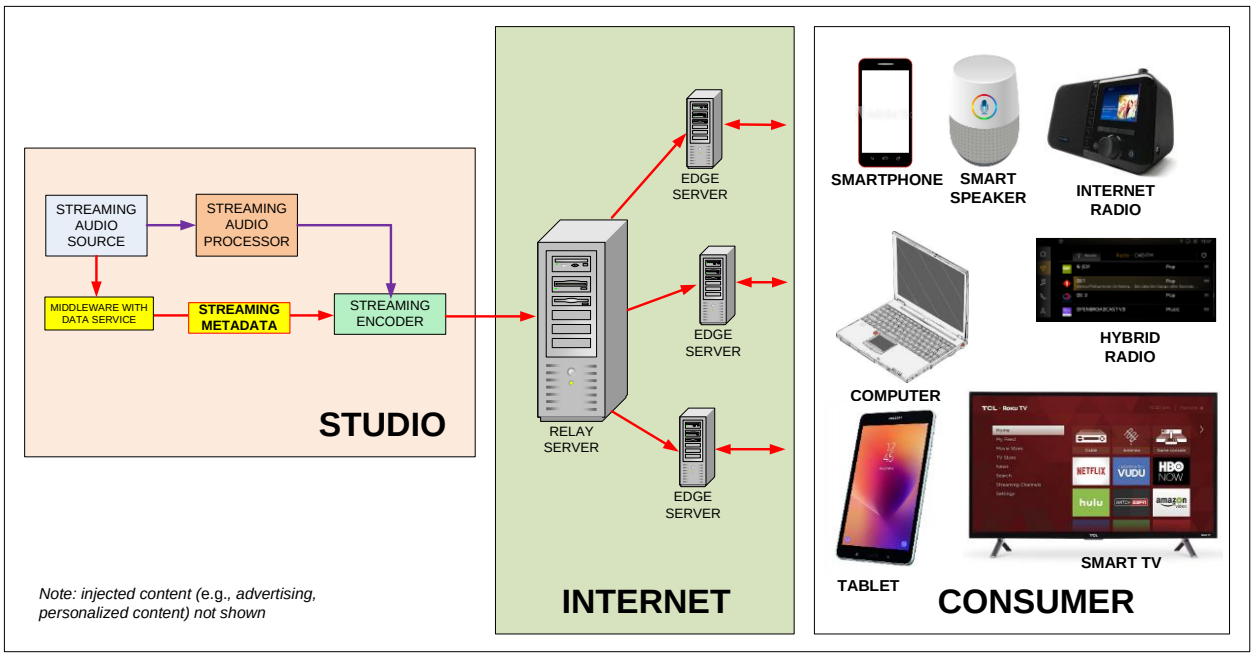

Figure 2. Diagram showing audio and metadata flow for internet streaming

3.3 Reception methods

3.3.1 FM mobile receivers

There are several options for listening to the FM radio on the go. Listeners have radios in the car and portable radios are available for listening outside of the car and home. In addition, consumers have the ability to hear emergency updates and information using OTA radios, especially important if cell service is unavailable. Local radio is a dependable lifeline, available when other forms of communication fail.

- Portable dedicated radio listening devices like the AudioVox IHDP01A Portable HD/FM Radio Player.
- Smartphones with enabled FM chip.
  [NAB reference link: https://nabpilot.org/work/projects/fm-radio-in-smartphones/]

3.3.2 Radio streaming mobile receivers

Most mobile radio streaming listening is done on smartphones, tablets and laptop computers.
There are a number of great applications ("apps") available in the Apple and Google app stores that offer radio streaming listening. In the space of radio streaming listening capabilities a consumer's choice comes down to what app, not device, is desired for use.

- Official station apps are dedicated to a particular local radio station. These apps in addition to supporting the station's internet audio stream version of OTA content offer additional capabilities like access to podcasts and social media portals.
- Radio aggregation apps are also available that make available dozens or hundreds of stations. These apps offer various listings of local stations as well as stations from around the country and the world. Listeners can browse and find stations in many different ways, offering new options based on the music or content desired. Many of these apps also offer additional capabilities to find interesting podcasts or playing artist info.

4 GENERAL TEXT HANDLING INFORMATION

Text in IBOC is transmitted in several ways, as explained in NRSC-5. It can be sent via SIS, via the audio service's Program Service Data (PSD) service (i.e. through MPS or SPS), or through the generalized Advanced Application Services (AAS) data service.

Likewise, text in RDS is sent through more than one path. It can be sent as various fields including PS and RT, or a reference to a look-up table may be involved, as in the case of PTY.

Streaming services have evolved over time, different protocols supporting different levels of text/data transport support: AMF0 (FLV, RTMP), RTP, WEBRTC, WEBSocket Messages have all been used as workarounds to support rich metadata being delivered to players and playback devices. The 2 most commonly supported at the time of writing (2019) are listed below. In both cases, generally, the software used for encoding these streams or the CDN providing the services for delivery will take care of these technical formalities as long as the metadata is delivered to them with a clearly identifiable structure. UTF-8 is supported with all modern streaming implementations and should always be privileged to ensure the integrity of text in multilingual situations. It is recommended that the metadata chain support UTF-8 from source to destination. This also allows the complete metadata chain to not experience problems where character sets are being rendered or translated incorrectly. Where is it is not possible use ISO-8859-1.

Common examples of character set translation issues can occur in HTML entities (é becomes eacute, & becomes invisible and " ' " becomes a box – i.e., "Guns N' Roses" becomes "Guns n□ Roses").

4.1 Shoutcast/Icecast

This service supports a single line of text; typically, it is "filled" with "<Artist> - <Title>" most streaming audio players will parse on the " – " (Space dash Space) and use the 1st element as Artist and 2nd element as Title. Otherwise, the server itself has an entry point where an audio streaming player be queried to send out other fields available like "StreamAlbum", "StreamUrl" and others.

According to the specification the text should be encoded as ISO8859-1, however UTF-8 is known to be fully supported by many servers and players.[1]

> NOTE: It is important to not confuse Shoutcast/Icecast with “Shoutvast2/Ultravox protocol” or the “Shoutcast XML Metadata” which supports the full transport of ID3v2.3 tags. These protocols were proposed by AOL/NullSoft and are only supported by Winamp and some other very rare exceptions.

4.2 HLS

This protocol is based on the delivery of file segments, basically sending short chunks of a continuous audio stream. ID3v2.4 is supported as the metadata format for HLS segments. Because HLS segments leverage ID3V2.4 the level of support for various fields is equivalent. It uses a combination of ID3 and MPEG-TS Program Map Table (PMT) to achieve this.[2]

> NOTE: The support for partial or complete set of ID3Tags is dependent on the streaming audio player’s abilities. Some will not read this metadata while others do. Encoder support of ID3Tags has not been uniform. This is why many internet streaming providers use alternative methods of delivering metadata.

Alternative methods include: Using In Playlist Text, Out of band metadata trough a synchronized WebSocket, or other more traditional methods where a webservice is used to supply the now playing information (e.g., artist, title, station identification).

Since a number of text items are common to both systems, a station which transmits RDS data, IBOC PSD/SIS data and streaming audio data should use a common format for common items. The following sections list these items and the recommended handling.

4.3 Adobe Flash/Real-Time Messaging Protocol (RTMP)

While client-side Flash support (FLV/RTMP) are being universally abandoned, the RTMP streaming protocol is still useful and is being used by many streaming platforms and providers for stream ingestion and backend delivery. RTMP has advantages in the preservation of metadata integrity and alignment and will continue as a viable transport method for some time to come. Platforms, like Facebook and Twitch, use RTMP as the protocol for user broadcasts. RTMP also provides additional features, such as tight stream/metadata alignment, that make it useful for delivery between streaming servers. Additionally, RTMP is the simplest format to manipulate metadata and delivery format further down the delivery chain without the need to modify the underlying audio itself (codec and bitrate).

Action Message Format (AMF) is a binary data exchange format developed by Adobe to serialize text and data objects for transfer between Flash servers and clients using an RTMP stream. The object being serialized can be plaintext and formatted in a markup language like XML. This enables servers to encode metadata into the stream to be sent directly to the client. The format of the metadata transmitted in AMF is left to the discretion of the stream provider and does not enforce adherence to a standard. However, it is recommended the fields reflect accepted or commonly used name standards like ID3.

---

[1] See http://wiki.shoutcast.com/wiki/SHOUTcast_2_(Ultravox_2.1)_Protocol_Details, http://www.smackfu.com/stuff/programming/shoutcast.html, http://wiki.shoutcast.com/wiki/SHOUTcast_XML_Metadata_Specification

[2] See https://developer.apple.com/library/archive/documentation/AudioVideo/Conceptual/HTTP_Live_Streaming_Metadata_Spec/2/2.html

4.4 Transmitted Character Sets and Receiver Display Character Sets

Streaming and ID3 tags support full Unicode. ShoutCast/IceCast and HLS support UTF-8. The biggest problem with encoding is with errors in choosing and conveying the encoded charset, e.g. ISO-Latin vs. UTF-8. If the encoding is done in UTF-8 and the decoder knows this, there generally are no problems. The upper 8 bits are used if the most significant bit of the lower 8 bits is set.

Streaming commonly uses UTF-8. Note that ISO 8859-1 and UTF-8 are not interchangeable.

RDS and IBOC transmit 8-bit bytes to represent characters. The character bytes are translated according to one of several "character set" translation specifications. The character set is the set of 255 images corresponding to all possible values of a byte. This is distinguished from a "font set" in that a font set is a specific design of a character set. Many font sets could map to one character set, but only one character set can map to a specific font set. Typically a receiver supports one or more character sets for display purposes. For example, HD Radio supports both the ISO 646 and the ISO 8859-1 character sets.

The three relevant documents which describe character sets are ISO 646:1991 [6], also known as ASCII; ISO 8859-1 [7], the most common character set in use for U.S. PC applications; and, the RBDS standard Annex E [1].

When a byte is transmitted via IBOC or RDS, the receiver needs to use the correct character set (typically implemented in hardware as a look-up table) based on the transport used (RDS, IBOC SIS, IBOC MPSD, or IBOC SPSD) and the byte value itself. Table 1 shows the transport and character set choices.

Table 1. Transport and character sets for RDS, IBOC and streaming audio

If it comes from:	***Use this character set for 8-bit chars (recommended)***	***Use this character set for fewer than 8-bit chars***
RDS	RBDS E.1 (same as RDS)	ISO 646 (English or Common)
IBOC SIS	As specified in [4]	As specified in [4]
IBOC MPSD	ISO 8859-1	ISO 8859-1
IBOC SPSD		
Streaming Audio	UTF-8	UTF-8
DTS Connected Radio	UTF-8	UTF-8

Note that there are differences in the character set between NRSC-4-B Annex E [1] and European RDS Annex E [8]. In particular, character 0x24 is a currency symbol, and should be represented as "$" (dollar sign) in North American implementations.

Note also that RDS/RT+ supports tags up to 64 characters in length (see [9], section 3). NRSC-5-A IBOC supports strings up to 127 characters and longer in some cases. However, many receivers limit string lengths to 64 characters—even 32 in some cases—and the broadcaster is advised to consider the effect of text truncation in the receiver. If truncation is not a severe concern, a reasonable compromise would be 64. As consumers adopt increasing numbers of IBOC receivers, this becomes less of a concern.

4.5 Extracting Text Strings from Transports

On receipt, the receiver must extract the appropriate string from the transport. Each transport specification has details on this process. For example, the *Comment* field can be sent by IBOC MPSD, IBOC SPSD, or RDS. In the two IBOC cases, the ID3 structure is defined [10] as follows:

```
<Header for 'Comment', ID: "COMM">
Text encoding          $xx
Language               $xx xx xx
```

```
Short content descrip. <text string according to encoding> $00 (00)
The actual text        <full text string according to encoding>
```

Details of the transport and such structures are left to the referenced specifications in this document. The harmonization between the various transports in the next sections are only considered after all transport-specific details have been removed, and the actual payload text is considered. Therefore, in the above example, the portion under consideration here is the actual text (i.e., the final line in the above example).

Note that IBOC supports MPSD/SPSD fields as listed below using ID3 V2.3 format tags. However, the format does not use the "unsynchronisation (sic) scheme" (also sometimes referred to as "sync-safe"; see [10], Section 5, "The 'unsynchronisation scheme'). This detail is important to the receiver in unpacking ID3 tag text from the full ID3 tag structure in that the receiver, on encountering a false sync field in the MPSD/SPSD fields, will not find the 00000000 pattern described in [10] Section 5. The comments in this paragraph do not apply to IBOC SIS fields or to RDS/RT+ fields.

5 HYBRID RADIO CONSIDERATIONS

5.1 Basic overview of hybrid radio

Hybrid radio is a generic term to describe a broadcast radio service that can be enhanced with the delivery of additional station information, programming metadata and associated IP audio streams via the internet.[3]

Hybrid radio requires that the radio receiver be able to directly or through an ancillary device, connect to the internet and accurately link broadcast services with IP based services. Hybrid radio provides broadcasters the opportunity to significantly improve the overall radio experience, making program discovery simpler, audio programming more engaging, providing for listening analytics and interactivity, and extending listening beyond the range of broadcast signals.

There are a number of platforms, services and techniques to enable such functionality and these platforms often take different approaches to achieve similar ends. For example, the DTS Connected Radio platform (described below) makes use of broadcaster-supplied metadata to populate song title and artist, and cover art/artist images, delivering this information to receivers using an internet connection. In contrast, the Audi Multimedia Interface (MMI) platform uses fingerprinting technology to identify songs and obtain cover art/artist images (over the internet), and does not rely on the availability of metadata from the broadcaster.

Both auto and consumer electronics manufacturers have reportedly expressed significant interest in hybrid radio functionality and are believed to have widely shared their requirements with suppliers. One auto manufacturer, Audi, introduced hybrid radio technology in select vehicles in Europe in 2017, and has announced plans to do the same in the US in mid-2020. The broadcast industry should ensure a deep understanding of these requirements to ensure successful support of hybrid radio services and the user experience.

Broadcasters should also take steps to ensure that they maintain control of the end-user experience and that any metadata or IP audio services are provisioned directly from the broadcaster. In addition, broadcasters should ensure that any content, metadata or streaming information published, is protected and only used for its intended purpose. This should include, all rights and permissions for content distribution and presentation.

Beyond enhancing radio discovery and the listening experience, hybrid radio has the potential to provide broadcasters with valuable user data associated with over-the-air listening. The robustness, accuracy and depth of these insights will be directly dependent on the overall service/system architecture and

[3] Note that the word "hybrid" is also associated with the HD Radio in-band/on-channel digital radio system, and in that context, hybrid means a combination of (legacy) analog and HD Radio digital radio signals.

implementations by receiver manufacturers. Broadcasters should seek to enable hybrid radio deployments that maximize the value to their audience, receiver manufacturers and the industry itself.

The benefits of hybrid radio include:

1. Enhanced discovery
2. Rich engagement
3. Service following (i.e, extended listening to broadcast radio programming outside of the reception area)
4. Interactivity
5. The potential for enhanced analytics on listening

To achieve these goals, radio stations must produce and distribute information about their station, programming and audio services and make this available over the internet.

5.1.1 Enhanced discovery

There are an ever-increasing number of broadcast radio services in any given market, due to factors such as proliferation of FM translators (for both FM and AM stations) as well as HD Radio multicast channels. In-band/on-channel digital radio services provide a variety of ways to navigate available content and stations should leverage hybrid radio capabilities to do the same.

Hybrid radio technologies enable receivers to constantly have information about program content and available services, much like a digital set top box or a streaming platform. This can enable hybrid radio users to easily navigate through program choices by genre, format, topics, events, etc.

It is critical that hybrid radio services be consistently supported by stations and open to all stations in the market to participate.[4] The foundation of these services is basic station information such as station name, call sign, slogan, genre and station logo(s). In addition, stations should be prepared to deliver basic "now-playing" information to provide more detail during discovery about what is actually on-air such as song name, segment topic or live event. This will provide a much more compelling user interface for radio listeners than the traditional linear tuning dial.

5.1.2 Rich engagement

Once a station is selected (*i.e.*, tuned to) on a hybrid radio receiver, and the audio program is playing, radio stations have the opportunity to offer rich engaging information that goes beyond what RDS and HD Radio services can offer using over-the-air signals alone. The opportunities will vary by format, where music stations will focus on album, artist and song information, and news/talk stations can focus on topics, hosts and breaking stories. The metadata, images and additional services offered via hybrid radio will vary by station and can help retain listeners, keep them listening to radio and help radio to better compete with services currently offered by pure digital platforms (like Pandora and Spotify).

The commercial opportunities can be significant as well. Broadcast radio stations can now offer text and visual enhancements to their clients and increase the effectiveness of advertisements via broadcast radio.

5.1.3 Service following

To ensure that hybrid radio receivers can easily switch to a simulcast IP stream of the over-the-air broadcast audio programming, broadcasters should ensure that their streaming audio services:

- Are not significantly delayed from the broadcast audio programming.
- Indicate if the programming on the stream is in fact a simulcast and that there is not a break in format.

[4] Note that analog AM stations, and in some cases analog FM stations without RDS (including FM translators), will be unable to support hybrid radio services because these stations cannot be uniquely identified.

- Do not include any pre-roll audio.
- Are provided in a secure way to ensure only authorized platforms can access the stream (for example, using the Client ID feature of RadioDNS. Note that the DTS Connected Radio platform has built-in security features to address this issue).

5.1.4 Interactivity

Because hybrid radio receivers are connected to the internet, they offer the possibility of two-way communication with listeners. Additionally, it becomes possible for broadcasters to connect listeners and social media platforms in a way that can enhance the listener experience and build the station brand and presence on the internet.

5.1.5 Enhanced analytics

Beyond enhancing radio discovery and the listening experience, hybrid radio has the potential to provide broadcasters with valuable user data associated with over-the-air listening. The robustness, accuracy and depth of these insights will be directly dependent on the overall service/system architecture and implementations by receiver manufacturers. Broadcasters should seek to enable hybrid radio deployments that maximize the value to their audience, receiver manufacturers and the industry itself. Service providers and receiver manufacturers must ensure proper adherence to privacy laws and policies applicable to the regions in which the system will operate.

5.2 RadioDNS Hybrid Radio Standard

RadioDNS, an open publishing and look up standard, is one such enabling technology that can provide a component of a hybrid radio service. The standard helps identify how to accurately identify a broadcast frequency to associated published content [11] and how to acquire metadata [12] and visual content [13] over that connection. This lookup and content acquisition can be performed directly from the receiving platform, but in the case of automotive implementations, is more likely to be utilized by centralized platforms developed by 3rd parties or by the automakers themselves to meet operational and service requirements. By way of example, both the Audi MMI and DTS Connected Radio platforms can utilize RadioDNS published content as a component of their hybrid radio services.

Figure 3 illustrates the RadioDNS lookup process. The broadcast signal transmits information to receivers which allow the receiver to identify the signal, including frequency, RDS PI code, and/or HD Radio SIS data. A RadioDNS-capable receiver takes this information and creates a DNS lookup following the information in [11], which is sent to the RadioDNS server, which in turn sends back to the receiver the web address (provide by the broadcaster to RadioDNS) for the station being listened to that the receiver can use to obtain the RadioDNS SI file and other information relevant to hybrid radio receiver operation.

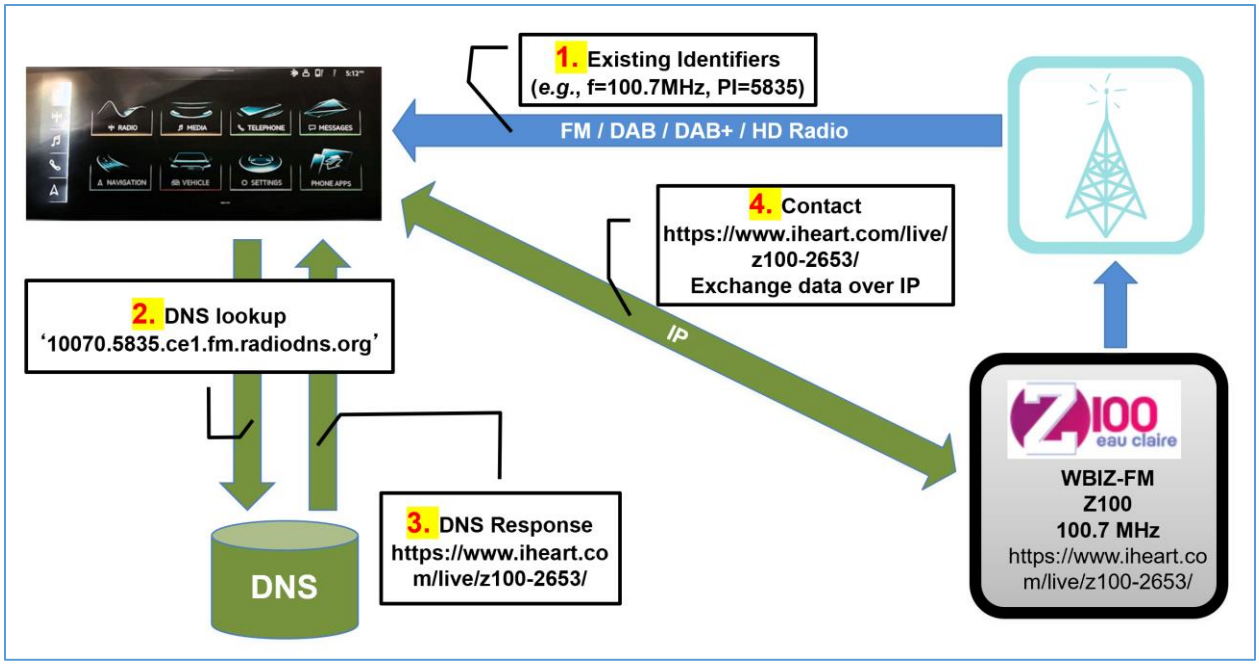

Figure 3. RadioDNS lookup process

Metadata relating to a radio service and its programs is defined in SI.xml and PI.xml files using an XML structure and acquired using HTTP/HTTPS.

Visual content that changes more frequently (often synchronously to the audio) is provided using STOMP or COMET for text information, and associated images acquired using HTTP/HTTPS. In general, images will reflect the content of the text content.

The metadata structure is designed to mirror closely metadata of RDS, and then expand upon it. Therefore there are direct mappings possible from elements in the SI.xml and PI.xml files to RDS metadata elements.

An SI.xml file may contain metadata definitions for more than one radio service, so care must be taken to reference the correct <service> element within the document.

Metadata and visual content are always encoded using UTF-8.

5.2.1 Controlling Access to Metadata and/or Content

In a basic RadioDNS deployment, metadata and/or content is freely accessible, but still subject to whatever usage terms are stipulated by the content provider. Those terms are referenced in the SI document (in the terms attribute). It is recommended to allow the most basic metadata elements (station names, descriptions, logos, genres, bearers) to be freely accessed.

Some content providers may wish to control access to some or all of their metadata and/or content, for example streaming URLs or enhanced on-demand content. Content providers can issue Client IDs to trusted users, which determine what metadata and/or content users are able to access.[5] It is up to each content provider and user to bilaterally negotiate the terms of access and manage use of the Client ID; RadioDNS is not a party to those agreements.

[5] See Section 10.5.5 of [12] for additional information about Client ID.

5.2.2 Current RadioDNS Hybrid Radio Implementations

RadioDNS is implemented in the following systems and platforms at time of writing (November 2019):

- **Automotive Implementations**
  Audi Vehicles with Audi Connect – A1, A6, A7, A8, Q3, Q8, E-Tron (N.America from 2020)
  VW Vehicles with Volkswagen Connect – Touareg
  Porsche Vehicles with Porsche Connect – models since 2019
  BMW Vehicles with BMW ConnectedDrive – models since 2019

- **Automotive Solutions**
  DTS Connected Radio
  NXP Connected Radio (Receiver Development Platform)

- **Domestic Implementations**
  Technisat – SONATA Home Entertainment System

- **Broadcaster Content Management Platforms**
  Quu Interactive
  Pluxbox
  Radioplayer
  Aiir
  EBU Radio Manager (also available as open source code)

5.2.3 RadioDNS Compliance Testing

In common with other open standards, anyone may independently implement any part of the RadioDNS standard(s). To provide confidence that implementations correctly follow the standards, RadioDNS has a compliance testing program. Implementors may test their platforms, clients or devices using the RadioDNS test sets, and if all the required tests are successfully passed, they receive a compliance certificate, and may apply to describe their implementation as “RadioDNS Compliant” and use the RadioDNS logo.

It is recommended that anyone implementing RadioDNS for provision to third parties considers certification, and anyone purchasing RadioDNS services from third party checks their compliance certificate for the functionality tested.

At the time of writing the following implementations have received RadioDNS Compliance Certification:

- DTS Connected Radio – for acquiring Service and Program Information (SPI)

5.3 DTS Connected Radio

DTS Connected Radio is a platform that provides end-to-end hybrid radio services, currently across 68 countries. It supports all of the features listed above in Section 5.1, including static and dynamic data and images, service following, enhanced discovery, interactivity, and analytics. It is compatible with analog broadcasts as well as DAB/DAB+ and HD Radio technology.

The DTS Connected Radio System ingests IP content from multiple sources, processes it, and makes it available to receivers via a standardized application programming interface (API). This API is available to receiver manufacturers via a license agreement with Xperi Corp. Receivers utilizing this API must undergo a certification process, to ensure compatibility with the DTS Connected Radio system as well as compliance with content use rights and provisions.

Although the curation process utilized by the DTS Connected Radio platform strives to adapt the format of information from various sources to the common receiver API, it is suggested that service providers follow the recommendations in Sections 7 and 8 of this document. This helps ensure a quality user experience.

Broadcasters and service providers can participate in the platform at no cost and via a variety of technologies, systems and standards. DTS connected radio obtains its IP content via the following types of sources:

- Public, open sources (such as RadioDNS) – note that DTS Connected Radio is compliant with RadioDNS.[6]
- Aggregators and platforms (such as Arctic Palm, Radio.com, Radioplayer and Radioapp).
- Direct station integration – broadcasters can interface directly to the DTS Connected Radio system using their own corporate programming and metadata platforms.

Broadcasters maintain complete control over their content and services and can choose which source is given priority for any component of their station(s) information.

Refer to Figure 4 for an illustration of the content aggregation and curation process.

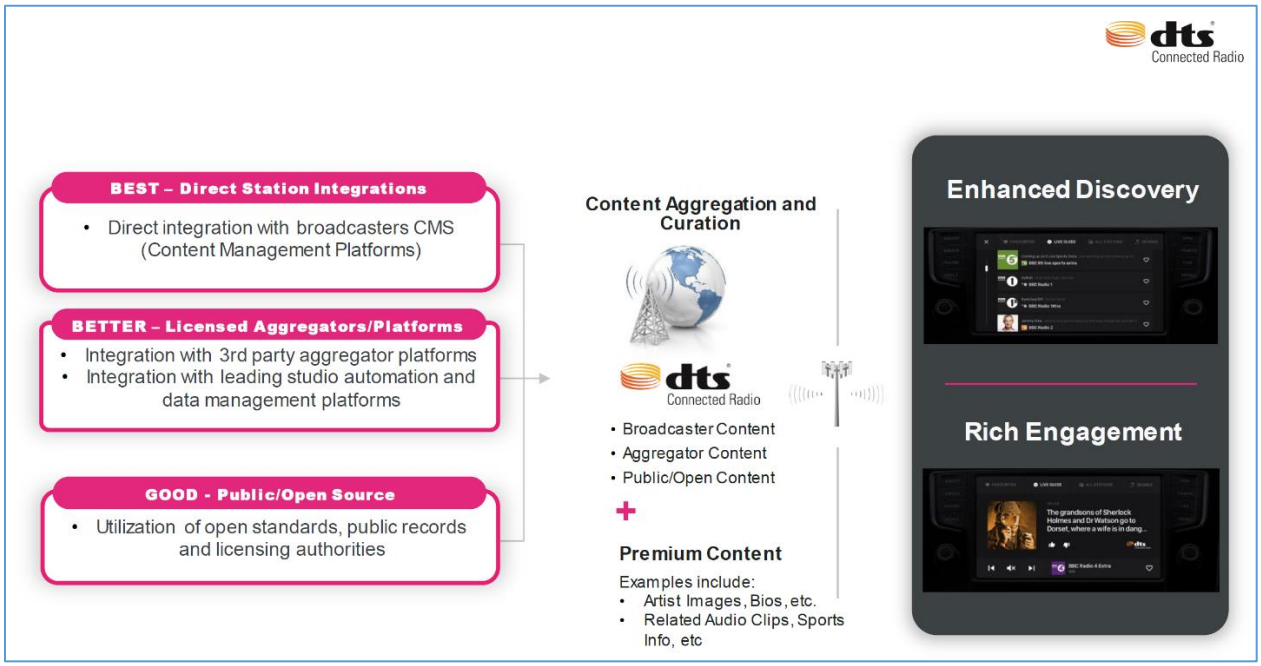

Figure 4. Content Aggregation from a Wide Variety of Sources Ensuring Broadcaster Control and Quality

The DTS Connected Radio System provides support for all of the dynamic and static metadata fields described in Subsections 7.1 and 7.2 respectively, as well as image metadata as described in Section 8. Specific details are available subject to an agreement with Xperi.

Example receiver displays are shown in Figure 5 and Figure 6.

[6] On March 19, 2019, Xperi announced that its wholly owned subsidiary, DTS, a global leader in high-definition audio solutions, had successfully completed RadioDNS compliance testing. (Source: Xperi press release.)

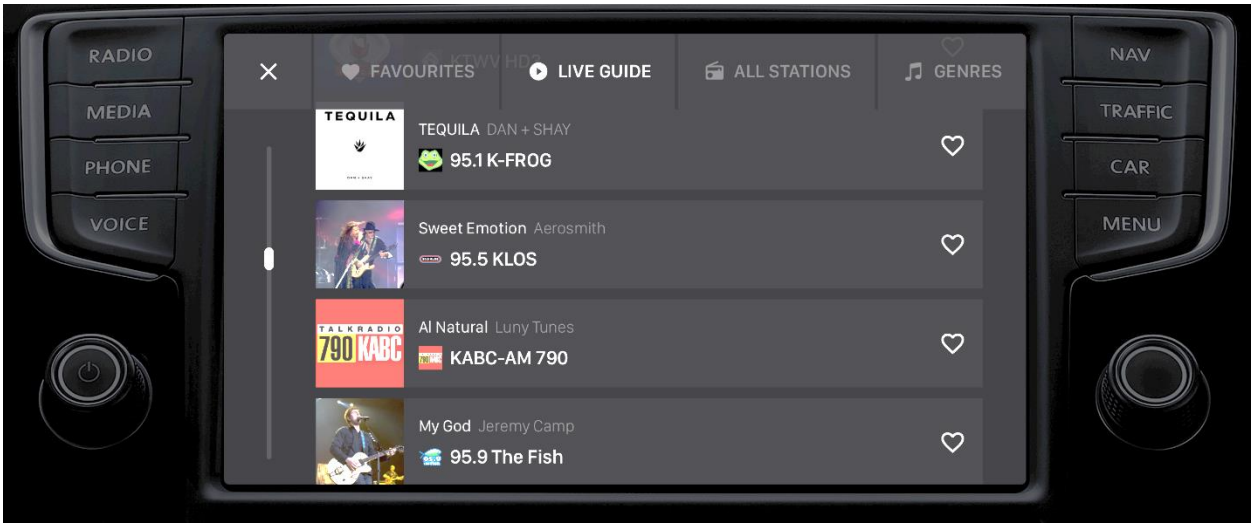

Figure 5 Example DTS Connected Radio Receiver - Station List Display

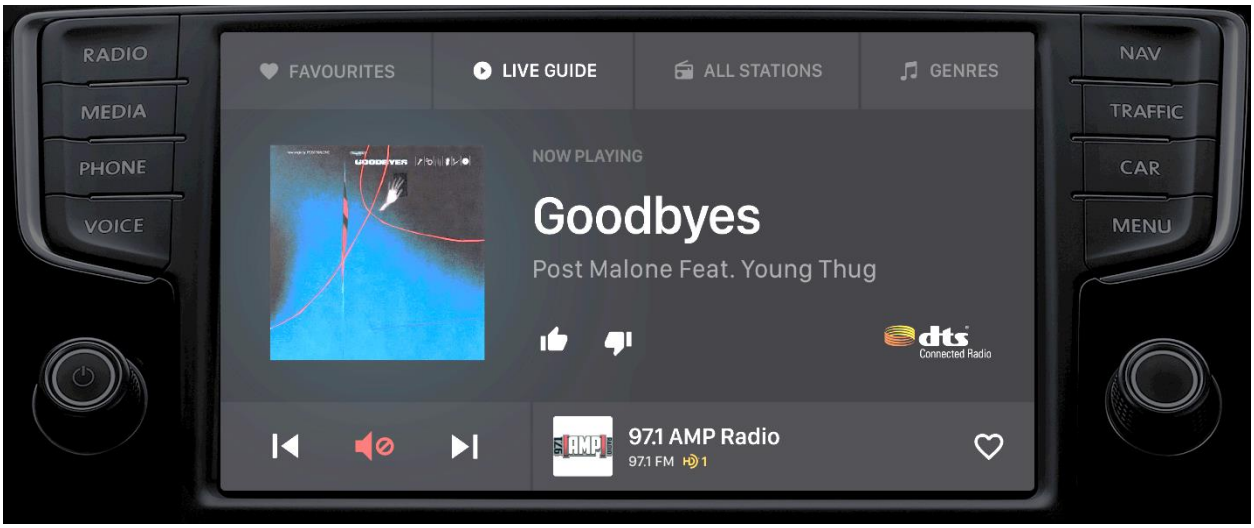

Figure 6 Example DTS Connected Radio Receiver - Now Playing Display

5.4 Considerations for automatic audio source switching

Given diverse bearers (analog AM and FM, HD Radio digital sidebands, IP streaming) for the same audio, a receiver may automatically switch between them to provide a consistent and continuous experience for the listener.

To enable “seamless switching” (where the user does not notice a discontinuity in the audio as a result of the switch between sources), the broadcaster should consider the following issues:

- Audio timing – the maximum time spread between the bearers should be minimized. Receivers should have sufficient storage capacity to buffer, analyze, time stretch and time align the bearers.

When using RadioDNS technology, the broadcaster can provide “hints” to the relative time offsets of each bearer in the Service definition in an SI.xml document (see TS 102 818 v3.1.1 section 5.11.1).

- Content synchronicity – do not insert additional audio on one bearer that is not present in the others, such that it would distort the time alignment between the bearers (for example, do not include “pre-roll” audio or extend program breaks by inserting additional audio on IP streams).

- Loudness and audio processing – minimize the variance in loudness and audio processing across bearers.

5.5 Considerations for Station Discovery

The first step in delivering hybrid (over-the-air plus internet) content to receivers is station discovery (by the receiver). In order to aid the station discovery process, broadcasters should make sure that the following fields are correctly populated in their stations:

- FM stations – Use RDS and broadcast PI code. Note that the NRSC maintains a database of PI codes for both full service and FM translator stations. It is important for hybrid HD Radio signals to include RDS with PI code, since the RDS PI code serves as a backup for when a receiver is beyond the service area of the digital signal but can still receive the analog signal.

- HD Radio stations (AM- and FM-band) – Station ID (FCC facility ID in the U.S) / country code and/or short station name (callsign)

At present, analog AM stations, and in some cases analog FM stations not broadcasting an RDS PI code, are not reliably discoverable by receivers using currently available technology.

6 STREAMING SERVICES CONSIDERATIONS

There is a difference between metadata sent to the streaming service or system (incoming metadata) vs metadata included or sent out to the listeners by the CDN. The format is dependent on the protocol (HLS, Shoutcast, RTMP etc.).
There are two separate metadata pipelines in the flow from publisher to listener: incoming metadata and outgoing metadata. Incoming metadata is sent from the publisher to the streaming provider, and outgoing metadata is sent from the provider to the listener. Each can have their own format and intended purpose for the recipient (the streaming providers metadata handling servers for incoming metadata, and the listener for the outgoing metadata). Below are descriptions of each, along with brief summaries of metadata handling in each protocol.

Note: All of the listed streaming protocols have no enforced standards for metadata fields, so the structure of the metadata and names of the corresponding fields are left to the discretion of the publisher. While no standard is enforced or supported by default, the metadata is often transmitted in a markup language (like XML) and will adopt similarities to an established standard (such as ID3) in the tag naming conventions in most widely accepted practices.

Incoming Metadata is the data sent out by broadcast middleware to specialized CDN servers (sometimes called edge or replay servers) which can validate and translate that data into a format understood by the streaming servers (ex: CSRDS). Commonly-used broadcast middleware products include Arctic Palm Center Stage Live, Jump2Go, and The Radio Experience (TRE). The spectrum of support for incoming metadata is very broad and varies too widely to enumerate effectively.

1. **RTMP**

   At one point in time this was the most widely used protocol for audio/video streaming due to its support of rich metadata and near frame accurate timing. It’s popularity is in decline due to the abandoning of Flash as a client but the RTMP protocol is still used by major platforms like Twitch, YouTube, and Facebook. Metadata is supported through the use of AMF messages instream.

2. **WEBRTC**
   This is a relatively new protocol and is rapidly rising in adoption. It is popularly used in platforms like Google Hangouts, HighFive, and Zoom. Sending metadata using this protocol leverages the use of RTP headers which are already recognized by most existing servers.
3. **Shoutcast/Icecast**
   A streaming protocol that has a long-established history of development, deployment, and use. The metadata again can conform to any tag/value pair with the exception of the natively supported StreamTitle field, which is a concatenation of the Title and Artist ID3 fields.

Outgoing Metadata is the data going from the CDN to the listening audience. It is always dependent on the format of the stream; however, the main formats have distinct metadata fields that are standardized and others that have become “de facto” standards as they are widely used and supported by many playback devices.

1. **RTMP**
   Although not the same, the principals of how metadata works are the same. It is accomplished by adding AMF messages within a stream and these messages have a structure that allow stream events named “OnCuepoint” and “OnMetadata” to occur during stream transmission. These events signal the reception of an AMF object that contains the key/value pairs in a format each provider has established.

2. **Shoutcast / Icecast**
   Delivery metadata using this protocol limits providers to a single text string. There is limit support for ID3 tags, specifically only the Title and Artist tags. These two are concatenated together and delivered as the StreamTitle field. Some providers will use the single field to insert a string of XML or JSON. However, it is not a universal standard and some client players will simply display the XML/JSON string as metadata.

3. **HLS**
   The standard way of inserting metadata into an HLS stream is by inserting ID3 tags into every segment. A problem with this method is there are only very specific JavaScript libraries that support this, and it also requires the browser to support HTML5/MSE. The ID3 tags proposed for use in HLS segments require the Apple version of the ID3 tags as opposed to the standardized versions. Another method of inserting metadata into an HLS stream is to use the #EXTINF field in the playlist data. The playlist method is easy to deploy as it is simply a field in the playlist you can insert any text data into, including markup like XML.

7 TEXT HANDLING FOR SPECIFIC FIELDS

This section defines text handling recommended guidelines for specific fields. Note that recommended guidelines for IBOC MPSD (HD-1) and IBOC SPSD (multicast channels) are identical. In the following subsections, descriptions are provided for PSD, which implies that both are supported. Some of these fields are supported by Annex U of NRSC-4-B but details are not provided within this document since RT+ is the preferred approach for harmonization of IBOC and RDS. Table 2 gives a summary of harmonization between RDS and IBOC text.

Specific metadata fields available in various transports often fall within two categories. There are content descriptors, which generally describe a specific piece of content that is airing at that exact moment, such as a song, advertisement, personality, show name or topic. These descriptors are designed to be dynamic and change as often as the programming of the content is changing (e.g., describing song A and then song B when it is on the air, or program A then program B, or topic A or topic B). As such, these fields can change very often – i.e., it is not uncommon to have these changes as quick as every few seconds in some instances. This is discussed below in Section 7.1.

There are also station or channel level descriptors, which describe the overall name of the station, its branding and/or its content or purpose. These fields are discussed below in Section 7.2. These are

generally static in nature and do not change often. To understand how frequent this may change, consult the technical specifications and implementation guidelines of the specific transport. When implementing a receiver design, one must consider that while these values do not change on a specific station frequently – when they do change, it is important to capture this change and display it shortly after it changes. A common example of this is when a radio station changes complete formats or types of programs it is airing. For example, it may change from a rock music format to a country music format. As such, typically the station naming fields and their descriptors all change when this occurs. Receiver designers must keep this in mind as to not cache or store this information without checking for an update again or with long polling intervals between refreshes.

Note that some transports such as RDS PS and RadioText often combine these two types of information in the same string. This is described in more detail in Section 7.3.

7.1 Content Related Descriptors (Dynamic)

A note about metadata fields and their corresponding streaming audio fields. The majority of streaming protocols have no native support for established or standardized metadata fields. Metadata is generally provided by a single field that allows the insertion of text data and no validation is enforced. This enables the provider to construct their own layout and format but most often this data adheres to an established field layout and comes in a markup language format. With the exception of the ID3 Title and Artist tags in Shoutcast/Icecast, there are no natively supported fields in these streams. The listed items for the Streaming sections below describe the method that could be used to transport these tags instead.

7.1.1 Title Field

The *Title* field is generally used for the title of the current audio piece, *e.g.*, song title. For non-music content (*e.g.*, News/Talk programming) program providers may typically insert suitable “topic,” “program name,” or other information descriptive of the current subject matter of the spoken content.

Description: *Title* is a one-line title name.
Comment: *Title* was inherited from TIT2 in ID3V2.3.0.
Format: *Title* is human-readable text in 8-bit character format. Null characters should not be transmitted.
RDS: *Title* should be sent as ITEM.TITLE as defined in [9]. Title is often sent in RT and PS as described below in 7.3.1.
IBOC SIS: Not supported.
IBOC PSD: *Title* is sent via attribute Title (ID3 tag TIT2).
Streaming 1 (HLS): See HLS Standard RFC8216 (“HTTP Live Streaming”), 4.3.2.1, tag is EXTINF (text format is UTF8)
Streaming 2 (Shoutcast/Icecast): TIT2 ID3v2.3 concatenated into StreamTitle field.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: For dynamic events, use the Visual Slideshow specification. In this specification, there is a “/text topic” that contains a general unstructured text string.
RadioDNS: For pre-scheduled events, use the PI.xml - <programmeEvent><shortName> or <programmeEvent><mediumName> or <programmeEvent><longName>.

On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.1.2 Artist Field

The *Artist* field is generally used for the Artist of the current audio piece, *e.g.*, song artist. For non-music content (*e.g.*, News-Talk programming) program providers may typically insert information related to the "host, source or creator" of the content (*e.g.*, program show, network, host, etc.).

Description: *Artist* is a one-line Artist name.
Comment: *Artist* was inherited from TPE1 in ID3V2.3.0.
Format: *Artist* is human-readable text in 8-bit character format. Null characters should not be transmitted.

RDS: *Artist* should be sent as ITEM.ARTIST as defined in [9]. Artist is often sent in RT and PS as described below in 7.3.1.
IBOC SIS: Not supported.
IBOC PSD: *Artist* is sent via attribute Artist (ID3 tag TPE1).
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): TPE ID3v2.3 concatenated into StreamTitle field.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: The Visual Slideshow specification "/text topic" contains a general unstructured text string.
On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.1.3 Album Field

The *Album* field is generally used for the Album of the current audio piece.

Description: *Album* is a one-line album name; i.e., it is the name of the album from which the current audio program was taken.
Comment: *Album* was inherited from TALB in ID3V2.3.0.
Format: *Album* is human-readable text in 8-bit character format. Null characters should not be transmitted.
RDS: *Album* should be sent as ITEM.ALBUM as defined in [9].
IBOC SIS: Not supported.
IBOC PSD: *Album* is sent via attribute Album (ID3 tag TALB).
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported
Streaming 3 (RTMP/Flash): AMF
RadioDNS: The Visual Slideshow specification "/text topic" contains a general unstructured text string.
On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.1.4 Genre Field

The *Genre* field is used for the genre or format of the current audio piece, e.g., into which genre does the current song or audio piece fall. The difference between *Genre* and *Program Type* is that *Genre* applies to a single piece of content (e.g. a Classic Rock song), but *Program Type* applies to the overall programming of the channel (e.g., a Classic Rock station).

Description: *Genre* is a short name of the category type (format) of the current audio content (i.e., whether a song is Rock, or Blues, etc.). *Genre* is a predefined enumerated type. The enumeration tables are identical between IBOC and RDS for the first 32 types. However, NRSC-5-A supports 256 different program types in all. While the first 32 do match exactly, RDS-only receivers will not be able to display the added program types.
Comment: *Genre* was inherited from TCON in ID3V2.3.0.
Format: *Genre* is sent as text in 8-bit character format, but the value is a numeric value in parenthesis; e.g. "(4)". Optionally, enhancement text can be added in RDS and IBOC. However, use in IBOC is considered non-displayable.
The numeric value (e.g., the 4 from "(4)") is used as an index into the *Genre* table. See [5] Appendix A-1 section 8, and [1] Annex U section U.7.
RDS: *Genre* should be sent as ITEM.GENRE as defined in [9].
IBOC SIS: Not supported
IBOC PSD: *Genre* is sent via attribute Genre (ID3 tag TCON).
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: PI.xml <programmeEvent><genre>*

On receipt: No action. Per section 7.1 of SY_IDD_1028s, “Genre should be considered non-displayable by radio receivers.”

7.1.5 Comment Field

The *Comment* field is generally used for text not described by other more specific fields. A *Comment* could relate to the current audio program content, or it might be unrelated information that the station chooses to send. For example, a *Comment* might be “This song was recorded live” (related); or a comment might be “WXYZ Fun Zone van at Smith Park on Saturday” (unrelated). In the case of the *Comment* field described here, either related or unrelated is possible.

Description: *Comment* is an optional text field that the broadcaster can send with any kind of human-readable information.
Comment: *Comment* was inherited from COMM in ID3V2.3.0.
Format: *Comment* is human-readable text in 8-bit character format. Null characters should not be transmitted. Within the *Comment* frame there are two supported fields: “Short content description” and “The actual text” (see [5], Appendix A-1).
RDS: *Comment* should be sent as INFO.COMMENT as defined in [9].
IBOC SIS: Not supported
IBOC PSD: *Comment* is sent via attribute Comment (ID3 tag COMM).
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported
Streaming 3 (RTMP/Flash): AMF
RadioDNS: The Visual Slideshow specification “/text topic” contains a general unstructured text string.
On receipt: On receipt of this frame, the receiver extracts the two COMM fields (which are separated by a null), and selects the appropriate character set as shown in Table 1 in order to display it. Note that there is no particular interpretation put on this text; as the name would indicate, this is simply a comment field that is available for the broadcaster to send and potentially be displayed on the receiver.

7.1.6 Commercial Field

The *Commercial* field is application specific and generally used to facilitate the sale of products and services. As it is not supported in RDS, there are no recommendations for harmonizing between RDS and IBOC.

RDS: Not supported
IBOC SIS: Not supported
IBOC PSD: *Commercial* is sent via attribute Commercial (ID3 tag COMR).
Streaming 1 (HLS): If the application could support the parsing of the #EXTINF tag then a commercial field could be added.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: Not supported

On receipt: The behavior is application-specific.

7.1.7 UFID Field

The *UFID* field (also known as Reference Identifier) can be used to transmit an alphanumeric identifier of the current content, or of an advertised product or service. An owner identifier is also included, and either field can optionally be of zero length. In IBOC it has more capability due to the greater length supported by the IBOC MPSD transport.

If harmonization is required, use the following recommendations on the broadcast side. *However, note that the use of this field is application-specific; these recommendations are intended for the application developer.*

Description: *UFID* is an alphanumeric field. It is application-dependent, and is typically used to uniquely identify content, product or services.
Comment: *UFID* was inherited from UFID in ID3V2.3.0.
Format: *UFID* is described in ID3V2.3.0; details beyond that are application-specific.
RDS: *UFID* should be sent as a Private Class as defined by [9].
IBOC SIS: Not supported
IBOC PSD: *UFID* is sent via attribute UFID (ID3 tag UFID).
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported
Streaming 3 (RTMP/Flash): AMF
RadioDNS: PI.xml <programme id> or <programmeEvent id>

On receipt: The behavior is application-specific.

7.1.8 Subtitle Field

The *Subtitle* field is generally used for as an enhancement, refinement, or additional information for the song title field *Title* (see section 7.1.1). It can be a second line for the *Title* field, or a subtitle.

Description: *Subtitle* is a one-line text string which adds information to the *Title* field.
Comment: *Subtitle* was inherited from TIT3 in ID3V2.3.0.
Format: *Subtitle* is human-readable text in 8-bit character format. Null characters should not be transmitted.
RDS: *Subtitle* should be sent as ITEM.MOVEMENT as defined in [9].
IBOC SIS: Not supported
IBOC PSD: Not supported.
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: The Visual Slideshow specification “/text topic” contains a general unstructured text string. Character 0x0B, if present within the complete text string, marks the start of the subtitle text.
On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.1.9 Conductor Field

The *Conductor* field is generally used for an additional performer’s name. The obvious usage is for a symphony’s conductor. It can also be used for another key artist who contributed to the piece.

Description: *Conductor* is a one-line text string which adds information to the *Artist* field.
Comment: *Conductor* was inherited from TPE3 in ID3V2.3.0.
Format: *Conductor* is human-readable text in 8-bit character format. Null characters should not be transmitted.
RDS: *Conductor* should be sent as ITEM.CONDUCTOR as defined in [9].
IBOC SIS: Not supported
IBOC PSD: Not supported.
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: The Visual Slideshow specification “/text topic” contains a general unstructured text string.
On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.2 Station or Channel Related Descriptors (Static)

7.2.1 Station Name (Short Format) Field

The *Station Name (Short Format)* field is used for the alpha call sign of the broadcasting station. In RT+ V2.1, it is referred to as "STATIONNAME.SHORT"; in IBOC it is referred to as "Station name (short format)."

Description: *Station Name (Short Format)* carries the call letters for a station.
Comment: *Station Name (Short Format)* is not from the ID3 specification.
Format: *Station Name (Short Format)* is human-readable text in 8-bit character format.
RDS: *Station Name (Short Format)* should be sent as STATIONNAME.SHORT as defined in [9]. Broadcasters who use the PS field in the manner specified by NRSC-4-B should also send this information in the PS field. Station Name (Short Format) is often sent in RT and PS as described below in 7.3.1.

IBOC SIS provides two mutually exclusive message types to convey similar information (see [4], table 4-1):

1. SIS Station Name (Short Format) – message ID 0001.
   This message only conveys up to four characters with a limited character set. It is intended to convey the station callsign

2. SIS Universal Short Station Name – message ID 1000 / Type 0
   This message conveys up to 12 characters with a much more extensive character set.

   A broadcaster must choose which of the two message types to send. SIS Station Name Short can be sent much more efficiently, which can be important, for example, when broadcasting emergency alerts, which shares the overall capacity of SIS. Older IBOC receivers may not display SIS Universal Short Station Name if it is longer than 6 characters.

IBOC PSD: Not supported
Streaming 1 (HLS):
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: SI.xml <service><shortName>
On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.2.2 Station Name (Long Format) Field

The *Station Name (Long Format)* field is available for a longer station identification, such as "WXYZ, Rock of the Bay". In RT+ V2.1, it is referred to as "STATIONNAME.LONG"; in IBOC it is referred to as "Station Slogan".

Description: *Station Name (Long Format)* is a longer name and slogan for a station. For IBOC applications, Station Slogan applies to the HD-1 channel only. Multicast channels have their own separate slogans, as described in Section 7.2.4.
Comment: *Station Name (Long Format)* is not from the ID3 specification.
Format: *Station Name (Long Format)* is human-readable text in 8-bit character format. Null characters should not be transmitted.
RDS: *Station Name (Long Format)* should be sent as STATIONNAME.LONG as defined in [9]. Station Name (Long Format) is often sent in RT as described below in 7.3.1.2.
IBOC SIS: *Station Slogan* is sent via message ID 1000 /Type 1 (see [4], table 4-1).
IBOC PSD: Not supported.
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC 8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF

RadioDNS: SI.xml <service><longName> and/or <service><shortDescription> or <service><mediumDescription> or <service><longDescription>

On receipt: The receiver selects the appropriate character set as shown in Table 1.

7.2.3 Program Type (PTY) Field

The *Program Type* field is used for the overall format of broadcast station – e.g., News, Rock, etc. The difference between *Genre* and *Program Type* is that *Genre* applies to a single piece of content (e.g., a Classic Rock song), but *Program Type* applies to the overall programming of the channel (e.g., a Classic Rock station).

Description: *Program Type* is a short name of the category type (format) of station broadcasting the content (i.e., whether a station is News, or Rock, etc.). *Program Type* is a predefined enumerated type. The enumeration tables are identical between IBOC and RDS.
Comment: *Program Type* was created as PTY in RDS, and brought into RBDS and IBOC essentially unchanged.
Format: *Program Type* is sent as a numeric value in IBOC in the MPS PDU Header Expansion field (see [3] section 5.2.1.6.2, Program Type). *Program Type* is sent as a numeric value in RDS in the PTY field (see [1] Annex F).
RDS: *Program Type* should be sent as PTY as defined in [1].
IBOC SIS: Not Supported.
IBOC PSD: *Program Type* should be sent as Header Expansion ID 010 as defined in [3] Table 5-7 and section 5.2.1.6.2.
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC 8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: SI.xml <service><genre>* and PI.xml <programme><genre>* and PI.xml <programmeEvent><genre>*

On receipt: The receiver needs only one table for both IBOC and RDS. On receipt of a numeric value from either of these transports, the receiver looks up the string in the table and selects the appropriate character set as shown in Table 1.

7.2.4 IBOC Service Name

The HD Radio system provides a separate transport to send independent station slogans for each multicast channel. This transport resides in the importer and is entered as the Service Name. The system forces the HD-1 Service Name to be identical to the SIS Slogan field discussed in Section 7.2.2 and is included for completeness. For stations without an importer, which therefore only broadcast HD-1, receivers will display the SIS Slogan field. For multicast stations, receivers will display the Service Name corresponding to the currently selected multicast channel. Note that older receivers may not display this field.

7.3 Transports with combined static and dynamic fields

7.3.1 RDS

RDS has two fields that are often used for station and content identification. A summary of these differences is included below for reference. For extended details please refer to [15] NRSC-G300-C Section 6.

7.3.1.1 RDS PS (Program Service) Field

The *RDS PS* field is the label of the program service consisting of not more than eight alphanumeric characters coded in accordance with [1] Annex E, which is displayed by RDS receivers in order to inform the listener what program service is being broadcast by the station to which the receiver is tuned (see [1] section 3.1.5.1). An example for a name is “Radio 21”.

RDS PS in its initial form was designed to be a static station identification field. However, in North America a significant number of radio station use RDS PS for both station and content identification. Dynamic use of PS for both types of content is still very common to cater to legacy receivers with limited displays. The NRSC encourages all stations and receiver manufacturers to employ and optimize the more future looking RadioText and RT+ identification of content ([15] Section 6.9).

7.3.1.2 RDS RT (RadioText) Field

The *RT* field is a general purpose text string, up to 64 characters, and can be any human-readable text. RT+ allows a broadcaster to identify and the receiver to extract specific fields for Artist, Title, Station Name (Short) and Station Slogan, which are sent as separate fields in IBOC as explained elsewhere in this document.

Description: *RT* is a multi-line general-purpose string.
Comment: *RT* comes from the original RDS/RBDS specification.
Format: *RT* is human-readable text in 8-bit character format. Null characters may be transmitted to pad out to 64 characters, but this is not necessary and may simply take up extra bandwidth.
RDS: *RT* should be sent as a 2A group as defined in [1]. Note that a 2B group could be used, but the length of the string is then limited to 32 bytes.
IBOC SIS: No direct mapping; Station Name (Short) and Station Slogan are sent via SIS separately.
IBOC PSD: No direct mapping; Artist and Title sent via MPSD separately.
Streaming 1 (HLS): EXTINF Media Segment Tag, Section 4.3.2.1 of RFC8216. This tag is intended to specify duration but can include human readable text in UTF-8.
Streaming 2 (Shoutcast/Icecast): Not supported.
Streaming 3 (RTMP/Flash): AMF
RadioDNS: The Visual Slideshow specification “/text topic” contains a general unstructured text string.
On receipt: The receiver selects the appropriate character set as shown in Table 1.

Table 2. Summary of harmonization between RDS and IBOC text

Reference	Item	RDS/RT+	IBOC PSD
4.1	Title	RT+ ITEM.TITLE	TIT2 as MPSD/SPSD Attribute Title
4.2	Artist	RT+ ITEM.ARTIST	TPE1 as MPSD/SPSD Attribute Artist
4.3	Album	RT+ ITEM.ALBUM	TCON as MPSD/SPSD Attribute Artist
4.4	Program Type	RDS PTY	Header Expansion ID 010
4.5	Genre	RT+ ITEM.GENRE	TCON as MPSD/SPSD Attribute Genre
4.6	Comment	RT+ INFO.COMMENT	COMM as MPSD/SPSD Attribute Comment
4.7	Commercial	Not supported	COMR as MPSD/SPSD Attribute Commercial
4.8	UFID	Use RT+ Private Class	UFID as MPSD/SPSD Attribute UFID
4.9	Program Service Information	RDS PS Field	Best equivalents are SIS message ID 0001 or SIS message ID 1000/Type 1 (see text)
4.10	Call Letters	RT+ STATIONNAME .SHORT	SIS message ID 0001
4.11	Station Slogan	RT+ STATIONNAME .LONG	SIS message ID 1000 / Type 1
4.12	Station Text Message	RT Field as per NRSC-4-B	SIS message ID 0101
4.13	Subtitle / Movement	RT+ ITEM .MOVEMENT	HD Radio does not support
4.14	Conductor	RT+ ITEM.CONDUCTOR	HD Radio does not support

Table 3. ***Summary of harmonization between RDS and streaming audio text***

Reference	Item	RDS/RT+	Streaming format 1 (HLS)	Streaming format 2 (Shoutcast)	Streaming format 3 (RTMP/Flash)
4.1	Title	RT+ ITEM.TITLE	#EXTINF	TIT2 as StreamTitle concatenated with Artist	AMF
4.2	Artist	RT+ ITEM.ARTIST	#EXTINF	TPE1 as StreamTitle concatenated with Title	AMF
4.3	Album	RT+ ITEM.ALBUM	#EXTINF	Not supported	AMF

8 PRESENTATION OF RELATED IMAGES

8.1 Harmonization

Transmission of broadcast metadata to receivers has traditionally been text focused. However, as receiver designs evolve, many new devices now support images for visual presentations to the listener. This visual image is often displayed in conjunction with the text-based metadata, and various transmission platforms have methods to send the images and trigger them on the display.

RDS: Not supported.
IBOC MPS Station Logos and Artist Experience (e.g. cover art) are both supported
IBOC SPS: Station Logos and Artist Experience (e.g. cover art) are both supported
Streaming 1 (HLS):
Streaming 2 (Shoutcast/Icecast):
Streaming 3 (RTMP/Flash):
RadioDNS: Visual Slideshow consists of a /text topic and an /image topic, which is in .jpg or .png format. The broadcaster is free to populate text or the image with whatever content they would like. The device will display this image to the listener when it is triggered by the broadcaster.

8.2 Image Specification and Standardization

There are several key image file attributes that need to be considered by service providers as outlined below. It is most important that service provider (typically the radio station, or the software vendor the station uses to provide the images) be aware of the various constraints on image files that may be imposed by both the transmission standards as well as by the radio designers. In addition, radio designers need to be aware of the transmission standards, but also include fault tolerance in the receiver design in case an improperly formatted image is received. Given that image metadata databases for songs may contain in excess of 100,000 files, there is always a finite possibility that some of those files may be in error in some way.

- **File Format** – Images created for radio metadata applications are typically either compressed JPEG images stored in the JFIF file format or else created and stored in PNG format. There are advantages and disadvantages to both depending on the source image. It should be noted that both file formats allow for many optional extensions. Since radio receivers are typically resource limited, it should be assumed that only basic features are supported. Details of each image type are given below.

    a. JPEG – JPEG is a lossy compression algorithm that works well for complex images such as photographs or album cover art. There are many tools available to edit and compress the source image. By default, many of these tools store the JPEG file with proprietary features in the file, such as EXIF, XMP, Pentax, SPIFF, JPEG-HDR, Ducky, Photoshop, and Adobe. Images may also support progressive scan or optional text strings. To guarantee receiver compatibility, and in many cases to also significantly reduce the file size, these features should be removed from the file. When editing an image with a proprietary tool such as Photoshop, this can be accomplished by exporting the image to standard JPEG (export to web).

    b. PNG – PNG is a raster-graphics file-format that supports lossless data compression. It works well for simple graphics images that can take advantage of a small color palette. Station logos often fall in this category. PNG also has the advantage that it supports transparency where unused pixels are not rendered on the display. Thus, images can appear in whatever shape the designer desires. For these reasons, PNG is well suited for station logos. PNG files consist of a number of “chunks” which are categorized as critical or ancillary. Similar to the JPEG case, ancillary chunks such as those containing EXIF metadata or text strings should be avoided. However, support for transparency is advised. But the graphical designer should be aware that if transparency is used, a logo

is typically displayed on a display screen that has a dark gray or black background. Logo colors should be chosen accordingly, logo designs should avoid using dark colors at the transparency edge. To help detect this problem beforehand when using transparency, it is encouraged that designer of logos superimpose the image on grey and black backgrounds to ensure the desired visual result.

- **File Size** – For radio transmissions, large file sizes may impact transmission efficiency and radio receivers may have strict memory limits. For these reasons broadcast systems may impose a file size limit. In addition, for streaming applications data charges may apply.

- **File Resolution** – Radio receivers may have specific allocations for the maximum vertical and horizontal image resolutions allocated for image display. For these reasons broadcast systems may require specific image resolution parameters.

8.3 Image Delivery over IP

The Visual Slideshow specification (ETSI TS 101 499) defines how to signal and transport images over IP.

The receiver opens a persistent connection to the visuals server, using either STOMP or COMET protocols. It waits for messages from the broadcaster to instruct the receiver to retrieve/show visuals, at arbitrary intervals.

The receiver is given an instruction to retrieve an image using HTTP from a unique URL. The receiver provides its screen resolution information as custom HTTP headers when making the request and will always receive an image which fits wholly within the rectangle defined by that resolution.

Broadcasters should attempt to dynamically create an image that best fits the rectangle requested by the receiver. A technique to do this is to hold the visual design template in HTML/CSS and use a headless browser (such as Puppeteer - pptr.dev) to render the design at the correct size and “screengrab” the image.

Performance can be improved by use of caching. The broadcaster should be careful to use URLs that uniquely identify a specific image and allow the image to be cached at the edge of their infrastructure, at intermediate CDNs, and on the receiver.

The broadcaster may instruct a receiver to retrieve an image, but not show until triggered, either by specifying a specific UTC time, or “now” to have it shown immediately. A receiver must respect this trigger time information accurately.

Where the receiver knows that it is introducing a local time shift to broadcast audio playback, the receiver must similarly adjust visual display times to ensure they remain aligned with the received audio.

APPENDIX A: GUIDELINES FOR USE OF INDIVIDUAL FIELDS

This Appendix lists some general guidelines or recommendations for individual fields.

A.1 Use of Overloaded Text Fields

A.1.1 Background

When a field such as Artist is used for more than the documented (primary) purpose, it is referred to as having been "overloaded." An example would be of using the Artist field for artist name, plus a weather report. In this example, the artist name would be the primary text, and the weather report text would be secondary.

However, some receivers will display such a field with the first 10-16 characters, for a period of time or until a button is pressed. This means that the primary text – artist – is not shown, if the secondary text – weather – is put into the field first.

A.1.2 Recommendation

NRSC-R300 documents the field lengths from 149,065 actual content pieces. In that study, it was determined that the bulk of content uses only about 16 characters (see R300 figures 1, 2, 4, and 5 for relative histograms). Since receivers are often designed to use only the first portion of a long text field, they generally can display much or all of the first field. If a second is appended as described here, be aware that it may not be shown on many receivers.

Therefore, in general, use of overloaded text is discouraged. If it is used, always put the documented-purpose text (primary text) first in a text field which is to be overloaded.

NRSC-G302

NRSC Document Improvement Proposal

If in the review or use of this document a potential change appears needed for safety, health or technical reasons, please fill in the appropriate information below and email, mail or fax to:

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