RDS in Europe, RBDS in the USA – What are the differences and how can receivers cope with both systems?

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The EBU's Radio Data System, devised essentially as a response to the difficulties faced by motorists wishing to listen to VHF/FM radio broadcasts, has established itself as an integral part of most European broadcasters' VHF/FM services, and a substantial number of motorists are now benefiting from more pleasurable listening conditions, easy access to traffic information, and enhanced safety.

The benefits of RDS have not gone un–noticed in other continents, and a variant, known as the Radio Broadcast Data System (RBDS), has just been agreed by the US standards authorities.

This article explains the main differences between the US and European radio data systems, deriving mostly from the differences in structure and content of US broadcasting compared to those of Europe, and describes some new concepts included in RBDS.

Finally, the article looks at RDS/RBDS receiver commonality, and examines the possibilities for a rapid expansion of RBDS based on existing RDS receiver technologies.

1. Introduction

The Radio Data System (RDS) for FM broadcasting was developed within the European Broadcasting Union. This system was specified by the EBU in 1984 and has been introduced in the large majority of European countries since 1987. Later the system was slightly enhanced through several modifications, and in 1990 it was adopted as a European standard of CENELEC (EN 50067). Today most FM stations in Western Europe use RDS, and receivers, mostly car radios, with RDS functionality are available in Europe from some 50 different manufacturers at prices that are only slightly higher than those of conventional radios [1, 2, 3].

Although the RDS system offers a wide range of implementation options (some of which, like Traffic Message Channel – TMC, are still under development), most of the existing RDS car radios have only the so called “five basic features”: Programme Identification (PI), Programme Service (PS) name, Alternative Frequency (AF) list, Traffic Programme (TP) identification, and Traffic Announcement (TA) signal. Programme Type (PTY) code will perhaps be one of the next popular features, apart from the Enhanced Other Networks (EON) function which is increasingly used now by the European broadcasting networks, and has lead to a so–called second generation of RDS receivers.

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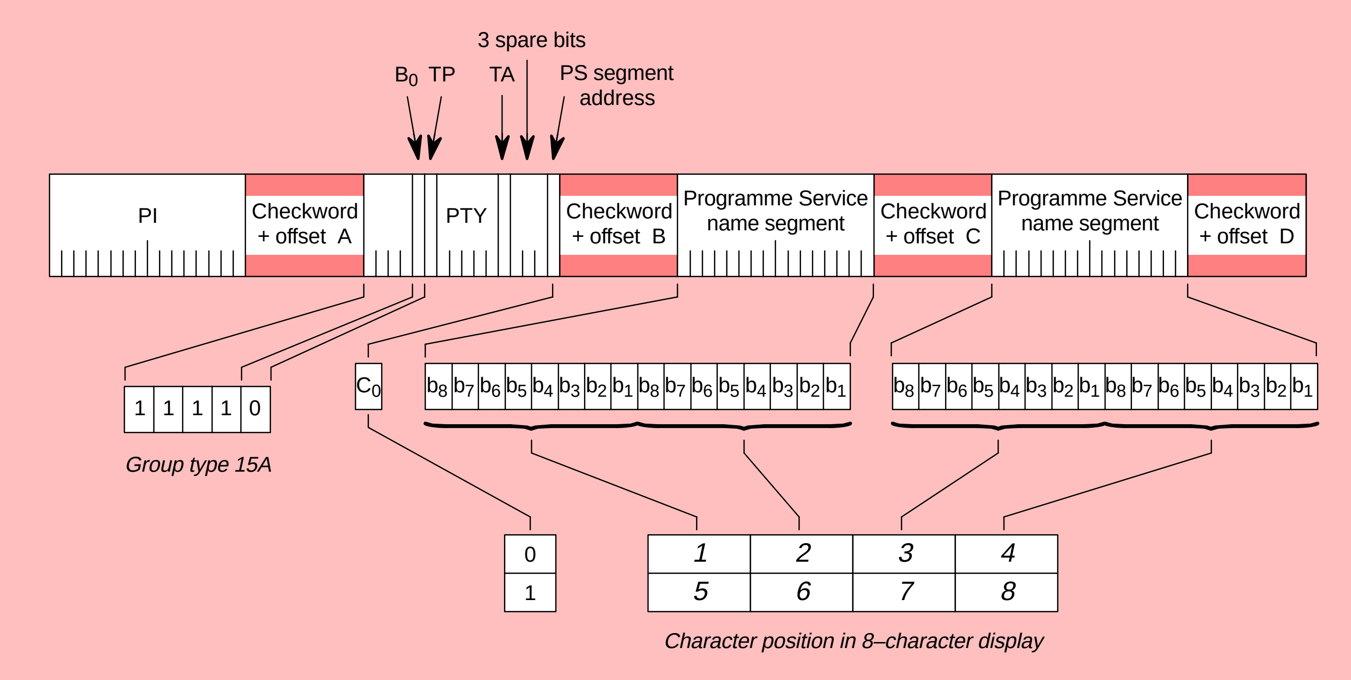
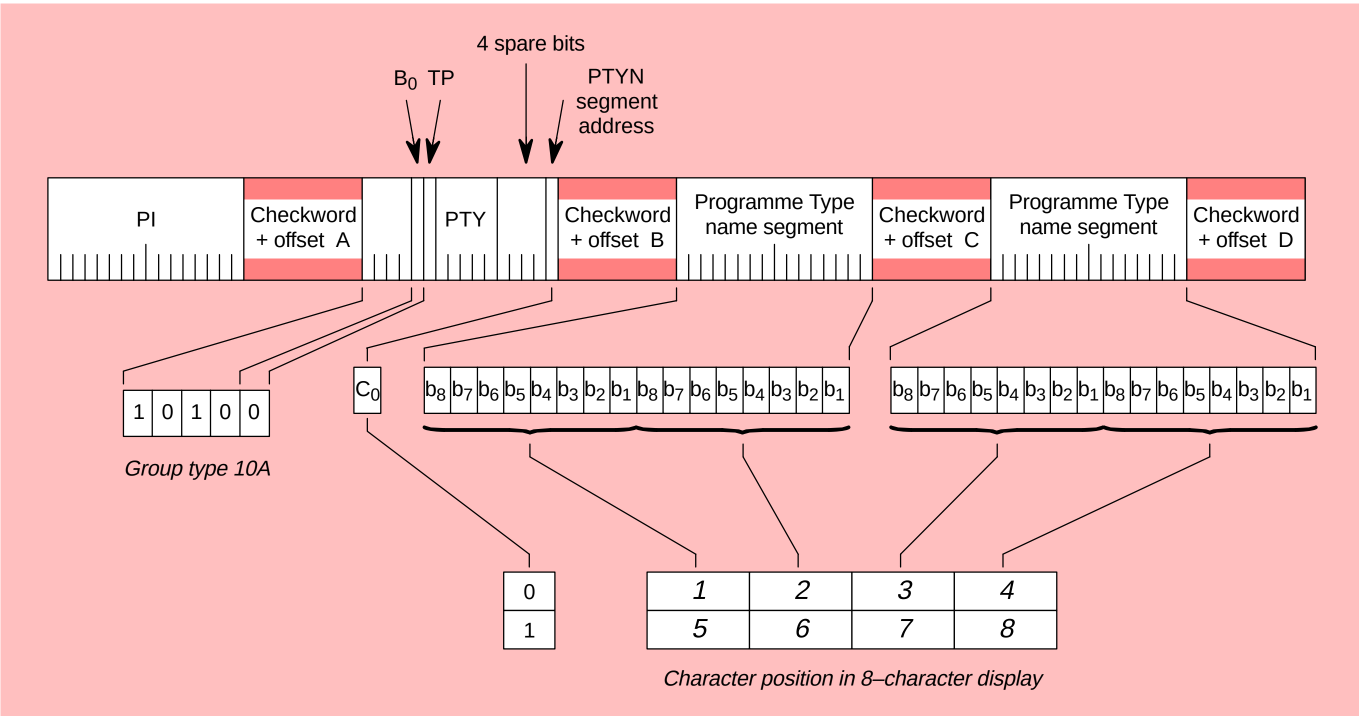


Figure 1
Group type 15A – Fast basic tuning and switching information.

Figure 2
Group type 10A – Programme type name.

In the United States, a Sub–group on Radio Broadcast Data Systems of the National Radio Systems Committee (NRSC), sponsored by the Electronic Industries Association (EIA) and the National Association of Broadcasters (NAB) began its work in February 1990, after the EBU had demonstrated RDS at various conventions of the NAB and the Society of Automotive Engineers (SAE). The NRSC Sub–group based its work on RDS as specified within the EBU, and every attempt was made to keep the US standard compatible with it. However, it soon became evident that the completely different broadcasting structure of the US required a number of modifications to be made. Finally, the US standard must not only cover FM broadcasting, as is the case in Europe, but also AM broadcasting.



In August 1992, the NRSC released for final adoption by 30 September 1992 the draft standard Radio Broadcast Data System (RBDS) version 2.0 [4]. The result of the final voting procedure was that the draft standard had been unanimously accepted, as reported to the RBDS Sub–committee on 10 November 1992. Final editorial changes are now being made to the RBDS draft standard and the release of the US RBDS specification is to take place at the Winter Consumer Electronics Show (WCES) in Las Vegas, Nevada (January 1993). During the WCES show, the EIA will be organizing a large promotion for RBDS, and the system will also be promoted by the NAB during NAB ’93 in Las Vegas (April 1993).

2. Differences between RDS and RBDS

2.1. The RDS component within RBDS

RDS has been fully included within RBDS, although with some slight modifications. The minor modifications to European RDS described in this Section were made to adapt RDS to the United States broadcasting environment:

2.1.1. Fast PS acquisition

Since US AF lists are smaller, AF Method B will not be required. The number of stations that have AFs in the United States is significantly fewer than in Europe. For this reason, Group type 15A (see *Fig. 1*) which transmits four PS characters per group was defined use the available bandwidth more efficiently and achieves faster PS acquisition. To maintain compatibility with existing receivers, Group type 0A will be transmitted even when Group type 15A is being used.

2.1.2. PI code assignments

Since there is no central agency in the US to keep track of PI code assignments, there was a need to define a procedure that can be used to establish PI codes for each programme. To ensure the PI codes were unique, a conversion from call letters (which are unique to each programme) was used. This conversion utilizes all PI code elements starting with a first nibble in the range from 1 to A inclusive. In doing so, the meaning of the second nibble, and thus the concept of using generic PI codes as defined in European RDS, was lost. For PI codes below $B000_{hex}$, receivers should therefore not allow any regional variant AF switching to prevent false AF or PI searches. For PI codes above $B000_{hex}$, the receivers may treat the PI code as defined under European RDS.

Number	CENELEC PTY (RDS)		US PTY (RBDS)	
0	No programme type, or undefined	NONE	No programme type	_****_
1	News	NEWS	News	NEWS
2	Current affairs	AFFAIRS	Information	INFORM
3	Information	INFO	Sports	SPORTS
4	Sport	SPORT	Talk	TALK
5	Education	EDUCATE	Rock	ROCK
6	Drama	DRAMA	Classic rock	CLS_ROCK
7	Culture	CULTURE	Adult hits	ADLT_HIT
8	Science	SCIENCE	Soft rock	SOFT_RCK
9	Varied	VARIED	Top 40	TOP_40
10	Pop music	POP_M	Country	COUNTRY
11	Rock music	ROCK_M	Oldies	OLDIES
12	M.O.R. music	M.O.R._M	Soft	SOFT
13	Light classical	LIGHT_M	Nostalgia	NOSTALGIA
14	Serious classical	CLASSICS	Jazz	JAZZ
15	Other music	OTHER_M	Classical	CLASSICL
16			R&B	R_&_B
17			Soft R&B	SOFT_R&B
18			Language	LANGUAGE
19			Religious music	REL_MUSC
20	Spares		Religious talk	REL_TALK
21			Personality	PERSNLTY
22			Public	PUBLIC
23 – 29			Spares	
30			Emergency test	TEST
31	Alarm	ALARM	Emergency	ALERT!

Notes:

The texts at the right of each column are recommended for use on eight–character receiver displays.

"_" indicates a space.

Table 1
European (CENELEC) and US PTY codes.

2.1.3. Programme type scanning

A new feature for the United States will be the Programme Type scanning feature. PTY information will allow a user to seek his favorite programme format, such as a particular type of music. Since US broadcasting differs in content, a new Programme Type list of 24 items was created (see *Table 1*). The US broadcasters are very sensitive to the programme type name shown on the receiver. Therefore, the Programme Type Name (PTYN), Group type 10A (see *Fig. 2*), was also defined. The default eight–character name should be shown during the scanning process. Once the receiver stops on a station with the default PTY category, a more specific PTY identifier may be given with PTYN. The PTYN is not intended to change the default eight characters which will be used during the search, but only to define more clearly the programme type once tuned to a programme. If the broadcaster is satisfied with the default PTY name, he will not need to use data transmission capacity to change the default name. Receivers that implement the PTY feature should allow the user to select one of the two different PTY tables (European CENELEC version and US RBDS version). The table may also be switched automatically using the Extended Country code (ECC).

2.2. *Optional multiplexing of RDS and MMBS*

RBDS includes a further option for the multiplexing of RDS with the Modified Mobile Search (MMBS) system, used exclusively by a company called Cue Paging.

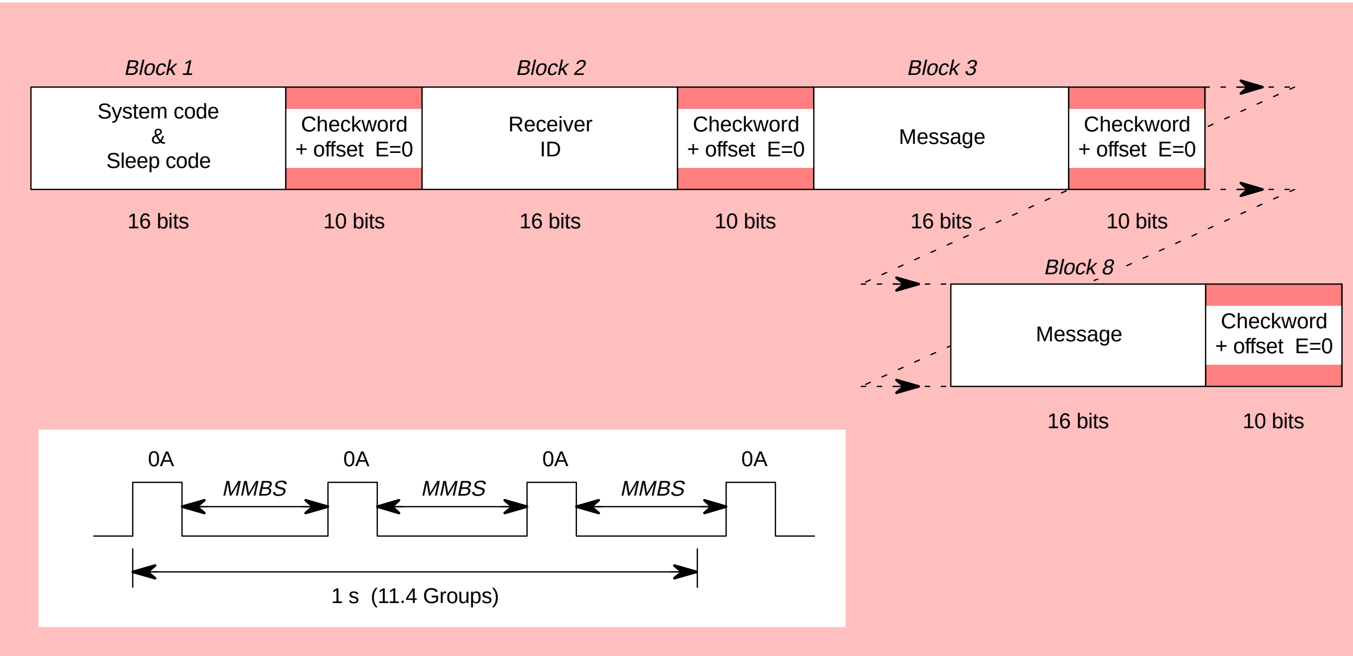
To receive RDS information from stations that time–multiplex RDS and MMBS information, receivers should recognize offset word E=0 (all zeros). Current receivers that flywheel through E words (even if they are seen as errors) will work with no modification. However, improved performance will be obtained with recognition of the new offset word. The MMBS information (blocks with E offset words) will be time–multiplexed into the RDS data stream in modulo–4 multiple blocks. Thus, between RDS blocks with offset words D and A, could occur 4, 8, 12, ... MMBS blocks with the E offset. The interleaving will be such that at least two groups of Group type 0A will be transmitted each second in compliance with the original European specification for acceptable acquisition of the PS name. However, the RDS and MMBS multiplexing will unavoidably degrade the performance for stations that desire to make use of the AF feature, due to the loss of repetition of the fast pertinent tuning information needed by the receiver. A typical time multiplex of RDS and MMBS data is shown in *Fig. 3*, where three groups of Group type 0A are inserted per second. Currently, Cue Paging utilizes the Mobile Search (MBS) paging protocol [5] at about 300 stations of the approximately 5000 existing FM stations, usually one per area, covering 90% of the population of the USA. The option of multiplexing between RDS and MMBS will thus permit these stations to implement RDS while maintaining compatibility with the existing MBS paging receivers.

2.3. *Optional in–receiver database*

RBDS includes an option for using an “in–receiver database”, typically requiring a 256 kbyte ROM along with some additional RAM capacity. This option permits a degree of RDS functionality for AM stations and FM stations that do not implement RDS.

To support all AM and FM stations with the RDS features of PS and PTY, an In–Receiver Database System (IRDS) may be used. This consists of a ROM which lists all the call letters (rather than

Figure 3
Typical time multiplex of RDS and MMBS.



PS) of all stations, together with their PTY. An obvious problem is that if a station changes its format or call letters, the ROM is outdated. However, the RDS Transparent Data Channels (TDC) 0 and 1 will be used to update the ROM. This feature is proprietary and requires the acquisition of a license from its owner for implementation in hardware, firmware, and/or software. Implementation details are given in the RBDS specification.

2.4. Option to add an AM data system

The RBDS specification includes a reserved section for the addition of an optional AM data system, the specifications of which remain to be defined.

A dynamic AM "RDS type" system is being investigated by the NRSC Sub–group. One proponent has a system that transmits the data as a two–tone signal within the AM baseband frequency and is compatible with AM stereo.

2.5. New concepts within RBDS

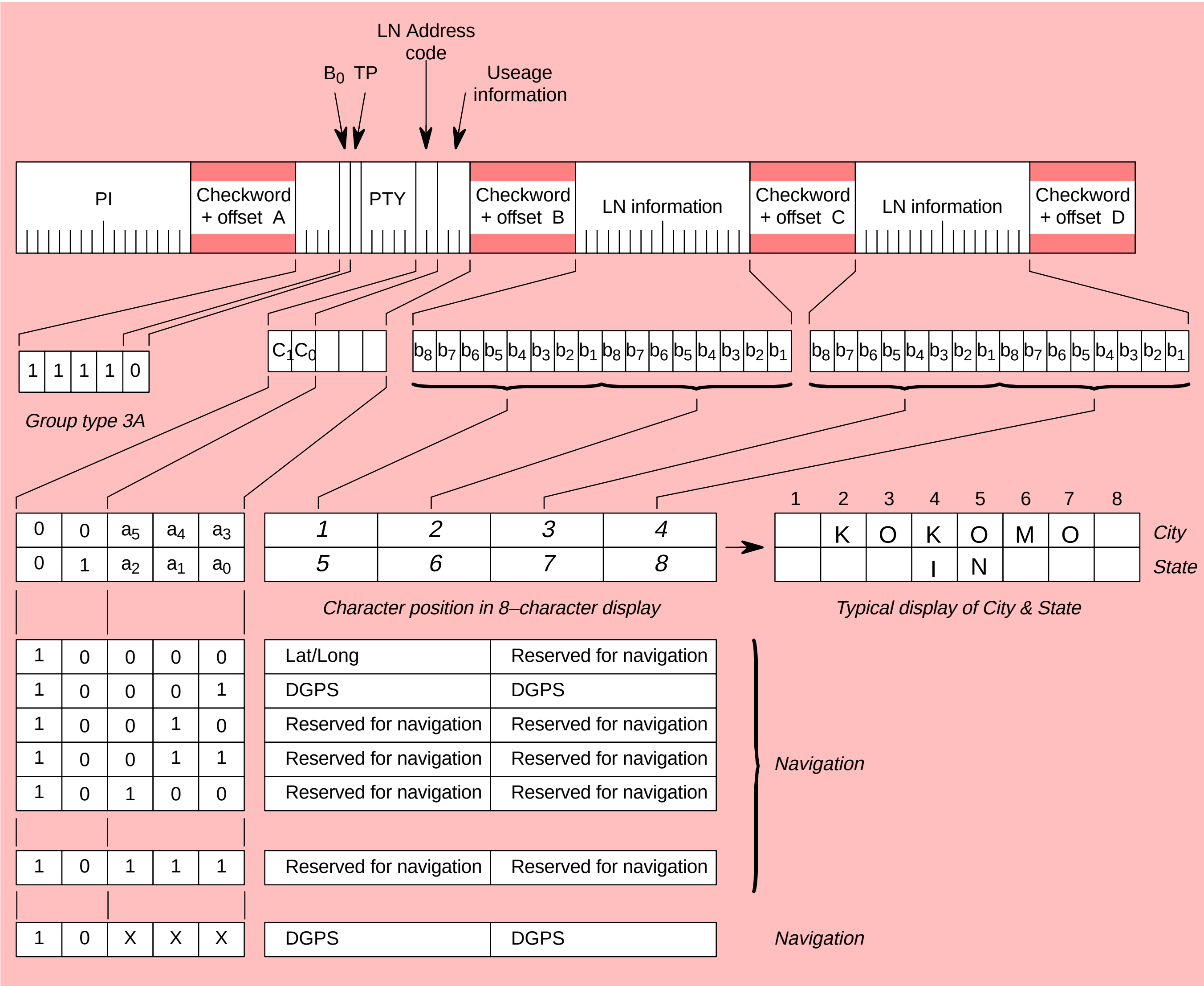
Several new concepts have been included within RBDS for future generations of US RDS receivers.

2.5.1. Location and navigation

The first new concept aims to establish a link between RBDS and the US satellite–based global positioning system, GPS (*Fig. 4*).

Group type 3A, known as Location and Navigation (LN), will allow the positioning strategy known as differential GPS (DGPS) to be exploited. The accuracy of normal GPS is affected by many factors such as frequency drifts onboard

Figure 4
Group type 3A – Location and Navigation (LN).



the satellites and ionospheric or tropospheric disturbances. To permit compensation to be made for these errors, DGPS uses a receiver at a known, fixed location, to determine correction factors (pseudorange corrections), which are generally valid over quite a large geographical area around the reference receiver (within about 1000 km). The DGPS technique permits much–improved positioning accuracy, even in moving vehicles. The pseudorange corrections are broadcast to GPS receivers in the surrounding area, and although this is currently done via a satellite link, it is envisaged that the RBDS data–stream will provide a satisfactory alternative. A bit definition has been defined by a DGPS Sub–group under the RBDS Sub–committee; this is based on an industry–wide standard called RTCM SC–104 (Radio Technical Commission for Maritime Services Special Committee 104). The transmission rate for the reduced bit definition is promising, but is still in the testing phases.

2.5.2. Reserved TDC

Channels 0 and 1 of Group type 5, corresponding to two of the 32 available Transparent Data Channels – are reserved for the IRDS updates described in *Section 2.3*. Channel 2 is reserved as an SCA switch and is intended to accomodate broadcasting such items as emergency, traffic and weather information via a separate subcarrier at 67, 76 or 92 kHz. The information on these subcarriers can be either speech or data. RDS acts as a switch to tell the receiver when an event is happening on these subcarriers.

3. Conclusions

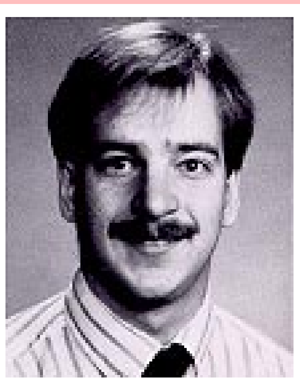
RDS and RBDS both allow broadcasters and receiver manufacturers to decide which of the possible standardized features they wish to implement. It is in that context that the question arises of whether RDS manufacturers can adapt their software to modify existing products, designed for Europe, for sale in the USA.

The answer to this question is not very obvious because of the large range of implementation options that are theoretically permitted in the two standards. However, in reality it should not be too difficult to solve the problem, because most existing RDS car radios have implemented only the five basic features already mentioned in *Section 1.*, and these also appear to be quite sufficient during the initial phase of RBDS implementation in the United States.

RDS and the three components of RBDS (RDS, MMBS and IRDS) also have in common exactly the same data broadcast signal modulation characteristics. This is a suppressed 57 kHz subcarrier which is PSK modulated with a data–stream of 1187.5 bit/s and identical baseband coding, and with data synchronization strategy optimized for mobile reception. Consequently, the same hardware for data demodulation and display can be used, and suitable radio data decoder ICs are now currently available from several manufacturers[1] at very competitive prices, because several million of these chips have already been sold. Consequently the question of adaptation becomes entirely a matter of software, apart from the additional memory needed to implement RBDS in its more complete form. A block diagram of a typical VHF/FM radio–data receiver is shown in *Fig. 5*.

As is common with all new system standards, a certain time is required by the manufacturers to implement them (typically three years). In this case, however, it is expected by all experts who were involved in the RBDS standardization process that the RBDS standard can be implemented

1. Philips (SAA 6579), SGS–Thomson (TDA 7330), Sanyo (LC 7070), and others.



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Mr. Beale joined Delco Electronics Corporation in June 1988. He is a project engineer in the Audio and Communications Advanced Development Group, specializing in digital communications system design.

Mr. Beale has been involved in all phases of the standardization of RBDS in the USA; his specific contributions have been concerned with the amalgamation of RDS, MMBS and IRDS while maintaining compatibility with the CENELEC RDS Standard.

A biography of __Mr. Dietmar Kopitz__ is given on page 38.

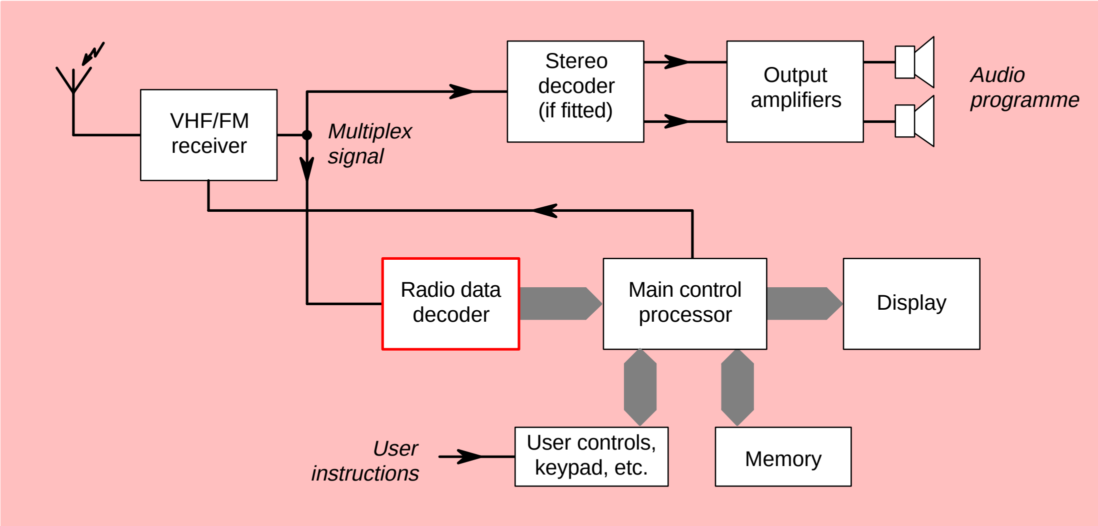

Figure 5
Block diagram of a typical VHF/FM radio data receiver.

with a much shorter delay, by using the existing and already well–proven RDS technology applied for the European market.

Therefore, the question asked above could perhaps be simplified to whether the typical European RDS software might be initially sufficient for implementing RBDS within a relatively short delay. Then, it is important to take advantage of the fact that RDS is fully included in RBDS, and the major modifications to be made could then be restricted in number. Perhaps the less–urgent items could be left for a later implementation, because they are less essential for the initial introduction of RBDS:

1. The PTY codes are different, and also there are a few new data groups (Group type 3A for navigation information, Group type 10A for Programme Type Names permitting the use of sub–categories within the relatively limited range of the 24 PTY format codes, and Group type 15A for a faster PS acquisition).
2. The multiplexed operation of RDS and MMBS will be encountered by a receiver rather infrequently, and only on one FM station per area. At the moment only 6% of all US FM stations use MBS. The only additional requirement to be met in this context is that the data synchronization mechanism, which is a sort of flywheel, will need to recognize the new offset word E (all zeros).
3. Implementation of the “in–receiver database” option is a completely separate issue, and it is likely that it will be further developed exclusively by the company which owns the licensing rights for this module. That company will also have to promote the inclusion of the option by receiver manufacturers. It may be noted also that the use of automated programme format search tuning in new RBDS receivers is still a controversial issue among broadcasters, this may cause a delay in establishing a ROM that contains an agreed programme format for all existing stations.

All the above indicates that existing RDS radios with the five basic features can perfectly meet initial RBDS requirements. If urgent changes to the existing software are nevertheless to be made, the first thing to do would be to add recognition of offset word E and, if PTY is additionally implemented, the new table of US PTY codes will have to be used. In contrast to the situation in Europe, EON will not yet be required in the US, since the functions associated with this feature are more advanced applications for large networks, and thus of little interest during the initial introduction.

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