A silent revolution -

- RDS for FM radio

RDS Forum authors team

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This book is dedicated to all colleagues within the EBU and the RDS Forum, who helped to make this RDS success story happen. Thanks for the many opportunities we had to work together.

Dietmar Kopitz

TABLE OF CONTENTS

In a Nutshell - a quick walk through this book

This is an updated publication on the Radio Data System (RDS) for FM radio, detailing its development, features, and future prospects, particularly with the introduction of RDS2.

The Impact and Future of RDS

The RDS technology has evolved significantly, with RDS2 increasing data capacity by a factor of 6, allowing for advanced applications like full-colour station logos. FM radio remains a key component of the European radio landscape alongside IP and DAB. The RDSeBook discusses the development, benefits, and future of the Radio Data System (RDS) in enhancing FM radio listening.

- RDS was introduced in 1985 and has revolutionized FM radio listening across Europe, improving user experience significantly.
- Nearly every radio in Europe now decodes RDS data, with hundreds of millions of receiver devices.
- RDS offers features like automatic tuning, travel news, and programme information, making FM radio easier to use.
- Some governments are attempting to transition to DAB radio, but public resistance suggests it may take at least ten or more years for digital listening to surpass FM.
- The text emphasizes the enduring value of RDS, predicting its continued relevance in the radio landscape.

The Future of RDS and RDS2 Technology

The RDSeBook discusses the evolution, significance, and future potential of RDS and RDS2 in FM radio broadcasting.

- RDS technology has been in use for over 40 years, with billions of receivers produced globally.
- RDS primarily facilitates auto-tuning and limited data services, while RDS2 allows for more extensive data transmission.
- RDS2 can transmit seven bytes per group at a rate of 11.4 groups per second across optional subcarriers 1 to 3.
- The RDS Forum anticipates increased market demand for RDS2 by 2025, supported by ongoing research projects.
- The RDS Forum management has been active since 2015, promoting the continued relevance of RDS2 technologies.

Development history and Impact of RDS in Europe

The section discusses the evolution of the RDS system in Europe, highlighting its development, challenges, and eventual adoption by broadcasters.

- In the 1970s, FM radio faced slow public acceptance despite 95% coverage in Europe, prompting research into improvements.
- The ARI system was proposed in 1974 for traffic information but faced criticism for its limited applicability across different broadcasting models.
- The EBU initiated the RDS development in response to the shortcomings of ARI, aiming for a universal identification system for FM programmes.

- The RDS specification was finalized in 1983, with successful field trials confirming compatibility with the ARI system.
- RDS was rapidly adopted across Western Europe, with the first commercial RDS car radio launched in 1987.
- By 1988/9, RDS was on-air almost all over Western Europe, marking a significant advancement in FM radio technology.
- The introduction of RDS is often referred to as a "silent revolution" in radio broadcasting, enhancing FM radio in-car reception and listener experience.

The Evolution and Impact of RDS Standards

- RDS became a world standard in 2000 with further enhancements like RadioText Plus introduced in 2009.
- The latest RDS standard, IEC 62106 Parts 1 to 6, was published in 2018, incorporating RDS2 developed since 2014.

RBDS Development and Standardization in the USA

The section discusses the development and standardization of RBDS in the USA, highlighting its adaptation from the European RDS system.

- Discussions for standardizing RDS in the USA began in 1990 under the NAB and EIA (now CTA), leading to the creation of RBDS.
- The RBDS standard was first adopted in January 1993 as a voluntary national standard, facilitating the use of existing RDS technology.
- New PTY codes were created, as European codes were inappropriate for American radio formats.
- By 1995, RBDS was recognized as the American standard, while RDS remained the term used for consumer products.
- The latest RBDS standard, NRSC-4-B, was published in 2011 and later incorporated into the IEC 62106 standard as Part 9 in 2021.
- The NRSC's RBDS Subcommittee was replaced in 2018 by a new Data Services and Meta-data Subcommittee to broaden its focus.
- RBDS promotion included notable events like the 1993 Chicago Consumer Electronics Show, showcasing its integration into consumer electronics.

Universal Encoder Communications Protocol - UECP

The section discusses the development, implementation, and ongoing updates of RDS and the UECP specification by the RDS Forum.

- The RDS Forum was established in 1993 to represent equipment manufacturers and broadcast service providers.
- The Universal Encoder Communications Protocol (UECP) became Part 10 of the RDS standard IEC 62106 in 2021.
- Over several billion RDS radios are currently in use worldwide, showcasing the technology's widespread adoption.
- Enhanced RadioText (eRT) was introduced to support non-Latin characters, accommodating diverse languages with UTF-8 coding.

- The RDS Forum has held 35 meetings, with the latest in Geneva, Switzerland, in 2024.
- The organization addresses issues like unregistered ODA applications and non-conforming PI codes to ensure proper RDS implementation.
- FM radio remains relevant alongside DAB and radio over IP, despite predictions of its decline.
- The RDS Forum continuously updates guidelines and standards to adapt to emerging markets and technological advancements.

Evolution and Milestones of RDS Development

- The FM/RDS receiver chip market expanded significantly, exceeding an annual production of a billion units by 2011.
- The RDS Forum continues to play a crucial role in the development and maintenance of RDS technology, ensuring its relevance in the digital age.

The RDS2 development process was initiated by Attila Ladanyi, with significant contributions from various industry leaders, culminating in the first live demo from Radio France and WorldCast Systems at the Paris Salon de la Radio 2019. Key innovations included the RX014 data analyser and the first RDS2 encoder, showcasing music cover art images via RDS2 on FM radio.

- By 2018, the first commercially available RDS/RDS2 encoder was presented at the NAB Show, and the RFT specification was published to achieve file tranfers with RDS2.
- A workshop in Paris in 2020 focused on transmitting station logos and enhancing FM radio services through RDS2.

RDS Data Transmission Capacity Overview

The RDS system transmits 673 usable bits per second on a 57 kHz subcarrier, accommodating 11.4 data groups per second, while RDS2 offers increased capacity on three optional upper subcarriers. RDS2 features one group type C that can carry seven data bytes, enhancing data transmission efficiency.

RDS Channel Reliability and Data Transmission

The section discusses the reliability of the RDS channel for data transmission, emphasizing the impact of multipath effects on message acquisition.

- Field tests indicate that RDS data injection levels of ±1 kHz are reliable only under optimal receiving conditions with minimal multipath effects.
- The reliability of RDS applications, such as PI and PS, decreases significantly in urban environments with high-rise buildings or mountains.
- Repetition of message elements is essential for effective communication, particularly for PS and TMC messages, while RadioText can tolerate occasional errors.
- Error detection is mandatory for all messages, but error correction is selectively applied, notably to RadioText, where minor errors are less critical.

- All previous RDS specifications published before 2018 have been cancelled, ensuring a unified and updated standard moving forward.

RDS and Automotive Radio Innovations

The section discusses the evolution and features of RDS technology in automotive radios, emphasizing safety, performance, and user experience.

- RDS technology enhances driver safety by automating program retuning and ensuring uninterrupted listening during travel.
- The Programme Service name (PS) has evolved from 8 characters to a maximum of 32 bytes with RDS2, accommodating diverse languages worldwide.
- Automatic Frequency (AF) switching is crucial for maintaining audio quality, with modern tuners achieving updates in 4-6 milliseconds.
- The TP/TA feature allows for efficient traffic announcements across networks, with EON enabling cross-referencing of relevant information.
- Multiple tuner concepts enhance dynamic performance, allowing background scanning and improved signal quality through phase diversity systems.
- RT+ enhances RadioText by structuring key elements for easier readability.

RDS and Traffic Message Channel Overview

This section discusses the development and functionality of RDS, particularly focusing on the Traffic Message Channel for traffic information.

- TMC transmits coded traffic information, allowing for efficient communication of driving conditions without overwhelming bandwidth.
- The essential elements of traffic information include what is reported, where the problem is, its effect, who is affected, duration, and avoidance strategies.
- TMC messages consist of core elements: Location, Event, and Duration, with standardized codes for efficient transmission.
- The Event List contains around 1,500 phrases categorized into 39 classes, covering various traffic situations and conditions.
- Location Tables, specific to geographical areas, can contain up to 64,000 codes, allowing precise mapping for navigation systems.
- Each TMC message typically requires 16 bits for a Location Code and 10 bits for the Location Table identifier.
- The standardized approach ensures that traffic information is presented in the user's preferred language and units, enhancing usability.

- The maximum rate for TMC data groups is one per four RDS groups, equating to approximately 50 messages per minute.
- TMC messages are designed to overwrite old messages in the receiver's memory to ensure timely updates.
- Messages automatically expire after 15 minutes if not updated or canceled, preventing outdated information from remaining in memory.
- RDS-TMC services are expected to continue into the 2030s, despite a decline in the number of services since 2020.
- RDS offers cost advantages over connected solutions, making it accessible to less-affluent consumers, especially in developing countries.
- TMC encryption protects service data, using a three-stage bit manipulation process with a Service Key not broadcasted publicly.
- RDS2 could potentially quadruple TMC message throughput by using additional sub-carriers, allowing for 200 messages per minute.
- TISA has not yet decided on the use of RDS2 for TMC, leaving future implementations dependent on service provider agreements.
- The design of RDS allows for localized traffic information, unlike DAB, which may transmit irrelevant data to users.
- RDS-TMC's efficient coding and transmission methods ensure reliable real-time traffic information for navigation systems.

The Future of RDS and FM Radio

The section discusses the ongoing relevance and advancements of RDS technology in FM radio broadcasting.

- RDS technology has been widely adopted in FM radio receivers over the past 30 years, with nearly all FM radios in Europe using it.
- Despite the rise of digital radio, FM and RDS remain attractive and mature technologies, with limited market acceptance for DAB.
- The RDS Forum has introduced RDS2, enhancing RDS capabilities with features like file transfer and improved data capacity.
- In the USA, over 450 stations have implemented RadioText Plus since 2008, while Germany has 25 regional FM programmes using it.
- RDS2 allows for many parallel active Open Data Applications, significantly increasing the potential for new applications.
- By 2025, FM radio with RDS is expected to continue dominating the market.
- The RDS Forum is committed to promoting RDS2 and its features, anticipating market readiness within 2-3 years from 2023.

- Radio listening remains popular, with consumers averaging two to three hours per day, making it a significant entertainment option.

RDS Character Encoding and Testing Overview

This section discusses RDS character encoding, the transition to UTF-8, and tools for testing RDS implementations.

- RDS character encoding issues arise from incorrect conversion between one-byte and two-byte character sets.
- The RDS standard IEC 62106-4 specifies a character set of 256 symbols, with ASCII characters below code 127.
- Special characters for Western European languages are represented in the upper range of the RDS character set.
- LPS and eRT are now exclusively coded in UTF-8, allowing for a broader range of languages and characters.
- RDS data can be tunneled over RDS2, allowing legacy data to be transmitted on upper subcarriers.
- The RX014 supports UTF-8 character coding and can decode enhanced RadioText in various languages.
- The Audemat FM MC5 offers extensive functionalities for FM measurement and RDS2 analysis.
- RDS Surveyor is an open-source program for RDS data analysis, available in both Java and web-based versions.

Understanding RDS2 Group Type C Functions

This section details the structure and functions of RDS2 group type C, including data transmission methods and protocols.

- RDS2 group type C is designed for specific data streams, primarily for ODAs and tunneling.
- The Function Header (FH) consists of a 2-bit Function Identifier (FID) and a 6-bit Function Number (FN).
- Four group type C identifiers are defined: tunneling legacy groups, RDS2 ODA data, assignment groups, and RFT data groups for file transfer.
- The RDS2 file transfer protocol (RFT) enables efficient file transport, allowing for missing groups to be restored later.
- RFT uses 16 pipes for file transfers, with each pipe corresponding to a specific ODA channel.

FlexiMax Project for Energy Flexibility

The FlexiMax Project aims to enhance energy flexibility and resilience in Europe's systems for a carbon-neutral future.

- The FlexiMax Project is part of an ADEME initiative targeting carbon neutrality by 2050 in a 100% renewable energy scenario.
- It focuses on managing increased electricity demand, improving power grid flexibility, and automating demand response to reduce infrastructure needs.
- The project utilizes FM-RDS broadcasting to control distributed electrical loads reliably and economically, without requiring new infrastructure.
- Expected outcomes include innovative products for broadcasting and energy industries, reducing the need for electrical network reinforcement and electrochemical storage.

Forward for this new eBook edition on RDS

When my predecessor Johnny Beerling wrote his introduction for the RDS e-book in 2013, it was assumed that FM would be phased out in the next 15-20 years and be replaced by DAB in Europe. Today we see that radio in Europe is based on 3 pillars: FM, IP and DAB or HD radio for North America. Thanks to huge progress made in DSP technology, RDS has made an enormous step forward with RDS2. The new RDS specification IEC 62106 with RDS2 is now adopted by the IEC. FM RDS has obtained its full place in the European radio landscape and also in the USA. RDS2 with an increase of a factor 6 in data capacity allows for state of the art product applications like a full colour station logo instead of an 8 character station name.
In this new edition you will learn more what is RDS2 all about.

I wish you happy reading

Frits de Jong , Chairman of the RDS Forum (since 2015).

Back in 1985 my boss, the Managing Director of BBC Radio, Richard Francis, sent for me and said that I was to take charge of the programme development and promotion of RDS. Not just for the UK, but through the European Broadcasting Union, for the whole of Europe.

"What is RDS?" I asked.

"It will be the most important development in radio since the invention of the transistor" was Richard's reply and that started my love affair with the system which has revolutionised FM radio listening over the last 27 years.

In retrospect, I see now that the broadcasters who started down the RDS road all those years ago were creating a silent revolution in radio.

In cars in particular, if you are driving across your country and you wish to remain tuned to the same national station you will have to retune many times. This is due to the fact that overlapping coverage areas from the network of transmitters carrying the same programme have to broadcast on different frequencies to avoid interference.

With RDS you can find the station by name and the clever radio does the rest for you, and to avoid traffic hold ups you can receive travel news relevant to the local area through which you are driving.

All by courtesy of RDS.

Today, thanks to the enthusiastic take up by chip manufacturers, nearly every radio in Europe has the capability to decode the RDS data and take advantage of what is on offer. Not just radios but smart phones too have integrated RDS and so there are many 100 millions of radios out there which offer the useful features. These days it is not just automatic tuning and travel news but text messages about the programmes and information about the music being played.

It really has made FM radio so much better and easier to use. All over the world people are using it without being aware and yet there are few who understand how it works.

In this book, edited by Dietmar Kopitz, you will find an explanation of the whys and wherefores of the Radio Data System, set out in an easy to understand, non-technical way. You will see how the system developed and understand why the transition to digital radio is happening so slowly.

Modern radios don't wear out and with a good RDS Radio there is little incentive to throw it away. There is little to be gained by switching from FM except where radio stations are offering unique programming on DAB or HD radio.

Some governments, like Norway and Switzerland, are keen to shut down the FM broadcasts so that they can sell off access to DAB to meet their budget deficits. However the public, by not switching over to DAB, are making this option very difficult and I foresee that it will be at least another twenty years before more people are listening on digital than on FM. In the meantime RDS sails on into the sunset with clear enjoyable listening for everyone. Long may it continue.

Now switch off your radio for a while and sit back and enjoy this electronic publication which gives you the whole inside story of RDS, the Radio Data System, by one of the founding fathers, Dietmar Kopitz, and other RDS Forum members.

Johnny Beerling, Chairman of the RDS Forum from 1993 to 2015 and its founder in 1993 (together with Dietmar Kopitz)

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RDS - a silent FM radio evolution

Silent means "relatively little talked about" anymore in the specialized press. Why? Perhaps with the RDS Forum being active since so long, everything has worked out so far quite fine. Only seldomly we receive suggestions to consider changes.

When RDS was created in the early eighties, one could not imagine that 40 years later this would still be an important technology for FM radio. Billions of RDS receivers have been made since then and the technology used as for more than two decades now relied mainly on ICs with Digital Signal Processing (DSP), a technology that has much helped to produce chips in large quantities providing radio manufacturers with a very inexpensive device delivering the FM audio stereo signal with the RDS data stream output. Thus, RDS became widely spread, worldwide. DSP technology also opened the door to achieve RDS2 at an almost insignificant increase of cost for the decoder, provided it could also be manufactured in large quantities, which was not yet the case until the end of 2024 and our hope is that 2025 will change this. For the moment such a market demand is still under develepment, notably with a Korean reseach project that will end in 2025. To offer the RDS2 option is very realistic, as we all know in the RDS Forum since 2015 and it is only a matter of time.

RDS and RDS2 have in a way different basic concepts, important to understand:

- RDS is mainly auto-tuning, extremely useful for mobile radios operated in FM transmitter networks transmitting the same audio content. A limited amount of data services, like TMC, is also possible. In addition, for all broadcasters, large or small, listeners can see what they hear: station name, programme title, artist name, song title, album name.
- RDS2 is mainly just transmitting data in the form of bytes and by means of Open Data Applications that can be defined by the transmission operator as required, i.e. seven bytes per RDS group and 11.4 groups per second on each of up to three additional subcarriers. Now you can achieve a lot more. RDS2 with FM radio permits to serve thousands, if not millions, of receivers at the same time. The data protocol is only uni-directional, but if the same information is repeated several times, the reception reliability can be high.

Thus, there appears to be still a long future for RDS, worthwhile to be explored, also by the younger generation. We had such a case already in 2020 at the Technical University of Chemnitz (Germany), where a student made his engineering master degree about the theme of a Software Defined Radio with the implementation of RDS2.

Dietmar Kopitz, Chief Executive of the RDS Forum.

In 1988 RDS was implemented on the BBC FM transmitter network. Johnny Beerling (former Chairman of the RDS Forum) presented the innovation at the opening ceremony in London.

1990: The BBC's RDS crew on the road for an EBU meeting on RDS in Torino, Italy. From left to right: Mark Saunders, Bev Marks and Johnny Beerling.

NAB '89: After the first presentation of RDS at SAE Detroit in 1984, Ford Motor Company became very interested to use RDS in their car radios and had started the devlopment of new products with RDS. Here is their test car.

RDS Forum 2012 at Glion/Montreux (Switzerland). From left to right: Dietmar Kopitz, Kent Adeborn, Johnny Beerling. Kent and his team had designed the first commercial RDS car radio, the Volvo SR-701, introduced into Volvo cars during 1987/8.

The RDS Forum management Committee since 2015. From left to right: Dietmar Kopitz, Chairman Frits de Jong, Vice-Chairman Mark Saunders and Attila Ladanyi.

Chapter 1

The RDS development history by Dietmar Kopitz

This Chapter gives a detailed overview about

The current RDS standard is IEC 62106-1 to IEC 62106-10 as from October 2018. Part 2 was updated in 2021, Part 6 in 2023.

- For RBDS the current standard is IEC 62106-9 (2021); it replaces NRSC-4-B from 2011.
- The RDS receiver measurement standard is IEC 62634 ed.2 from 2013.
- The Universal Encoder Communication Protocol UECP is published by the RDS Forum. Updated to include RDS2, it became IEC 62106-10 in 2021.
- The RDS Guidelines are published by the RDS Forum and are available for free from the RDS Forum's web site.
- The RDS-TMC standards are ISO 14819 - all parts are maintained by TISA.

The EBU Specialists Group testing first RDS proposals at Bern/Interlaken (Switzerland) in 1980.

HISTORICAL DEVELOPMENT

Early in the 1970s, many public broadcasters in Europe were beginning to ask themselves: what could be done with FM? It had been introduced in the 1950's and yet it was none too successful, despite continued investment in the transmission infrastructure. Many big broadcasters had, by the mid-1970s, completed their national FM networks with nominal service coverage around 95% of the population, or more. Nevertheless audience research and FM receiver sales continued to suggest that something was impeding the take-up of FM radio services by the public. In particular, the in-car entertainment sector had worked hard on improving receiver sensitivity which helped improve reception significantly. Some other factor must have been playing a role in this slow acceptance of FM services. Various research organisations were asked to look at this situation and reported mixed but highly constructive solutions.

In 1974 we had in Europe the following situation: at that time the largest German car radio manufacturer Bosch/Blaupunkt had developed, in close collaboration with the research institute of the German public broadcasters (IRT), the ARI-system. ARI stands for "Autofahrer Rundfunk Information" which means "broadcast information for motorists"

Bosch/Blaupunkt was hopeful at that time that this ingenious system would be adopted by the broadcasters all over Europe, which would have been an advantage from the receiver manufacturer's point of view because of the convenience of a more uniform market for the sales of car radios.

To gain the broadcasters' support, the ARI system was submitted by the German public broadcasters to the European Broadcasting Union's Technical Committee, with the view to obtain then a recommendation from the EBU that this system should be generally used all over Western Europe.

The EBU is a European professional association of mostly public broadcasters, in Western Europe at that time, but it now also includes the broadcasters of Central and Eastern Europe. The EBU is in fact the authority to establish or harmonize operational broadcast practices in Europe. In doing so, there is full awareness in the EBU that it is not a standardisation organisation. Therefore, the EBU collaborates very closely with standardisation organisations like the ITU, CENELEC, IEC, ISO and now mostly with ETSI to create the necessary standards, normally before any recommendation, relating to an operational practice for broadcasting, is issued.

Rather unexpected by those who undertook the initiative in the EBU, to recommend the ARI system for general introduction in 1974, their motion launched the RDS development within the EBU. Why? In the EBU's Technical Committee there was large disagreement about the universal applicability of the ARI system. The regional broadcasting model used in Germany and for which the ARI system was conceived, was in fact rather exceptional. Instead of regional broadcasting companies, most countries used national networks, whereas regionalisation, though quite useful for road traffic information, was not a common practice at that time.

Also, for ARI it was assumed that in each region, there would only be one programme that contained broadcast information for motorists. In reality though, national broadcasters inserted these announcements in several of their programmes. Thus, within the Technical Committee of the EBU a number of provoking questions were being asked, such as:

- Would it not be better seeking to develop a system that uses digital modulation instead of the analogue AM used in ARI?

- Why should we adopt a system that permits identification of only one programme, namely the one that contains the traffic announcements? It would be much better to develop a universal system that permits identification of any FM programme, for example by programme type.

- The hand-over mechanism for broadcast networks by means of the area codes used within ARI is inconvenient from the broadcasters' point of view, since it does not permit identification, unambiguously, of the possible alternative transmitters within a given network, i.e. alternative frequency lists are required instead.

This criticism of the ARI system immediately set the scene for the RDS development to start. There was general agreement within the EBU that this would be a very useful undertaking. The task was given to a working group that was in charge of all questions related to sound broadcasting. This group, in fact, took some time to take off the ground, since it had no experience at all with the use of digital modulation systems. Therefore, after having reflected upon the most suitable subcarrier frequency (57 kHz or 76 kHz, both integer multiples of the 19 kHz pilot-tone) for the purpose of achieving a minimum of interference from the data signal to the stereophonic audio programme or, the required coverage area (the same as for monophonic reception), the ARI compatibility and, also very important, to aim at no degradation of the established protection ratios that are internationally used within the ITU for the purpose of frequency planning of broadcast networks, or even single local transmitters.

The EBU working group then created a specialist group of experts in data broadcasting. In most European countries, in the late seventies, the public broadcasters and the telecom organisations that operated transmitter networks, had already experimented with data transmissions where a subcarrier within the FM multiplex signal was phase-modulated. This kind of experience existed especially in Scandinavian countries, for example in Finland and Sweden.

The EBU Technical Committee had, at that time, a so-called "Bureau", which was their small management committee supervising the activities of the associated working groups and also being responsible for organising the work decided by the full committee. In that Bureau there was one member from the Finish broadcasting company Yleisradio who had already written his doctoral thesis about the technology that was about to be developed by the EBU's specialist group.

It is interesting to note, even from the present point of view, what Dr. Kari Ilmonen's thesis in 1971 was all about, and what kind of research work he had then initiated in consequence within the Technical Department of Yleisradio. One of his collaborators had also joined the EBU specialist group and he so contributed to the work being then undertaken, already on the basis of the background thus gained.

Dr. Ilmonen's thesis was about listener preferences for loudness in speech and music broadcasts when these occur at various sequences in the same programme. To permit a separate adjustment of the volume and some kind of automatic control function in broadcast operations and the receiver, an identification of each speech or music item was suggested. If this could be done, then one could also in addition make an identification for programme type. He then drew up a list that closely resembles those PTY lists now used in RDS and DAB. He also suggested using a 57 kHz subcarrier, amplitude-modulated by FSK frequencies, to achieve the objective for such a universal identification system. Being in the EBU and the representative of a small country, Dr. Ilmonen insisted strongly that Europe needed a standard for a unified system, thus giving a strong impetus on the management level to conduct the work with this very important objective clearly in mind.

How did the EBU specialists then proceed in their work? In 1976, already there were several different radio data systems proposed from Finland, the Netherlands and Sweden. The specialists tried to identify what these systems had in common and they looked at a form of coding of the data stream that would permit optimal performance in the mobile reception mode at typical car travelling speeds and subject to severe multipath interference, as would usually occur with FM in mountainous regions.

To determine these basic parameters, it was agreed to conduct a first field trial in 1980 in the area of Bern/Interlaken in Switzerland. Representatives from the European receiver manufacturing industry (EUROTECH, later EACEM) were invited to join. A questionnaire was sent to broadcasters and industry to determine the desirable features of the up-coming system. The data broadcast tests in the region of Bern/Interlaken were then recorded by various research laboratories and analysed with the view to optimise the mobile reception.

In 1981, there was subsequently agreement of co-ordinated applications and the principles to be used in baseband coding. Test transmissions then started in several countries such as France, Finland, Germany, Netherlands, Sweden and United Kingdom. Since the system parameters were not yet fully defined, each country had designed its own particular radio data system and sometimes, one country even tested several different variants. Thus by 1982, eight different systems were already known and it became an imminent task to bring the choice straight down to one.

1982 saw the EBU specialists defining, prior to any further evaluation, the objective criteria upon which the choice should be made and they agreed to jointly conduct a laboratory and in addition a field test in Stockholm. Out of this evaluation, the Swedish PI system emerged as the winner and was then retained as the basis for further RDS development in the EBU. This PI system was already in use in Sweden, since 1978 for the operation of an FM data broadcasting paging system, called MBS.

Subsequently, an ad-hoc group was created to meet at the BBC Research Department with the task of fixing the baseband coding for all known applications that one had wished to cover with the unified FM radio data system.

The features thus coded were tested in a second field-trial in the area of Bern/Interlaken. Once the data were evaluated by the research laboratories involved, the RDS specification was drawn up in a final technical specification, called RDS, by the EBU specialists meeting in 1983 in Bern, Switzerland.

The European car radio manufacturers, who were consulted, were still quite concerned about the EBU's RDS system meeting the requirement for ARI compatibility, because that system had, since its introduction in 1974 been very successful in Germany, Austria, Switzerland and Luxembourg. The majority of all car radios sold in these countries were equipped for ARI functionality.

Other European countries were less interested and did not use ARI at all. Nevertheless, since RDS was designed to be compatible with ARI, the challenge of passing successfully a field trial to confirm that compatibility to those manufacturers putting it into doubt had to be taken. Of course, such a field trial had to be carried out in Germany, in an area of equally difficult mobile reception as the one encountered in the Bern/Interlaken area. Munich/Berchtesgaden was chosen for this field trial to take place in 1983 and RDS passed successfully this rather critical test.

As a consequence the RDS specification was then adopted by the EBU and EUROTECH in 1984, published and also submitted to the ITU and CCIR Study Group 10 (now ITU-R Study Group 6) in particular. This Study Group extracted the essential characteristics from the EBU specification and transcribed them to a new CCIR Recommendation 643 which was then adopted in 1986 and updated in the fourth version in 2022.

All the above shows clearly how RDS has emerged over the time and exactly within the years 1975-1984. In the retrospective of all said above, we saw in this 10 year long development appearing:

- The desire to universally identify each FM programme; this created the PI and PS features.
- The desire to identify broadcasts for motorists more universally than ARI; this created the TP and TA features.
- The desire to hand-over a mobile receiver within a network; this created the AF feature.
- The desire to identify programme type; this created the PTY feature.

A system was now designed for the mobile listener who had needed, without any doubt, much help with in-car reception of FM, for the various reasons already established by audience research; namely automatic retuning from one transmission coverage area to the next area and so on; and also, an emulation of the ARI system used in Austria, Germany, Luxembourg and Switzerland which alerted drivers to traffic announcements. Many other features were proposed and built into the RDS system to be dynamically multiplexed as needed in each transmission. The key mechanisms were designed for mobile reception and a group/block data structure to ensure very fast data synchronisation and decoding of certain features whilst allowing some features to be conveyed at a slow rate for general information.

The EBU Working Group that developed RDS, meeting at the BBC in 1991.

Since the system design was developed by broadcasters working in the well regulated environment of the 1970's, a number of features were considered, but not fully developed at that time. However their far reaching decisions to expect future enhancements has allowed RDS to mature over the following years; really a "silent revolution" for FM radio to establish itself as the main radio distribution medium, even under the challenges of digital radio, already with DAB around in 1993 and regretfully still not yet a full European market success when compared to FM/RDS radio.

In 1990 the EBU sent Johnny Beerling (BBC), Fritz Blaser (Swiss PTT), Dietmar Kopitz and Bev Marks (both EBU) to Singapore to first present RDS to Asian broadcasters.

In 1985, the receiver industry represented in EUROTECH agreed with the EBU the general introduction of RDS and promised, on the condition that the EBU would give their support towards the development of the RDS-TMC feature (see Chapter 7) that the first RDS receivers would be presented at the international consumer electronics show IFA'87 in Berlin. From 1988, these receivers would then be marketed in all those countries where RDS was already introduced.

Given the fact that the RDS development was so well co-ordinated by the EBU and broadcasters in all European countries were, through this activity, fully aware of the benefits created for their listeners (some said they could now "surf" the radio waves), the introduction of RDS, Europe-wide was quite fast. So fast, indeed, that some then called it the "silent revolution".

Broadcasters started to implement RDS transmissions, with a mixture of self- built RDS encoders and there was a beginning of a small specialised professional equipment market selling RDS encoders and associated RDS monitoring equipment. The earliest implementations were undertaken by some large network broadcasters and they selected just a few RDS features to start their trials and pre-service activities. Within a couple of years some problems had come to light as these initial transmissions began to give evidence that the original standard was somewhat lacking when "real world" situations were faced.

The first commercial RDS car radio on the European market was the Volvo SR-701 in 1987.

In 1988/9, when receivers were ready to conquer the European market, RDS was already on-air almost all over Western Europe.

EVOLUTION OF THE RDS STANDARDS

The first RDS "standard" was published in March 1984, titled: EBU Tech 3244: Specifications of the radio data system RDS for VHF/FM sound broadcasting, and it contained some 14 different RDS features.

It is very illuminating to realise how the publication of a very technical and specific niche standard (notice how it was called a "specification") can affect all of us, as consumers, for evermore. It is calculated that there were far over one billion FM/RDS receivers (the mobile phones with FM/RDS radio included) worldwide in the hands of consumers by the end of 2012 and a very high proportion of those used the abbreviations like AF, TP, TA, RT for example on their front panels or in their displays. Did the standards writers realise the impact their work would have? These abbreviations, we now live with, do not appear to be very user-friendly and most consumers have been subjected to them, not knowing their origins. This is indeed a lesson for all designers to consider very carefully for future broadcast systems: the laboratory quick fit naming solutions need careful consideration for long term user-friendliness. However, the RDS designers were indeed very far sighted technically as we shall observe later.

The Volvo car radio SR-701 designers Adeborn and Gudmandsen (RDS Project leader).

It is true to say, that up to 1984, not too many receiver designers had considered RDS because this standard came from the research laboratories of broadcasters and not from consumer receiver manufacturers. But that situation changed, and the commercial receiver companies soon realised the benefits that RDS had been designed for, to bring to the broadcasters' listeners and to their future customers. Within a year, development work was being undertaken in both Europe and elsewhere and the first RDS receiver came from a car company, Volvo, anxious to improve car-safety by the introduction of several automatic features which an RDS receiver could provide. Of course, almost all well-known commercial car receiver companies now produce RDS receivers and this came about because the broadcast sector was also committed to RDS and started to introduce RDS transmissions all across Europe.

Between 1984 and 1989 four supplements to the original specification were issued, covering Alternative Frequencies: Methods A and B; Radio Paging (RP); Programme Type Codes (PTY) definitions and Enhanced Other Networks (EON). With the perspective of that epoch there is no doubt that the EON development was a major change to the standard, that had come about from the joint efforts of broadcasters and receiver designers attempting to implement a system which allowed signalling from one radio programme network belonging to a broadcaster to another radio programme network of the same broadcaster. Experience had shown that the earlier ON mechanism of the original standard just did not work well enough and thus had to be abandoned.

After much thought, at an EBU meeting held in July 1987 and a number of subsequent meetings to distil the details, several new concepts were developed, also using EON, which could give a receiver a full "picture" of a broadcasters networks within a 2 minute interval. Then dynamic signalling could vector a receiver to specific services as needed, for example a travel bulletin could be received from another local transmission in the area of reception.

By common consent, BBC Radio agreed to become the field test site for the EON techniques and implemented EON then during 1988 with signalling associated to five local radio services and referenced by the BBC Radio networks. That trial was very successful and the UK became then a continuing test site for many RDS receiver designers from all over the world, who came to test their software implementations of EON for second generation RDS receivers (see also Chapter 6).

Over the years RDS has also attracted a number of different RDS encoder manufacturers and originally each chose a communications protocol for use between studio and transmitter site where the RDS encoders are installed, to achieve dynamic control of the transmitted RDS data. Initially this aspect of RDS escaped the standardised approach to RDS, perhaps because the manufacturers efficiently satisfied their client broadcasters and very few initially requested dynamic control of the RDS features. But gradually the need for features such as TA flag control and then the PTY feature and after all RadioText (RT/eRT and RT+/eRT+) which was increasingly implemented in RDS home receivers, car radios and mobile phones, have shown that broadcasters definitely needed dynamic control. What was even more common, because over time they have wished to purchase RDS encoders from several sources, was the need for a standardised encoder communication protocol, the UECP (see Chapter 4).

With significant development work going on in European industrial manufacturing companies, it became clear that a better recognised international standard would serve well to publicise the RDS system and to ensure consistent design activity in the diverse organisations now working on RDS products. So, in 1988 CENELEC, began in close cooperation with the EBU, to transcribe EBU Tech 3244 and its four supplements into a European standard, EN 50067. This was published in December 1990 and established at that time of the nineties the definitive standard for Europe.

EN 50067:1990 became the "solid rock" which the RDS system needed on both ends of the transmission chain, from a broadcaster's stand point, to ensure reliable transmissions, and from the RDS receiver designers point of view to ensure reliable reception. Both these parties required the RDS standard to link them together and give each the certainty that RDS would indeed give the radio user the assistance that RDS had promised nearly 10 years before.

So here was the first significant demonstration that the original development of the RDS specification had been given future proofing as the additional features, in the four supplements, could be added quite easily and allow continued development of both the transmission equipment and RDS receivers.

Nevertheless standards also require stability to allow development time and the issue of EN 50067:1990 with endorsement from both the broadcast and the manufacturing sectors, promised this then for the future. But, of course, Europe could not now keep RDS to itself. Already some broadcasters from other parts of the world had noticed what RDS could do. Notably broadcasters in two very diverse countries, Hong Kong and South Africa, started to negotiate for RDS technology. They were prepared to invest in RDS to eventually promote the technology to both their customers - the listeners - and to the RDS receiver suppliers. In the absence of a worldwide standard for RDS, they naturally opted for RDS implementations using EN 50067:1990, especially because the consumer manufacturers could only offer products manufactured for that standard. In both these cases the broadcasters had similar structures to those already found in Europe, so the RDS standard requirements fitted their networks well and virtually no adaptation was forced upon them.

If a standard has been well designed, then additions to it will offer enhancements that industry and consumer alike want. However, the timing of such enhancements has to be considered carefully to ensure that the revised standard does not destabilise the market place. Accordingly the EBU issued a proposal, SPB 482, which contained certain enhancements to EN 50067:1990, that were made to clarify to a greater level of detail certain coding issues which had become necessary. That work was ready for the next issue of the standard. This was to prove also valuable in the developments that were taking place in the USA. In effect, parallel discussion proceeded over the next 24 months or so and EN 50067:1992 was issued in April of that year. It just missed the work of another small EBU group who had developed PI codes and ECC proposals for the worldwide implementation of RDS and their output was published, in August 1992, by the EBU as SPB 485 (rev 1992) covering Allocation of country/area identification codes in RDS.

The revised text which was published in September 1996 by CENELEC and it was then prepared by the RDS Forum, created in 1993, with full involvement of experts from the EBU. Certain elements of text were revised to accord with experience gained with the RDS system and changes in broadcasting practice since the initial specification was published. An interesting example were the new clauses relating to the PS feature.

The most important enhancement was the Open Data Application ODA which was added as a new feature to permit a flexible extension of RDS to still undefined applications. Furthermore, cross-references were made to the CEN standards, defining the RDS-TMC feature.

Receivers produced to accord with the new specification were, of course, backwards compatible with RDS broadcasts which conform with previous editions of the RDS specification. This fundamental principle has also to be met until today.

Next came EN 50067:1998, but in the year 2000 RDS became a world standard of the IEC with the reference IEC 62106 ED.1.

In 2009 a new feature was added, RadioText Plus, and enhanced RadioText with an extended character set was specified. RT+ and eRT are both public ODAs.

In 2013 IEC 62634 ED.2 was published, defining methods of measurements for RDS receivers.

In October 2018 a totally re-structured version of the RDS standard was published as IEC 62106 -1 to -6. This included RDS2 which was developed by the RDS Forum since 2014.

RDS-TMC

In the mid-1980s, the EBU RDS experts were prompted by European car radio manufacturers, and EUROTECH in particular, to consider an RDS feature, that was quickly given the name: "Traffic Message Channel (TMC)". Indeed, by the time EN 50067:1992 was published, TMC had just the RDS group type 8A allocated. This feature was soon recognised by traffic management experts in Europe as a potentially very valuable feature, since it permitted the delivery of coded traffic messages which, in-car navigation systems could well interpret. This was a simple idea, but unfortunately many complex issues were associated with this feature and the European Commission of the EU had then funded much research into the development of this application.

In this process many new standards about messages, dictionaries for all the languages needed and their management were created. The coding of RDS-TMC has been undertaken by many workers co-ordinated by the EC projects. Field trials in the mid-1990s showed that RDS-TMC would work well, but significant infrastructure requirements were needed to implement RDS-TMC fully across Europe and by now this is all in place, to a large extent funded by those relevant EU projects.

The RDS-TMC standards, using the RDS ODA protocol, were published by ISO under the reference ISO 14819 (all parts). The body in charge of maintaining these specifications is now TISA in Brussels, coordinated by ERTICO. A kind of liaison still exists with the RDS Forum today.

For more details about RDS-TMC see Chapter 7.

RBDS

In 1990 discussions started in the USA under the auspices of the NAB and the EIA (now CTA) about standardising RDS for the USA, and the National Radio Systems Committee (NRSC) was asked to come up with the technical specifications,

In the USA the radio environment, most notably radio networks and relay transmitters or transposers, as they are called in America, are more infrequently found, quite different from Europe, so RDS clearly needed some adaptation. But the NRSC sub-committee, which had elected to call the American standard “Radio Broadcast Data System - RBDS”, realised that RDS would be more quickly implemented in the USA if core aspects of both systems were shared, because RDS knowledge, RDS encoders and RDS receivers were all readily available. Indeed the subcommittee that worked on RBDS standardisation even wished for as much harmonisation as they could achieve.

Apart from a few new features, the RBDS standard required special interpretation of two of the existing features. Firstly, the PI code structure of EN 50067:1990 was unsuited to the different regulation of radio stations in the USA where “call letters” are the only centralised data that can be relied upon. Thus a clever algorithm was developed to allow conversion of “call letters” into a unique PI code so that existing RDS encoders and RDS receivers could use this PI code without any problem. The reason for this approach was that one wanted to avoid the need for a federal organisation to be charged with administering PI codes for RBDS implementation. Secondly, the US specific programme format of radio stations needed a new list of PTY codes since PTY codes for Europe were quite inappropriate. Thus, a different set of PTY codes was developed for the USA. This was the other significant demonstration that RDS could, largely, be compatibly upgraded as time progressed and new ideas were required.

Generally it was thought that RDS receivers could now be used anywhere in the world provided the ECC feature was used to uniquely designate a country, because the original RDS specification had only considered countries that were members of the EBU and then expansion to the whole world had become a distinct necessity.

In the USA, the RBDS specification was first adopted in January 1993 as a voluntary national standard, jointly issued by the EIA (now CTA) and the NAB. As explained above, this standard included as its major component the RDS system, and European receivers could easily be modified for use in the USA. In the large majority of cases, they would even have worked well unmodified, especially with the five basic features PI, PS, AF, TP and TA.

Simultaneously, as the European RDS standard was upgraded in the years 1995-97, an upgraded RBDS specification was completed by the end of 1997 within the NRSC.

RBDS was then specified with the view to harmonize, to the largest extent possible, the RBDS specification with the RDS features specified in Europe.

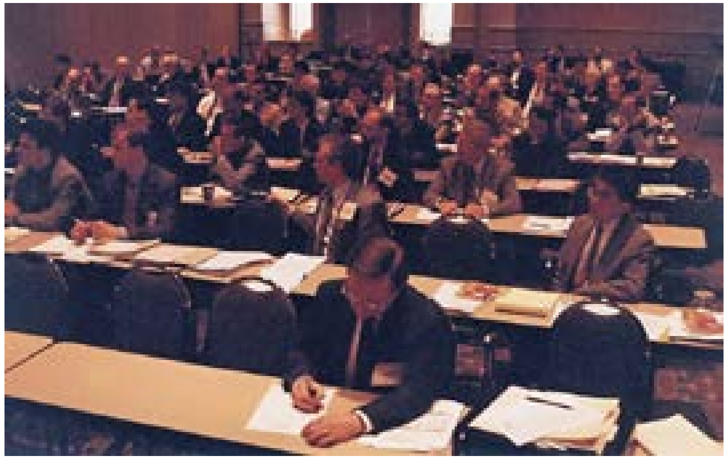
In the USA, since about 1995, RBDS is only the name for the American standard. When implemented in receivers, the system is called RDS, as indeed anywhere else in the world. RDS in the US is identified with the same logo as specified in the IEC standard, once developed for the EBU by the BBC.

RBDS promotion during the 1993 Chicago Consumer Electronics Show. From left to right: John Casey, who a little bit later became Chairman of the RDS Advisory Group USA (Denon Electronics) which was an RDS marketing activity started in April 1995 and sponsored by the EIA's Consumer Electronics Group (now CTA), Alan Haber (Radio World), Jerry LeBow (Sage Alerting Systems) and Dietmar Kopitz (EBU).

1993 - CES Chicago: Delco Electronics promoted RDS.
Note: RBDS is the name of the North American standard, but consumer products are marketed in the USA, as everywhere, under the name RDS.

1995 - The US company SPECIALIZED COMMUNICATIONS INC advertised these MusicBoards and RDS software to broadcast programming information, such as artist name, song title and news events for display on these “smart” billbords and RDS receivers with RadioText.

During the 1995 meeting of the RDS Forum in Philadelphia the board was demonstrated on Y100, Philadelphia’s New Rock music radio station 100.3 FM.



In 1995, to enhance the collaboration with the USA, the RDS Forum and the RDS Advisory Group USA met in Philadelphia.

The NRSC followed the updating process of the RDS standard with the help of the RDS Forum. The latest version of the RBDS standard had the reference NRSC-4-B, published in 2011, now retired. It contained only the differences with respect to the IEC standard 62106 and references to the IEC standard for all other details. In 2021 the RBDS specification was added to the IEC 62106 standard as Part 9.

The NRSC had up to October 2018 an RBDS Subcommittee that dealt with RDS issues in North America. Then this committee has been replaced with a new Data Services and Metadata Subcommittee (DSM). It has been given a wider scope: metadata used for radio using all its distribution media.

UECP

Under the auspices of the EBU, many major RDS encoder manufacturers have cooperated to develop the Universal Encoder Communications Protocol UECP, which since 1993 was updated by the RDS Forum. This protocol, now briefly called the "UECP", allows broadcasters to specify associated network servers and RDS control systems that uses a common data format which then enables easy installation with all existing RDS encoders.

In 2021 the UECP became part of the RDS standard IEC 62106 as Part 10. For this new version the UECP has been adapted by the RDS Forum to fully support RDS2.

RDS Guidelines

As long as standards are in use by the few people who helped develop them, then all is likely to be well, because they know what they intended when drafting the specifications. But once a wider group of users has a need for a standard, then the intentions, not fully or well specified, can be misunderstood or misinterpreted. Furthermore field experience of implementing standards tends to throw up many new issues.

Recognising a need for more information about RDS, in these circumstances, the EBU and later the RDS Forum published Guidelines for the implementation of the RDS system, which are intended to encapsulate the knowledge and the experience gained by the implementers on the transmission side as well as at the receivers' end.

Thus, with all the developments that have taken place over recent years, it was necessary to prepare a new edition of the RDS Guidelines document, version 5.1, and the RDS Forum undertook this work during the years 2010-2013. Now the RDS Forum constantly updates the RDS Guidelines and makes them freely available for downloading from its web site.

For RBDS in North America specific Guidelines exist as well. They can be downloaded for free from web site of the NRSC: www.nrscstandards.org

RDS FORUM - a world-wide association of RDS users

The RDS Forum was formed in 1993 as a self-funded non-profit organization to represent the interests of consumer electronics manufacturers and broadcast service providers, and to foster and develop the best practice and implementation of the Radio Data System.

The RDS Forum provides the mechanism whereby many experts share their knowledge about the RDS system through occasional and regular meetings, the medium of the internet and by the distribution of an extensive annual electronic document collection.

In the last ten years the RDS Forum has proved its worth many times over by:

- drafting and maintaining the worldwide IEC RDS standard updated as from 2018 with the new features RT+ and eRT added in 2009 (in 2021 being updated again);
- developing a new IEC standard 62634 of 2011 to measure the RDS performance of receivers;
- writing detailed RDS guidelines to show users how RDS should be best implemented and how the transition to digital radio can be handled by mobile receivers;
- advising how to best implement all the RDS features and how to test them with existing and new receivers;
- showing how to compatibly extend the limit of the RDS data transmission capacity by adding RDS2;
- showing how to add hybrid radio enhancements;
- with RDS2 service following of IP radio streams with the same audio content as on FM;
- with RDS2 transmitting the station logo and visual information as a slideshow that can be fully synchronized with music items to show their cover art;
- updating the Universal Encoder Communication Protocol for broadcast service providers (UECP) that ensures connectivity with the transmitter network, permitting the use of RDS encoders from different manufacturers within the same transmitter network.

Furthermore the RDS Forum is in a strong position of knowledge to resist any unjustified patent claims that may arise. By the way, the RDS specifications are and remain an open technology, even with RDS2.

The RDS Forum continues an ongoing vital development role, running the Open Data Applications (ODA) registrations office (except for North America where the NAB assumes this task) required to register new applications within RDS/RDS2 and secure their compatibility with the standardised RDS features.

The RDS Forum maintains a comprehensive website too. This ensures that worldwide interests are well informed and kept up to date on all developments.

The RDS Forum meeting in Glion in June 2017. This venue, Hotel Victoria, above Montreux in Switzerland,, was used for annual meetings for 20 years since 1999.

SangWoon Lee explains that in Korea the market potential of RDS2 is explored within a national research project. One of the objectives is to develop an IC for RDS2. Car maker Hyundai is part of that project.

30 years after the creation of the RDS Forum in 1993 its 35th meeting was held in 2024 at Geneva, Switzerland.

www.rdsforum.org

The RDS Forum has been an enormous success; RDS is now widely implemented with well over several billion RDS radios in use worldwide.

Long Programme Service name (LPS) was added in 2018 to be coded in UTF-8 and maximal 32 bytes, sufficient for most languages worldwide.

In the nineties the prediction was made that DAB technology would replace FM soon. However, now we see that the reality is completely different. The RDS Forum believes that FM radio has its firm position next to radio over IP and DAB and in addition is only a transitional technology. FM/RDS radio was also increasingly used since more than 10 years in mobile phones, but nowadays less as mobile operators prefer radio over IP instead of FM. A technical drawback of FM is that it requires an antenna, which was initially the wire of the headphone, but nowadays smartphone users changed to wireless headphones.

The RDS Forum spent a lot of time in considering service following with switching forth and back between FM/RDS and DAB for mobile reception with car radios.

Using the RDS/RT+ feature it is increasingly popular for broadcasting music items to provide 'titles' and 'artist' information over RadioText, in both, Europe and the USA.

New markets and broadcasters are constantly emerging with a need to develop RDS for their own use.

The RDS Forum has recently recognised the need to address displays for non-Latin characters. Enhanced RadioText (eRT) was designed specifically for the countries using non-Latin characters, so that all their languages and character sets can be supported using UTF-8 character coding.

A key role of the RDS Forum is to safeguard a proper implementation in order to avoid problems like:

- unregistered ODA Applications;
- non-conforming PI codes causing chaotic receiver performance, producing undesirable effects outside national borders;
- wrong injection levels causing widespread interference in receivers;
- Radio Text and Radio Text Plus delivered incompatibly with receiver display ability;
- FM-RDS/DAB tuners randomly switching between radio programmes;
- wrong support for multi-standard radio programme service following, very important for car radios travelling large distances.

These sort of problems will only grow without the authority of the RDS Forum monitoring, and where possible, the RDS Forum will give support for correcting such errors and help to maintain a proper implementation of the RDS standard.

The operational expenses of the association are shared among all those interested to join it.

Over 40 years of RDS development and maintenance work

The years up to 1992 before the RDS Forum existed

1975	Pre-development start within EBU
1980	First field trial at Bern/Interlaken, Switzerland
1982	Test to choose modulation system for RDS in Stockholm, Sweden RDS baseband coding agreed at BBC Research Centre, Kingswood Warren, UK Second Field Trial at Bern/Interlaken
1984	First presentation of RDS at the SAE Convention in Detroit, USA Ford starts RDS car radio development at Detroit First RDS Specification EBU 3244 published
1985	Large scale pre-operational broadcasting trial in Germany EBU recommends RDS introduction Industry/Broadcasters agree first receivers maket launch for IFA Berlin 1987
1986	First presentation of RDS at NAB Dallas, USA RDS CCIR Recommendation 643_1 published by ITU-R
1987	Ireland, France and Sweden introduce RDS First RDS receivers shown at IFA Berlin, Germany Volvo markets the World's first RDS Car Radio
1988	Austria , Belgium, Denmark, Germany, Italy and United Kingdom introduce RDS Blaupunkt, Grundig and Philips mass produce RDS car radios
1989	Presentation of RDS in Washington DC and NAB Las Vegas, with test cars from Ford
1990	Norway, Netherlands, Portugal and Switzerland introduce RDS First presentation of RDS at BroadcastAsia at Singapore and in South Africa CENELEC adopts RDS as the European Standard EN 50067
1991	First RDS-EON receivers shown at IFA Berlin First presentation of RDS in China RDS presentation at New Orleans to US Public Radio Hong Kong introduces RDS
1992	New version of CENELEC RDS Standard published South Africa introduces RDS USA: NRSC RBDS standard completed ...

	... over 40 years of RDS development and maintenance work The years since the RDS Forum exists
1993	RDS Forum created . First meeting at EBU in Geneva. Grundig presents at IFA Berlin first portable RDS receiver. Second RDS Forum meeting at ARD/SDR in Stuttgart
1994	European Commission recommends RDS-TMC for Trans-European Road network First version of Universal Encoder Communication Protocol published by EBU
1995	RDS Paging Association created EIA activates RDS promotion in USA First RDS Forum meeting in the USA together with the RDS Advisory Group USA
1996	RDS Forum enhances RDS CENELEC standard NRSC in the USA agrees with RDS Forum to harmonize RBDS and RDS
1997	New NRSC RBDS US voluntary standard published UECP enhanced to conform with new RDS CENELEC standard Germany - First country to introduce RDS-TMC
1998	New RDS CENELEC standard version published First RDS-TMC pre-standard published by CEN
2000	New RDS world standard IEC 62106 ed1 (replaces European standard CENELEC EN 50067) FM/RDS receiver chip market much expands because of usage in many mobile phones
2003	RDS-TMC standard ISO 14819 published
2008	New RDS features RT+ and eRT specifications agreed by RDS Forum
2009	IEC RDS standard 62106 ed2 published (new features RT+ and eRT and revised character tables) Kenwood RBDS car radios with RT+ feature Apple iPod nano 5G with first FM/RDS radio and RT+ feature
2010	Fully updated UECP version 7 published by RDS Forum to conform with IEC 62106 ed2 Nokia phones (N8, E7, C7 and C6) with FM/RDS radio and RT+
2011	New RDS receiver measurement standard IEC 62634 published New version of RBDS standard NRSC-4-B published New version of ITU Rec 643-3 published to conform with IEC 62106 ed2 FM/RDS receiver chip market exceeds annual production of 1 billion FM/RDS receiver ICs
2012	RDS Guidelines (version 5.1) updated by RDS Forum (to support transition to digital radio)
2014	RDS experts meet in Budapest and recommend to RDS Forum to go ahead with RDS2
2015-16	First RDS2 Info Day meeting 2015 in Berlin; Second RDS2 Info Day 2016 in Paris at Radio France
2018	IEC publishes the re-structured RDS standard IEC 62106-1 to -6 which includes the RDS2 option
2021	The RDS standard IEC 62106 is updated again to include RBDS, the UECP and the RFT for RDS2
2022	ITU-R published Recommendation BS.643-4 on RDS and RDS2.
2023	IEC 62106-6 ED.2 published with RDS2 ODAs for Station logo, Slideshow and Internet connection

RDS2 milestone creators








Upper row from left to right: Attila Ladanyi motivated the RDS Forum to launch the RDS2 development process, Hendrik van der Ploeg (NXP - NL) created the first RDS2 decoder using a modified NXP chip set, late (passed away 12/2023) Joop Beunders (MacBe - NL) used this chip set and created the RX014 first RDS/RDS2 data analyser, Allen Hartle together with Seth Stroh (both Jump2Go - USA) created the first RDS2 encoder. **Lower row from left to right:** Seth Stroh, Olivier Soulié (WorldCast Systems - FR) helped to adapt the UECP for RDS2. Vincent Simonacci (Radio France) and David Jaillet (Caméon/Biyotee - FR) created the first live demo at the Salon de la Radio 2019 for the FIP radio programme in Paris with music cover art images distributed via RDS2 on FM radio.

RDS2 milestones

2014: The RDS Forum meeting in Glion decides to examine the feasibility of RDS2, delegating this task to a small group of RDS experts. A workshop in Budapest is held a few months later to examine this.

2015: Following the Budapest workshop recommendations the RDS Forum decides RDS2 development. First RDS2 Info Day in Berlin: Presentation of first RDS/RDS2 encoder by Jump2Go and USB RDS/RDS2 RX014 data analyser by MacBe.

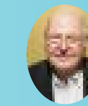
2016: RDS Forum submits to the IEC the draft for newly re-structured RDS/RDS2 standard. This contains a number of enhancements such as the UTF-8 character coding for eRT and LPS which is entirely new. Also, many unused RDS features were deleted from the RDS standard. Second RDS2 Info Day in Paris - Presentation of RDS2 image transfers at Radio France. WorldCast Systems presents an RDS/RDS2 analyser

2018: At NAB Show in Las Vegas - WorldCast Systems presents the first commercially available RDS/RDS2 encoder. RDS2 file transfer protocol RFT specification is published in October. Updated RDS IEC standard 62106:2018 Parts 1 to 6 are published. Radio France demonstrates the RFT implementation, transmitting and receiving files with station logo and music cover art.

2019: At the Salon de la Radio 2019 Radio France and Caméon together with Worldcast Systems presented new possibilities for transmitting the station logo and music cover art by means of the new RDS2 file transfer protocol. The RDS Forum completes the RDS standard development for Parts 9 (RBDS) and 10 (UECP) and integrates the RDS2 file transfer protocol RFT in a new version of Part 2. All three RDS standard drafts are submitted to the IEC for standardization. WorldCast Systems launches its new Audemat RDS/RDS2 encoder on the market; it replaces the previous Audemat RDS encoder model, fully compatible.

2020: The RDS Forum holds a workshop in Paris to examine ODAs for RDS2 to transmit station logos, music cover art and images with or without text, as well as linking FM radio to the same radio programme on Internet to enhance service following. At the Salon de la Radio 2020 the RDS2 development is presented by some RDS Forum members in a public workshop.

RDS on the basic subcarrier - What is it all about ? by Dietmar Kopitz



This Chapter gives a detailed overview about RDS and RBDS. It provides much of the necessary background that will help to better understand the details given in later chapters about RDS and RDS2 and their implementation options.

RadioText Plus is used in more recent car receivers that display for RTmusic items the title and the artist's name. BMW has such a product.

OBJECTIVES TO BE ACHIEVED WITH RDS

The Radio Data System, RDS, offers broadcasters a flexible data-transmission channel accompanying VHF/FM sound broadcasts. Additionally, RDS offers the possibility for data service providers to introduce new data services. Thus, RDS can accommodate a wide range of possible implementation options. Optional RDS2 with the three additional subcarriers extends these possibilities.

Following a long period of system development in the 1970s and early 1980s, and field trials in several European countries, RDS is now implemented in over 50 countries worldwide, in Europe, in some Asia Pacific region countries, South Africa, Latin America and in North America (USA, Canada and Mexico, using RBDS).

SYSTEM CHARACTERISTICS

RDS development had started with a number of functional requirements to be fulfilled. These were:

- The radio data signals must be compatible; they must not cause interference to the reception of sound programme signals on existing receivers.

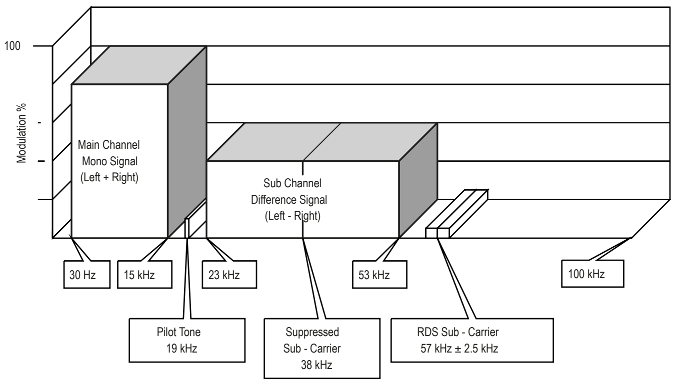
- The data signals must be capable of being reliably received within a coverage area as great as that of the monophonic main programme signal.

- The usable data rate provided by the basic 57 kHz data channel should support the requirements of station and programme identification and provide scope for future developments.

- The message format should be flexible to allow the message content to be tailored to meet the needs of individual broadcasters at any given time.

- The system should be capable of being reliably received on low-cost receivers.

These requirements have significantly influenced the choice of the modulation parameters and the baseband coding characteristics.



Spectrum of a pilot-tone stereo multiplex with the basic RDS data stream using the 57 kHz subcarrier.

The multiplex spectrum of a stereophonic FM broadcast signal comprises the small signal level RDS signal, centred around the 57 kHz subcarrier which is the third harmonic of the 19 kHz pilot-tone of the stereophonic modulation system. This choice of the subcarrier was critical for meeting the requirement to minimize data signal interference to the audio channels for existing receivers. The other parameter that is critical to achieve the same goal is the injection level of the data. The higher it is, the more rugged is the data service but under multipath conditions the interference to the audio channels will also increase. It was found in field trials that a minimum was ±1 kHz and a reasonable operational choice was ±2 kHz. At these levels there is usually virtually no interference from the data channel detectable during radio listening.

The use of the biphase coded data signal also helps compatibility with the audio programme signal because coherent components at around 57 kHz were found to introduce data-modulated crosstalk in receivers that used a phase-locked loop (PLL) stereo decoder.

The bit rate of the basic RDS 57 kHz subcarrier data stream is 1187.5 bits/s (1187.5 = 57’000 / 48) which, with biphase coding and the specified 100 % cosine roll-off filtering, gives an overall bandwidth for the data signal of approximately 5 kHz, centred on 57 kHz.

Choice of baseband coding

Multipath, in an FM system, produces distortion of the demodulated signal. The distortion components resulting from the relatively large amplitude sound programme signal components can easily swamp the data signal. When a vehicle moves along a road characterized by multipath interference, the quality of the received FM signal varies rapidly. At some moments, the demodulated audio programme is distorted; at others, it is completely broken up. The very important lesson learned from the 1980 and 1982 field trials in the Bern/Interlaken area was that reliable mobile reception is only possible when the radio data message stream is broken up into small independent entities (the RDS groups of 104 bits), each of which can be received, decoded and applied independently of other parts of the data stream. This factor was crucial to the basic design of the RDS system and must be clearly understood for the design of new applications within RDS, such as those that can be carried within the ODA feature.

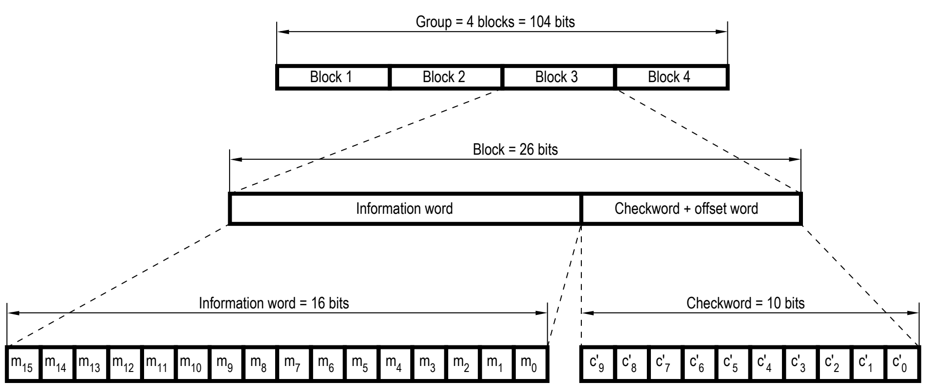
As with many other serial data transmission systems designed for mobile communications, the data stream in RDS had to be partitioned into data groups and blocks. The groups consist of four blocks, each being 26 bits long. The group thus consists of 104 bits. One block consists of a 16 bit/2 byte long information word and a 10 bit CRC checkword to which is added an offset word that creates the flywheel synchronisation mechanism that makes RDS so rugged under severe multipath receiving conditions.

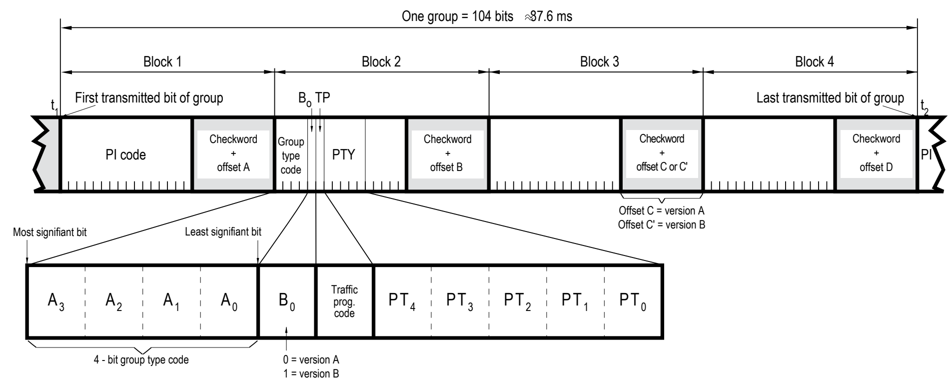
Message format and addressing

The RDS coding is structured so that the messages to be repeated most frequently and which need a short acquisition time, normally occupy the same fixed positions within a group. This allows decoding without reference to any block outside that containing the information. The first block of each group always contains a Programme Identification (PI) code; the Programme Type (PTY) code and the Traffic Programme (TP) flag occupying fixed positions in bock 2 of every group.

The group type code is specified by a 4-bit code which defines the group type (from 0 to 15). This code is sent in the first four bits of the second block of every group. In addition, the fifth bit of this block defines the "version" (A or B) of the group type. In version A groups the PI code is inserted in block 1 only. In version B, the PI code is inserted in block 1 and 3.

Groups are, in general, reserved for a particular application or message type, e.g. RadioText, Clock Time and Date, Long PS, etc.





The above two figures explain the coding of the message format and the group addressing on the basic subcarrier 0.

APPLICATIONS OF RDS

The Radio Data System permits some 20 functions to be implemented. The eight most important ones (also called the basic RDS features) are implemented everywhere and are intended primarily to be used in the mobile reception mode with car radios having automated tuning functions:

- Programme Identification (PI) - a 16-bit code containing a country symbol, a regional code, and a number permitting the identification of the broadcaster and the particular programed.

- Programme Service name (PS) - comprising eight alphanumeric characters from an uppercase and lower-case basic character set, and serving to give the listener information about the name of the programme, e.g. "Radio 1".

- RadioText (RT and RT+) - 64 characters of text for display by receivers.

- Alternative Frequency (AF) lists - one or more lists can be transmitted, each containing a maximum of 25 frequencies (represented by the corresponding Band II channel numbers) of transmitters or rebroadcast transmitters relaying the same programme audio content.

If the programme will contain announcements about local and/or regional traffic situations, the following features should be used to identify this:

- Traffic Programme (TP) code - serving to identify programmes which, from time to time, carry messages addressed to motorists.

- Traffic Announcement (TA) signal - switches a traffic announcement to a pre-set volume level and, if the motorist is listening to an external audio source rather than the radio, TA stops the external audio playback and switches the radio on to receive the traffic message instead, and after the announcement it goes back to the playback audio mode.

- Enhanced Other Networks Information (EON) - RDS information relating to other broadcast services. The information includes the PI, AF for quick retuning to the radio programme-service referenced and TP, TA, and PTY of this service.

- Clock Time and date (CT) - a code, usually originated from standard time transmissions, to enable receivers to display the current time and date.

Most of the following other features are optional:

- Decoder Information (DI) - indicates whether the PTY is dynamic or not.

- Programme TYpe (PTY) - an identification code to be transmitted with each programed item and which is intended to specify the current Programme Type within 31 possibilities. This code can be used for search tuning and alarm messages.

- Enhanced RadioText (eRT) - Using the UTF-8 character coding method optimized to suit all countries not using Latin based characters such as Greek, Arab, Cyrillic, Korean, Chinese, etc.

A powerfull and very universal feature is the ODA

The ODA - Open Data Application - permits new applications to be designed and implemented in still available data groups with an Application Identification (AID) registration using the ODA registration service from the RDS Forum or the NAB. Interesting ODA examples are RDS-TMC, RT Plus and eRT. Using preferably the optional upper subcarriers for RDS2, the ODA feature offers a lot more development options, most of which will come up in the near future and offer more metada and images to enhance the listener experience with FM receivers using a graphical display like smart phones or many car radios with DAB or HD radio already do.

DATA CAPACITY IMPACT ON APPLICATIONS

Attention is drawn to the fact that the RDS data transmission capacity is rather limited, specifically on the basic subcarrier of 57 kHz. On each of the subcarriers the system can accommodate only 11.4 data groups per second. On the basic subcarrier of 57 kHz this corresponds to only 673 usable information bits per second. This takes into account that each information word contains 16 bits per block and that a data group has five address bits that are used for the group type identification.

With RDS2 on the upper subcarriers there is more data capacity available since those RDS features used for automatic tuning are used only on the basic subcarrier. Also, there is only one group type C that can carry seven data bytes. Refer to Chapters 8 and 9 for more details about RDS2.

SYSTEM PERFORMANCE AND RELIABILITY

Field tests carried out by a number of broadcasters' research laboratories all came to the same conclusions.

One of the methods used to investigate the reliability of the RDS channel for the transmission of real applications, such as PI and PS which are very important for the operation of the automated tuning function of an RDS receiver, is to measure the "waiting time" between successful acquisitions of a particular RDS message.

Relatively low RDS data injection levels, say ±1 kHz, offer a reliable data system only under receiving conditions with little or no multipath effects (typically towns with flat buildings and flat countryside). In a moving receiver, once multipath effects occur due to reflections of the transmitted signal caused by high-rise buildings or mountains, there is a sharp decrease of the reliability for a correct reception of the applications. All depends at the end of whether the data are sufficiently often repeated in the data stream. In ODA applications, additional CRC checkwords may also be considered to better protect the data transmission application that one wants to implement.

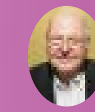
Studies usually confirm the ruggedness of the fixed format PI codes compared for example with the PS code. Therefore often consumer receivers store the PS name, displaying the stored name once the PI code is received. Therefore the use of the PS name to convey, for example, some limited dynamic text information composed of scrolling text or short words of at maximum eight characters to the radio listener cannot be recommended and according the the RDS standard IEC 62106 shall not be used, but in RBDS it is permitted. In reality it is used here and there in Europe and the least worse case is then a time shared mode.

Repetition of message elements transmitted within RDS is a general requirement. This is needed, for example, for PS and TMC messages, but to a lesser degree to RadioText, where the occasional reception of some wrong characters will be perceived as less annoying to the reader.

Error detection has to be applied to all messages and error correction can only be applied to some applications, as for example, RadioText, i.e. when an error caused exceptionally by the correction system is not perceived as being critical.

Chapter 3

The RDS features in detail by Dietmar Kopitz



This Chapter describes the RDS features in a general manner.

AFs	**A**lternative **F**requencies list
CI	**C**ountry **I**dentifier
CT	**C**lock **T**ime and date
DI	**D**ecoder **I**dentification for dynamic PTY indicator
ECC	**E**xtended **C**ountry **C**ode
EON	**E**nhanced **O**ther **N**etworks information
eRT	**e**nhanced **R**adio**T**ext
EWS	**E**mergency **W**arning **S**ystem
ODA	**O**pen **D**ata **A**pplication
PI	**P**rogramme **I**dentification
PIN	**P**rogramme **I**tem **N**umber
PS	**P**rogramme **S**ervice name
LPS	**L**ong **P**rogramme **S**ervice name
PTY	**P**rogramme **TY**pe
PTYN	**P**rogramme **TY**pe **N**ame
RT	**R**adio**T**ext
RT+	**R**adio**T**ext **Plus**
TA	**T**raffic **A**nnouncement flag
TMC	**T**raffic **M**essage **C**hannel
TP	**T**raffic **P**rogramme flag

DESCRIPTION OF THE RDS FEATURES

Alternative Frequencies list (AF)

The list(s) of alternative frequencies give information on the various transmitters broadcasting the same programme in the same or adjacent reception areas, and enable receivers equipped with a memory to store the list(s), to reduce the time for switching to another transmitter. This facility is particularly useful in the case of car and portable radios. In the Netherlands, for example, a programme can be received in the entire country, and although the Netherlands are not very big, this cannot be accomplished by just one large transmitter. Therefore 13 AFs are present in the RDS AF list giving the frequencies of all 13 transmitters which broadcast this same radio programme. A car radio will check at intervals all 13 AFs and when one looks to yield a better receiption quality, the radio will switch to that frequency. Before staying there it will look at the PI code as both PI codes should match exactly. When a match is found the radio will stay on the new frequency and checking continues. The first time a PI code is being checked the mute will be activated because it also could be a different station altogether and the listener would all of a sudden hear a different audio. When the PI code is verified, subsequent switches will be made without activating the mute function. Different PI codes on frequencies from the AF list are often found in border areas.

Clock Time and date (CT)

Time and date codes shall use Coordinated Universal Time (UTC) and Modified Julian Day (MJD). Details of using these codes, which are intended to update a free running clock in a receiver, are explained in the RDS standard. If MJD = 0, the receiver's clock shall not be updated. The listener, however, will not use this information directly and the conversion to local time and date will be made in the receiver's circuitry. CT is used as time stamp by various RDS applications and thus it must be accurate.

Decoder Identification (DI) and dynamic PTY Indicator (PTYI)

These bits indicate if PTY codes are switched dynamically.

Extended Country Code (ECC)

RDS uses its own country codes. The first most significant bits of the PI code carry this RDS country code. The four bit coding structure only permits the definition of 15 different codes, 0x1 to 0xF. Since there are many more countries to be identified, some countries have to share the same code which does not permit a unique identification. Hence, there is the need to use the Extended Country Code which is transmitted in Variant 0 of Block 3 in type 1A groups and together with the country identification in bits b_{15} to b_{12} of the PI code render a unique combination. The ECC consists of eight bits. DAB uses the same coding, but the codes are not always identical with those used by RDS,

Enhanced Other Networks information (EON)

This feature can be used to update the information stored in a receiver about programme services other than the one received. Alternative frequencies, the PS name, Traffic Programme and Traffic Announcement identification as well as Programme Type can be transmitted for each other service. The relation to the corresponding programme is established by means of the PI for the referenced programme. Linkage information, consisting of four data elements, provides the means by which several programme services may be treated by the receiver as a single service during times when a common programme is carried. Linkage information also provides a mechanism to signal an extended set of related services.

Emergency Warning System (EWS)

Nowadays EWS shall be implemented as an ODA.

The EWS feature is intended to provide for the coding of warning messages. These messages will be broadcast only in cases of emergency and will only be evaluated by special receivers. This function is for example implemented in France and in Sweden. It is also used in the USA. All these systems are different due to national requirements. For this reason, the RDS standard does not yet include their specification.

In House application (IH)

Nowadays IH shall be implemented as an ODA. This refers to data to be decoded only by the broadcarer or the transmission operator. Some examples noted are identification of transmission origin and remote switching of networks.

Open Data Applications (ODA)

Open Data Applications are a very effective and flexible way for adding additional applications to an RDS service. A number of different ODAs may exist on any service, subject to capacity. ODAs may be transmitted constantly, or only when required (e.g. an application which provides an alert in the case of extreme weather, or switching alarm sirens on and off, or with utility management switching electric water heaters on and off depending on electricity power tarrifs etc.). The Open Data Application feature is conveyed in an allocated group within an RDS transmission. On the basic subcarrier 57 kHz the group allocated is indicated by the use of group type 3A which is used to signal to a receiver the data application identification code AID of 16 bits in accordance with the registration details in the Open Data Applications Directory and as specified in the RDS standard IEC 62106-3. The ODA implementation with RDS2 on the upper subcarriers is similar, but then the different group structure C is used, which opens up enhanced possibilities to use the ODA concept. For more details on RDS2 refer to chapters 8 and 9.

Programme Identification (PI)

The Programme Identification (PI) is a code enabling the receiver to distinguish between audio programme content. The most important application of the PI code is to enable the receiver in the event of bad reception, to switch automatically from the currently tuned frequency to an alternative frequency – the criterion for the change-over to the new frequency would be the presence of a better signal having the same Programme Identification code or if Regionalisation is used a regional variant of it. It follows therefore that the PI must be allocated in such a way that it uniquely distinguishes each audio programmme content from all others in the same area.

The actual value of the PI code is largely unimportant as it is not intended for direct display. Of importance, however, is that a methodology exists within a broadcast area (i.e. a continent), to ensure uniqueness of PI code allocations to programme services.

In Europe for example, the ‘pool’ of the theoretical 65536 unique values have been allocated firstly at international level, and thereafter at national and regional levels for allocation by the appropriate regulator authorities. Hence, there is a structure to PI code allocations in Europe.

North America with RBDS uses a different approach.

The primary purpose of the PI code is to facilitate automatic tuning between different transmitters all carrying the same audio content, the physical location of the transmitter itself is immaterial in determining the PI code. It is the location of the origin of the audio programme which decides the value of the PI code to be used. Hence, transmitters broadcasting an international programme originating in one country and being relayed by transmitters in other countries would carry the same PI code, regardless of their locations, or otherwise automatic tuning between transmitters cannot occur. Additionally, as the relay transmitter will relay the RDS data, as well as the audio content, it is obvious that the PI code allocated to the transmitter at the ‘head’ of the chain of transmitters will simply be re-broadcast by all transmitters in the relay chain. As the PI has a unique value in each area, it may be thought of as a ‘primary key’ to which all other RDS parameters about a particular service are referenced. For this reason, on the basic subcarrier the PI code appears in every RDS group type, and when referring to other services as done in EON.

Short-range transmitting devices connected to audio sources, when additionally using RDS features, require also the use of a specific PI code.

Programme Service name (PS)

This is the label of the programme service consisting of not more than eight alphanumeric characters coded with a special RDS character set, specified in IEC 62106-4 and displayed by RDS receivers in order to inform the listener what programme service is being broadcast by the station to which the receiver is tuned. An example for a name is 'Radio 21'. The Programme Service name is not intended to be used for automatic search tuning and except for RBDS is not not be used for giving sequential information for which RT and eRT shall be used.

Long Programme Service name (LPS)

The Long PS, using group type 15A, is an alternative to the PS. It allows use of more than eight characters (up to 32 bytes of UTF-8 coded characters). As UTF-8 coding is supported, the range of languages covered is increased. For backwards compatibility with existing RDS receivers, the PS shall also be transmitted using group type 0A or 0B. The use of LPS to transmit text other than the static Programme Service name is not permitted. RT or eRT shall be used for other programme-related information. The Long PS is complementary information to the PS and it may be used to replace the PS on a display. While the acquisition of the PS is time critical, the acquisition of the Long PS is not. The Long Programme Service name is STATIC, identifying the name of the radio programme or station. If less than 32 bytes are to be sent, then the LPS shall be terminated with control character 0x0D. All bytes following the control character shall be ignored by the receiver.

Programme TYpe (PTY)

This is an identification number to be transmitted with each programme item and which is intended to specify the current Programme Type within 31 possibilities. This code could be used for search tuning. The code will, moreover, enable suitable receivers and recorders to be pre-set to respond only to programme items of the desired type. The last number, i.e. 31, is reserved for an alarm identification which is intended to switch on the audio signal when a receiver is operated in a waiting reception mode. RDS and RBDS use different code tables.

Programme TYpe Name (PTYN)

The PTYN feature is used to further describe current PTY. PTYN permits the display of a more specific PTY description that the broadcaster can freely decide (e.g. PTY=4: Sport and PTYN: Football). The PTYN is not intended to change the default eight characters of PTY which will be used during search or wait modes, but only to show in detail the programme type, once tuned to a programme. If the broadcaster is satisfied with a default PTY name, it is not necessary to use additional data capacity for PTYN. The Programme Type Name is not intended to be used for automatic PTY selection and must not be used for giving sequential information.

RadioText (RT)
This refers to text transmissions coded in accordance with the *basic RDS character set* and addressed to receivers, which are equipped with suitable display facilities. The maximal text length is 64 characters. Text elements can be tagged with RT+.

Enhanced RadioText (eRT)
This is an enhanced RadioText alternative to enable text transmissions that are UTF-8 coded and addressed to receivers, which are equipped with suitable display facilities. eRT uses an ODA and is backwards compatible with old receivers incapable of response to using this feature.

RadioText Plus (RT+)
This allows to tag specific elements of RadioText and permits, among many other possibilities, to improve the presentation on a display for RT or eRT. This way of presenting, for example, music titles and artist names is more user friendly then scrolling the same information through a display, as it is often done with RT. Presenting the tagged items on separate lines permits the listener to read the information at a glance and in cars this is important as the driver should is not distracted. The tagged RadioText elements can also be stored as a list that could be searched by the end user, for example when an FM/RDS radio is implemented within a mobile phone. A popular application also is to list the radio programme's home page web address so that a smart phone could automatically bring it up on the display and permit the listener to browse for complementary background information or the programme being listened to. RT+ is an ODA and is thus backwards compatible with old receivers not using this feature.

Traffic Announcement identification (TA)
This is an on/off switching signal to indicate when a traffic announcement is on air. The signal could be used in receivers to

- switch automatically from any audio mode to the traffic announcement;
- switch on the traffic announcement automatically when the receiver is in a waiting reception mode and the audio signal is muted;
- switch from a programme to another one carrying a traffic announcement.

After the end of the traffic announcement the initial operating mode will be restored.

Traffic Message Channel (TMC)
This feature is intended to be used for the coded transmission of traffic information. The coding for TMC is separately specified in the ISO 14819 series. It is an ODA. The feature can be open or encrypted for conditional access.

Traffic Programme identification (TP)
This is a flag to indicate that the tuned programme carries traffic announcements. The TP flag must only be set on programmes which dynamically switch on the TA identification during traffic announcements. The signal shall be taken into account during automatic search tuning.

The new RDS standard edition IEC 62106:2018/2023 includes the following significant technical changes with respect to the previous version IEC 62106:2015:

- The standard has been totally re-structured:

  Part 1: RDS system overview: Modulation characteristics and baseband coding
  Part 2: RDS message format: Coding and definition of RDS features
  Part 3: Coding of Open Data Applications
  Part 4: Registered code tables
  Part 5: Marking of RDS1 and RDS2 devices
  Part 6: Compilation of technical specifications for Open Data Applications in the public domain
  Part 9: RBDS
  Part 10: Universal Encoder Communication Protocol - UECP (with support for RDS2)
- Provision has been made to carry RDS on optional multiple data-streams (RDS2).
- Data in the additional data-streams is using a newly defined group type C data structure.
- AF coding below 87.6 MHz (down to 64.1 MHz) can use ODA-AID 0x6365 (see IEC 62106-6).
- Long PS (UTF-8) support has been added using group type 15A (see IEC 62106-2).
- Coding for EWS, TDC, IH and RP. is no longer detailed in the RDS standard as these can use in future the ODA concept.
- Translated PTY terms for 20 languages were added (see IEC 62106-4).
- New are receiver profiles, conformity requirements, certification and compliance test (see IEC 62106-5).
- Obsolete and no longer part of the RDS standard are: MS (Group 0A, 0B and 15B) certain DI codes (mono/stereo, artificial head, compression), Language code, and PIN (Group 1A).
- In 2021 Part 2 was issued as Edition 2: It contains a specification RFT for RDS2 file transfer.
- In 2023 IEC 62106-6 ED.2 for RDS2 the ODAs for Station logo, Slideshow and Internet connection were added.

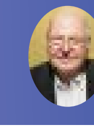
Summary of all eight Parts of the RDS standard IEC 62106

Part 1 (2018) : This document defines the RF modulation characteristics of the RDS system with legacy RDS using only the 57 kHz subcarrier and the optional three upper subcarriers for RDS2, all intended for application to VHF/FM sound broadcasts in the range 64.0 MHz to 108.0 MHz, which can carry either stereophonic (pilot-tone system) or monophonic programmes in full conformity with ITU-R Recommendations BS.450 and BS.643.
Part 2 (2021) : This document specifies the coding of the three data group types used in RDS, group type A and B for legacy RDS, using only the 57 kHz subcarrier, and group type C used for RDS2 on the optional three upper subcarriers. All RDS features and functions including the Open Data feature ODA are described. New is the RDS2 File Transfer protocol RFT. For RDS, the CRC-16 is also specified.
Part 3 (2018) : This document specifies the process to be used to create ODAs. These are new RDS applications that can be added to RDS/RDS2 by fully maintaining the compatibility with receivers designed without any knowledge about them. These applications are identified by a unique code that has to be registered. The procedure to be used is detailed here.
Part 4 (2018) : This part provides a number of tables for use in the implementation of the RDS system such as the RDS specific character set, country codes and extended country codes and the PTY tables for RDS (not for RBDS) with translations into a number of languages . This document specifies also the procedure to be used for registering a new value in an existing table or the registration of a new table.
Part 5 (2018) : This part defines receiver profiles and criteria that can be used for marking RDS receiver devices.
Part 6 (2023) : This part contains the technical specifications for Open Data Applications in the public domain. These include RadioText Plus, enhanced Radiotext using UTF-8 character coding and AF lists when frequencies below 87.5 MHz need to be used. These are all legacy RDS ODAs. The public RDS2 ODAs for Station logo, Slideshow with optional images and text and Linking the receiver to IP service options are added as from 2023.
Part 9 (2021) : This is the RBDS specification for North America. RBDS uses RDS as specified in all other Parts. However, with respect to Part 2, a few important differences apply. They are all listed here. The content of this document is taken over from a national US standard, of which the reference is NRSC- 4-B. The US NRSC retired this document now as Part 9 has become its replacement.
Part 10 (2021) : This is the specification of the Universal Encoder Communication Protocol – UECP. The UECP satisfies the need for harmonized RDS encoder communication protocols and facilitates the interworking of various RDS system components, such as RDS servers, data bridges and encoders, regardless of the supplier. The UECP supports all current RDS features and the optional RDS2 implementations. All new developments using the ODA protocol with legacy RDS only using the 57 kHz subcarrier and/or RDS2 with up to three additional subcarriers are supported. The UECP is backwards compatible with all previous versions published by the EBU and the RDS Forum since 1994. Some RDS features initially specified by the EBU and no longer used were however deleted, as laid out in Part 2.

NOTE: All previous versions of the RDS specifications published by the EBU, US NRSC, Cenelec and the IEC (before 2018) have been cancelled and do no longer apply. Backwards compatibility has been maintained, however. Anything unclear in the above specifications shall be communicated back to the RDS Forum.

Chapter 4

The RDS Encoder Communication Protocol UECP by Dietmar Kopitz



This Chapter explains the need for a communication protocol to be used between broadcaster's RDS data server (studio) or data service provider (e.g. for TMC) and RDS encoders at the FM transmitter sites. The EBU had developed a specification, first published in 1994, for this protocol which is commonly called the UECP (Universal Encoder Communication Protocol). It was continuously updated by the RDS Forum and it became in 2021 Part 10 of the RDS standard. This new Part 10 the UECP has also been adapted to support RDS2. It is recommended to use the UECP, especially when RDS is implemented within a network of several transmitters. If not, alternative modes of communication are possible where the disadvantage is that they will be encoder manufacturer specific.

WHY THE EBU DEVELOPED, WITH ENCODER MANUFACTURERS, THE UECP?

In the early nineties, when the EBU decided to support the requirement that the various existing and implemented RDS encoder communication protocols should be harmonized, such harmonization would, when achieved, enable broadcasters to purchase RDS system components (e.g. RDS encoders, RDS server computers and software) from a variety of sources. This would permit significant economies in network operation and it would offer above all the necessary high flexibility to implement, in successive stages, enhancements to already existing RDS implementations, specifically within transmitter networks. RDS system component manufacturers would then be able to integrate their products with those from other manufacturers, enabling more complex systems to be produced than those that would otherwise have been impossible.

These proprietary update protocols had similar functional elements, however they differed significantly in their environmental models. The structure, functionality and addressing of their intended networks and the data structures within each RDS encoder are often quite different. Therefore the Universal Encoder Communication Protocol (UECP) specification, now very widely accepted, was based on harmonized environmental and encoder models.

The UECP is a layered communication protocol which is in line with the OSI reference model (ISO Recommendation 7498). The UECP in its current version (IEC 62106-10) has been updated by the RDS Forum since 1993.

The UECP model and protocol provides a template specification upon which new products may be based and most specifically it permits other existing encoder communication protocols to be enhanced. Thus many existing devices can be adapted to meet the RDS functionality required.

Organizations and manufacturers that have contributed within the EBU and later within the RDS Forum to the elaboration of the UECP specification included: Aztec, Auditem/WorldCast Systems, BBC, Deutsche Telekom, Ericsson (formerly Teli), IRT, Qbit, RE Technology, Rohde & Schwarz, TDF, Telefunken Sendertechnik and Teleray.

In the RDS Forum 2025 we know the following encoder manufacturers
that support the UECP with RDS, but their encoders are yet only "RDS2 ready" which means the more recent UECP commands for RDS2 may not yet have been implemented:

> 2wcom (Germany) and
> WorldCast Systems - WCS (France)

where WCS is more advanced as far as support for the RDS2 implementations is concerned, which is due to their experience gained with a number of national projects testing or demonstrating RDS2.

UECP CONCEPT

Addressing method

Communication to RDS encoders needs to be capable of many levels of addressing:

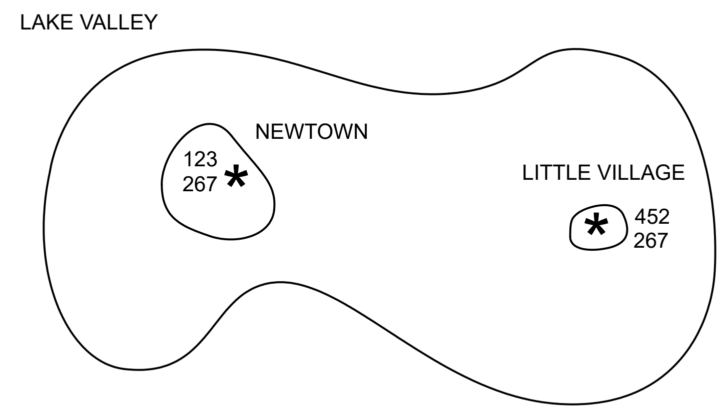
> To all encoders.
> To specific sets of encoders or to a particular device.

This may be accomplished by a suitable logical addressing method.

Site address

In defining an environmental model for the UECP, the following assumptions were made:

- The data stream will feed one or more transmitter sites. Each site will have a unique address, known as the site address (a number in the range 1-1023). All encoders at a particular transmitter site share the same site address.
- An encoder will possess one or more site addresses. One of these must be unique to the particular physical site location. Additional site addresses are permitted for a particular area, region, or country. To clarify this concept, an example is given. All encoders at the NEWTOWN site have the unique site address "123". Other encoders in the system are not permitted to use this address. Encoders at the NEWTOWN site also have the site address "267", which is allocated to all encoders in the LAKE VALLEY area. Messages arriving at the NEWTOWN site with either of these two site addresses will be accepted. Messages arriving at the LITTLE VILLAGE site (address "452"), also in the LAKE VALLEY area, will not be accepted if they carry the NEWTOWN site address, but will be accepted if they carry either the LITTLE VILLAGE or the LAKEVALLEY site address.



Fictitious example of site addressing with the UECP.

This describes only the first level of the addressing system.

Encoder address

A second level of addressing is introduced, the encoder address (in the range 1-63). Several RDS encoders are installed at each transmitter site, serving a number of programme services. Backup equipment is sometimes provided, sometimes not. A single backup encoder may even be provided for several programme services. Whatever the situation may be, each encoder at the site needs to be individually addressable. An encoder will possess one or more encoder addresses. One must be unique to the encoder at that site. Additional encoder addresses may be assigned according the encoder's usage or manufacture.

Radio service address

The site and encoder addresses are not intended to specify a particular radio service. The specification of a particular radio service, a third level of addressing, is accomplished by using a Programme Service number. The site and encoder addresses should be thought of being entirely physical, and are used only to address a certain "box" at a certain location. The functionality of the "box" is irrelevant in this context.

It is expected that many messages will be sent to all RDS encoders. Thus, the global number of "0" is defined for both, the site and encoder addresses. Messages bearing the global site address are deemed to be acceptable at all sites in the system. Messages bearing the global encoder address are deemed to be acceptable at all RDS encoders at sites specified by the accompanying site address.

An RDS encoder will have two destination address lists, one of acceptable site addresses and the other of acceptable RDS encoder addresses:

- The site address list includes "0" (the global site address), the unique site address and any additional site group addresses.
- The encoder address list includes "0" (the global encoder address), the unique encoder address and any additional encoder group addresses.

A message is acceptable to a particular RDS encoder only if the site address is contained within its site address list and encoder group addresses.

The RDS encoder address is contained within its RDS encoder address list.

UECP Monitor and Analyzer Software

You may need such a tool if you send your RDS data with the UECP to your transmitter sites.

Former RDS Forum member Qbit in Germany can propose a tailor-made solution.

Contact: https://www.qbit.de/

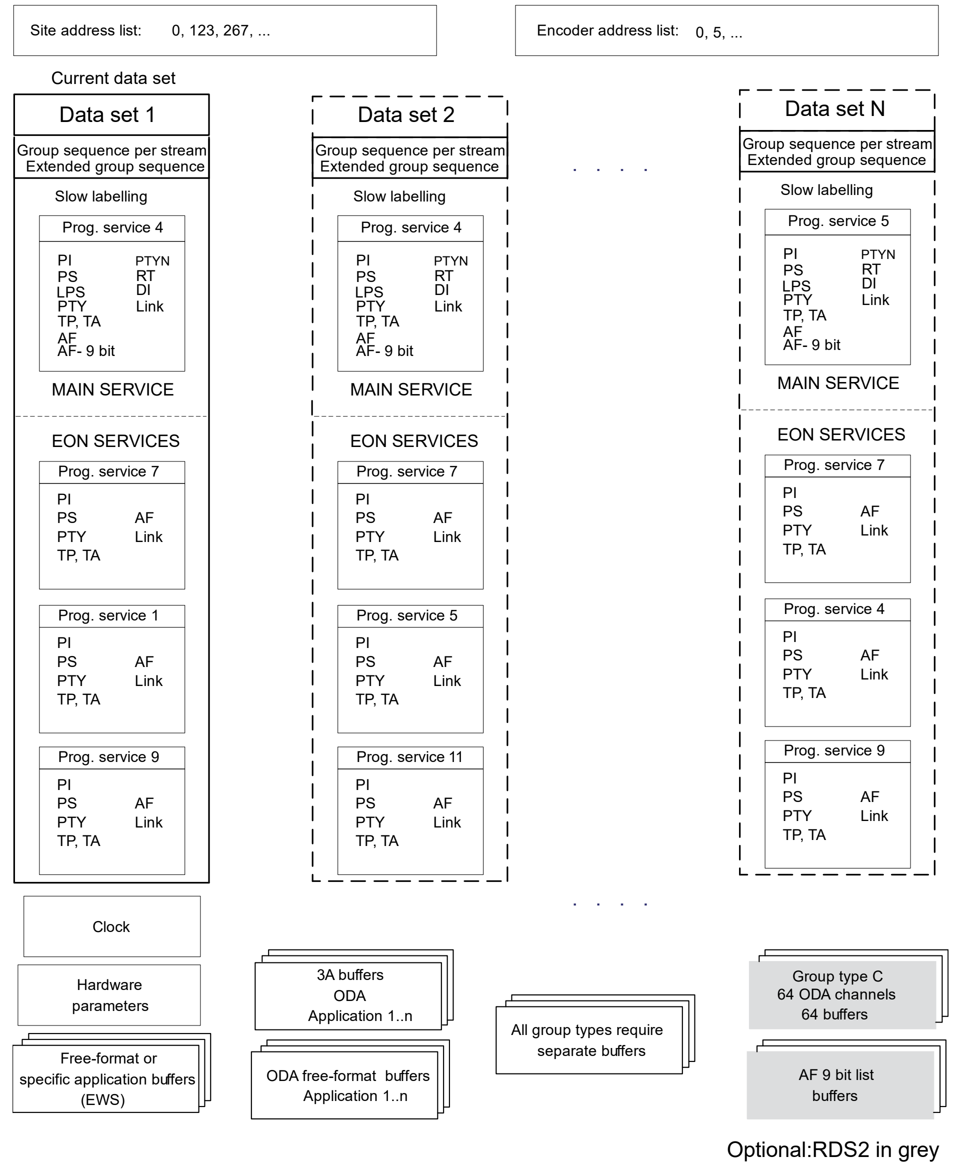
RDS Encoder conceptional model
Software model

Messages are accepted by the RDS encoder in accordance with the addressing method described above. Applicability is further determined by optional fields within the message itself. This permits addressing of the following structures within an RDS encoder:

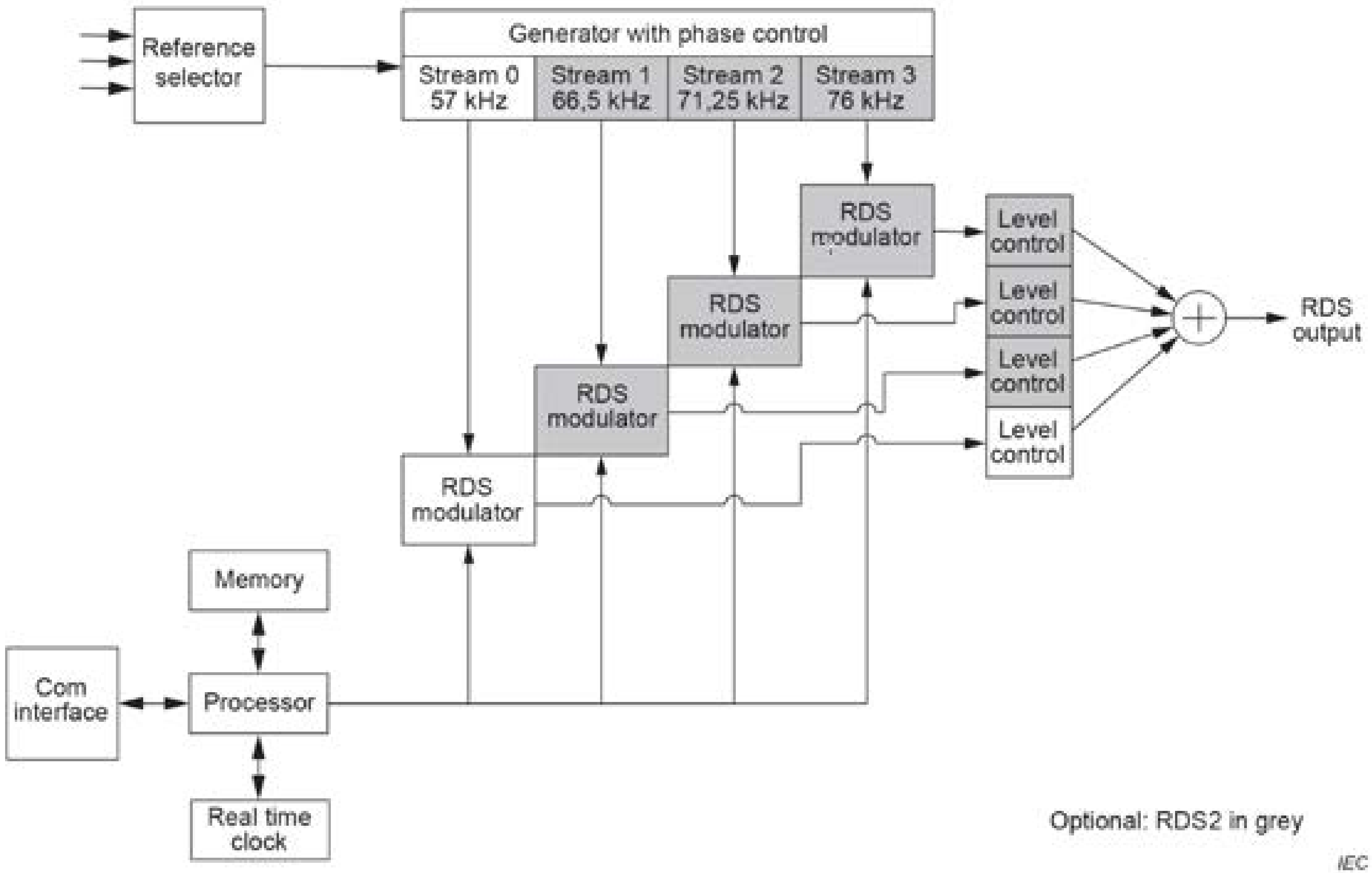
Data sets: An encoder will have one or more *data sets*, each of which results in a particular RDS output. Each data set may refer to many programme services using the RDS EON feature. Only one data set is responsible at any one time for the encoder's output and is known as the current data set. Data sets are addressed by the protocol as described below.

Programme services: All programme services are identified by a unique *Programme Service number* which is used to label data within RDS networks. In a network providing the EON feature, data for several programme services will be sent to an encoder which may then identify that the data refers to one or more of the data sets and elements within the data sets used by that encoder. Programme services are addressed by the protocol as descibed below. There is a specific memory area in each data set for each programme service.

Buffers: Some information is buffered, for example ODAs, Files over RDS2, RT, TMC and Free Format Groups. This means that the received information is placed in a queue awaiting transmission. It is possible to configure a buffer for cyclic transmission.



RDS UECP encoder software model.



Simplified hardware model of an RDS encoder

Hardware model

A simplified hardware model of an RDS encoder has been used in the development of the UECP. The model does not include such obvious or necessary components as a power supply or a control panel, but includes only the blocks necessary to understand and develop the protocol itself. These are:

· *Processor*: The central processing unit of the encoder, a microprocessor, with access to input and output devices, the real-time clock, and memory.

· *Memory*: Comprises ROM and RAM necessary for the operating software of the encoder, and appropriate RAM and ROM for stored data.

· *Serial communication interface:* Data, according to the UECP, is received and transmitted using the serial communications interface, also with a suitable adaptation to the Internet.

· *RDS modulator:* Produces the RDS bi-phase signal, in accordance with Part 1 of the RDS standard.

· *57 kHz oscillator*: Frequency and phase locked to the third harmonic of the selected 19 kHz pilot-tone reference source.

· *Reference selector (optional)*: Selects one source of 19 kHz reference signal, out of a maximum of six, to lock to the internal 57 kHz oscillator.

· *Level and phase control*: The level and phase of the RDS signal may be adjusted by the processor under the appropriate commands.

· *Real time clock*: Maintains the current time of day and calendar date. Used to generate type 4A groups (CT).

The Data Set Number (DSN) permits a message to be targeted to the following within an encoder

► a specific data set,

► the current data set,

► all data sets.

The Programme Service Number (PSN) permits a message element to operate a number of services within one or more data sets. Message Element data consist of one byte describing the length (number of bytes that follow as data) and the data which are all coded as bytes.

Different classes of message commands (MECs) are defined such as RDS message commands, Open Data Application commands, Clock setting and control and Remote and configuration commands (RDS adjustment and control, Control and set-up commands, Bi-directional commands and Specific message commands).

Remote and configuration commands permit to control the various functionality options of RDS encoders or permit request messages to be given from the RDS encoders in the

UECP transmission modes

The UECP is designed to operate in various communication modes as follows:

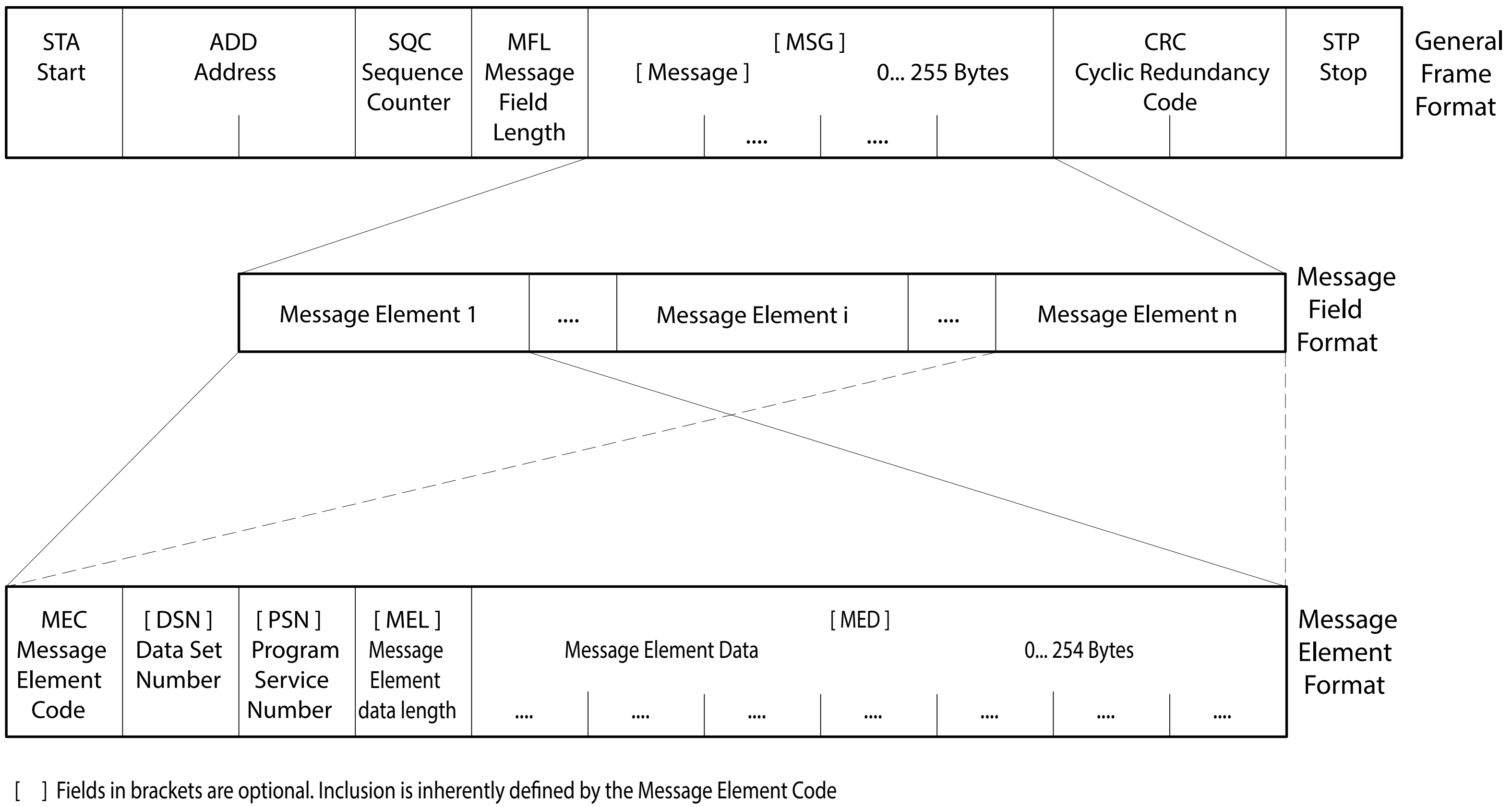
· *Uni-directional mode*: This mode is used on one-way communication links. Data is transmitted to one, a group or all RDS encoders. Answer-back is not required.

· *Bi-directional mode, requested response:* This mode uses a two-way communication link to transmit data to one, a group or all RDS encoders. It enables the server to request data, status, and error report from RDS encoders.

· *Bi-directional mode, spontaneous response*: A two-way communication link enables a server to transmit data to RDS encoders, and request data from RDS encoders. RDS encoders are also able to spontaneously generate status and error messages.

UECP protocol description

To ensure electrical and mechanical compatibility of equipment, interfacing to the RDS encoder is accomplished with a serial interface, based on the well-known standard EIA RS 232C.



UECP data frame format consisting of a stream of bytes.

This is a full-duplex interface with hardware handshaking, able to operate with modems. Alternatives that can be used are the IP protocols TCP (bi-directional, but only point-to-point) or UDP (uni-directional, one-point to many), the latter being ideal for transmitters operated within a network.
The UECP can also be used via satellites with DVB-S, but only in the unidirectional mode, from the RDS data server to all RDS encoders concerned.
The UECP uses data frames that are built and then byte-stuffed prior to transmission.

Several message elements may be packed together into one message field , the UECP frame, subject to a maximum message field length of 255 bytes. An individual message element must not be split between different message fields.
The complete message field may be represented as follows:
MEC,[DSN],[PSN],[MEL],[MED],[[MEC,[DSN],[PSN],[MEL],[MED]], ...

The Data Set Number (DSN) permits a message to be targeted to the following within an encoder

> a specific data set,
> the current data set,
> all data sets.

The Programme Service Number (PSN) permits a message element to operate a number of services within one or more data sets. Message Element data consist of one byte describing the length (number of bytes that follow as data) and the data which are all coded as bytes. Different classes of message commands (MECs) are defined such as RDS message commands, Open Data Application commands, Clock setting and control and Remote and configuration commands (RDS adjustment and control, Control and set-up commands, Bi-directional commands and Specific message commands).
Remote and configuration commands permit to control the various functionality options of RDS encoders or permit request messages to be given from the RDS encoders in the case of a bi-directional transmission mode being used.
RDS message commands permit to communicate all the RDS features which have to be processed by an RDS encoder.
The data are transmitted to the RDS encoder using the specified command structure and are stored in memory according to the encoder software model.
The RDS encoder must also be told the group type sequence to be transmitted on each of the four subcarriers. This is achieved with the “Group sequence” command, which is treated by the encoder like a group enable command. When a specific group is encountered in the sequence, data relating to that type is transmitted if available. If no data for a specific group type are received, then the group type is not generated and the next group type in the sequence is used instead. With this method also the desired repetition rate for every group type is implicitly defined in a very flexible way for the broadcaster or service operator.
The UECP data frames contain a frame sequence counter SQC. Its function is to let the encoder detect missing frames, i.e. gaps in the sequence of received frames.

The components of each UECP data frame are:

Field Description	Descriptor	Field Length
Start	STA	1 byte
Destination address	ADD	2 bytes
Sequence counter	SQC	1 byte
Message field length	MFL	1 byte
[Message]	[MSG]	0...255 bytes
CRC-16 checkword	CRC	2 bytes
Stop	STP	1 byte

The format of each Message Element is:

Field description	Descriptor	Field length
Message element code	MEC	1 byte
[Data set number]	[DSN]	0...1 byte
[Programme service number]	[PSN]	0...1 byte
[Message element data length]	[MEL]	0...1 byte
[Message element data]	[MED]	0...254 bytes

The symbols [ ] indicate that this field is optional. They are used, as required by the specific MEC command.

UECP Message command examples

Message command format

The message description is made in accordance with Table A.1. The first column indicates the field name of the message that is detailed in the second column.

Table A.1 – Message command format

Field name	Byte definition	Comments
	MSB LSB	
MEC		Message Element Code
[DSN]		Data Set Number
[PSN]		Programme Service Number
[MEL]		Message Element Length
MED		Message element data

[,,,] optional

Each element in Table A.1 represents one byte where the bits are numbered from 7..0 (from left to right). For transmission of a respective message each byte is represented by two hex symbols whose permitted range is indicated in the respective element. Symbol 0x00…XX or 0x00…0X specifies the range of the hex value that may be used for the byte in the particular field, where X is in the range 0...F.

The third column gives comment information of the context of the table. A hex symbol means that any hex value may be used within the indicated range. Any other information describes the nature of the data that is put in the table.

The coding of all RDS features is in the same format as used in IEC 62106-2, IEC 62106-3 or IEC 62106-6 and IEC 62106-9, unless otherwise specified.

Example PS / MEC 0x02

Field name	Byte definition	Comments
	MSB LSB	
MEC	02	Message Element Code
[DSN]	00..FF	Data Set Number
[PSN]	00..FF	Programme Service Number
MED	20..FE	PS character 1
MED	20..FE	PS character 2
MED	20..FE	PS character 3
MED	20..FE	PS character 4
MED	20..FE	PS character 5
MED	20..FE	PS character 6
MED	20..FE	PS character 7
MED	20..FE	PS character 8

Function: to set the PS name of the specified programme service(s) of the specified data set(s).

Coding of PS is in accordance with IEC 62106-2.
Example: <02><00><02><52><41><44><49><4F><20><31><20>
Set PS in current data set for programme service 2 to >RADIO 1<

Example of a commercial RDS/RDS2 data server product available from RDS Forum member WCS:

WORLDCAST SYSTEMS

Audemat RDS Server

The broadcaster's gateway to efficient RDS data distribution

From automation to RDS encoders, the Audemat RDS Server is the ultimate tool to build a seamless, end-to-end RDS data distribution

The Audemat RDS Server is the ultimate tool to send your Now Playing data to your RDS encoders' network. Working as a gateway between the automation software and the RDS encoder, the server can configure the most advanced RDS encoder settings and convert all automation formats to UECP in order to address all RDS encoders.

Using ODA? No problem! Just send your data to the Audemat RDS Server and it will route it to every encoder in your network.

Powerful, adaptable and easy to use, the Audemat RDS Server will bring you more efficiency, save your team time, and enable you to focus on delivering a great user experience to your listeners.

RDS2 RDS RBDS | Full UECP | Web based | Now Playing

RDS signal monitoring, analysing and testing by Dietmar Kopitz

This chapter gives some practical advice about how to use a product to look into the details of the RDS signal performance of any new or existing RDS receiver and analyse the content of the FM/RDS signals found on air.

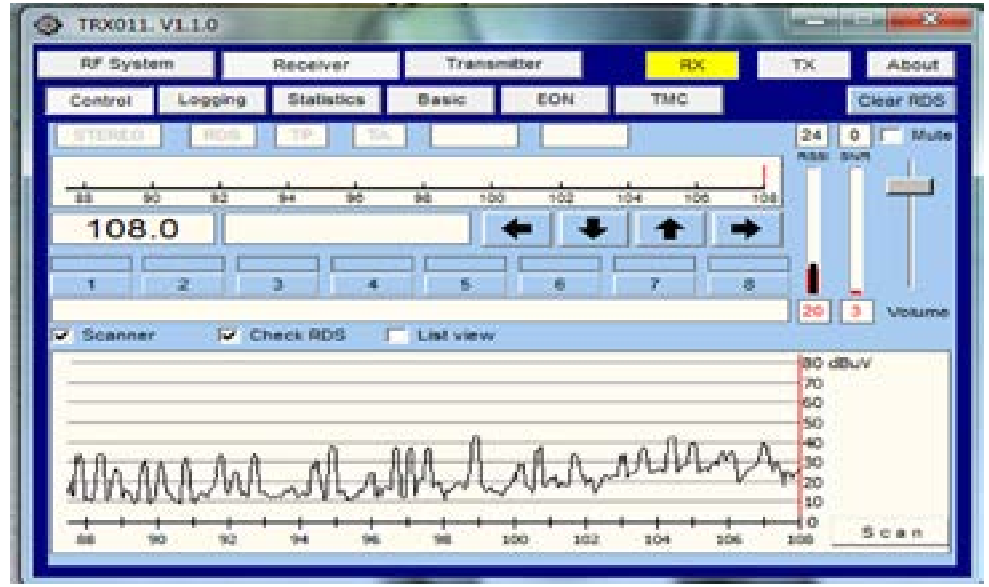
On screen we can see the band scan result. It only took a minute to get the complete picture about RDS on air. The TRX011 box with its rod antenna is visible on the left.

Note that the product described below is no longer available in 2025, because its designer, RDS Forum member Joop Beunders passed away in December 2023. A replacement product is already under development.

I think, everyone interested in RDS would like to know what RDS signals are really on air. Here was the solution. In June 2012 RDS Forum Member MacBe (in the Netherlands) presented a new product, the TRX011 that I immediately perceived as a "wonder box". The new product was relatively inexpensive and had the size of about a cigarette box. It was designed to be used with a Windows PC and it had to be connected to the PC via USB and no separate power supply for the box was needed.

The software for analyzing and setting the transmitted RDS data was part of the package and regular updates from MacBe were included. Note specifically that you can transmit with this wonder box your own RDS data. It has implemented all RDS features including those that use the ODA, such as RDS-TMC and RT+. As eRT is an ODA, you can test it as well,with a string of UTF-8 coded bytes with characters of any language.

The wonder box designed by Joop Beunders, who was one of those RDS design engineers that had the longest professional experience with RDS. Joop started his RDS development work in the late seventies with Philips in Eindhoven (Netherlands) building hardware for the Dutch RDS candidate system SPI. To enable his TRX011 product to receive and transmit RDS data, he was using an integrated circuit designed some years ago by another RDS Forum Member, Silicon Labs in Texas, now Skyworks. They brought this chip, Si 4721, to the market to permit small add-on products to be made for the many iPod and MP3 players available then. This was to permit these music players to transmit within a short range of a few meters distance the music and data (mainly titles and artist names) via FM/RDS to supply them to a free FM channel to which the car radio could then be tuned (examples of such device suppliers were Belkin, Gear and many more). The IC can transmit any of the RDS data features so that, if the add-on device is well designed, such a short-range transmitter could signal via AFs an alternative free FM channel when the car is driven over a long distance. The information where such a free channel will be available would be obtained from a band-scan performed during the journey, carried out at frequent intervals by the receiver part of this IC.



The band scan result can also be displayed as a list showing the PI code and the PS name.

The first thing one wants to know is how many FM stations can be received in the location where one is. More cecently, if you use the DS016 docking station with the RX014 (two later products from MacBe), you can even remotely monitor RDS and RDS2 at any location using the Internet for the RDS data transfer to your own location.

We start to make a band-scan and my particular monitoring result is that in Geneva (in my office) we can receive about 30 FM stations; some of them transmit the same programme on different FM channels. In terms of radio programmes available, the scan result tells us that there are over 20. The complete band scan took only one minute.

We want of course to know whether these stations all use

RDS. To find that out we just have to look up the scan list report provided by the TRX011 box. We found that all the FM transmitters receivable in the Geneva region use RDS.

Number	Frequency	Signal	SNR	Offset	Valid	PI code	PS name
1	87.80	36	24	0	Y	43B1h	DRS 1
2	88.40	37	24	1	Y	4F17h	TREE
3	89.60	34	19	1	Y	F203h	MUSIQUE
4	90.00	23	3	-49	Y		
5	90.10	27	11	0	Y	F219h	VIRGIN
6	90.20	21	2	39	Y		
7	90.80	34	20	1	Y	43D4h	l'autre
8	91.80	32	2	0	Y		
9	92.20	28	10	-1	Y		
10	92.70	34	20	0	Y	F22Bh	ORIENT
11	94.40	29	11	0	Y		

Save scan

List options:

Show only valid stops

Scan

Here we see the scan result as list giving for RDS the PI code and the PS name.

Now we would like to investigate a special problem related to the static PS name feature. We put the emphasis here on "static" as the PS name has in the RDS data stream the function to serve as an identifier to the listener of the name to the tuned programme (or any other alternative radio programme on air). The PS name is composed of eight alphanumeric characters and some examples are

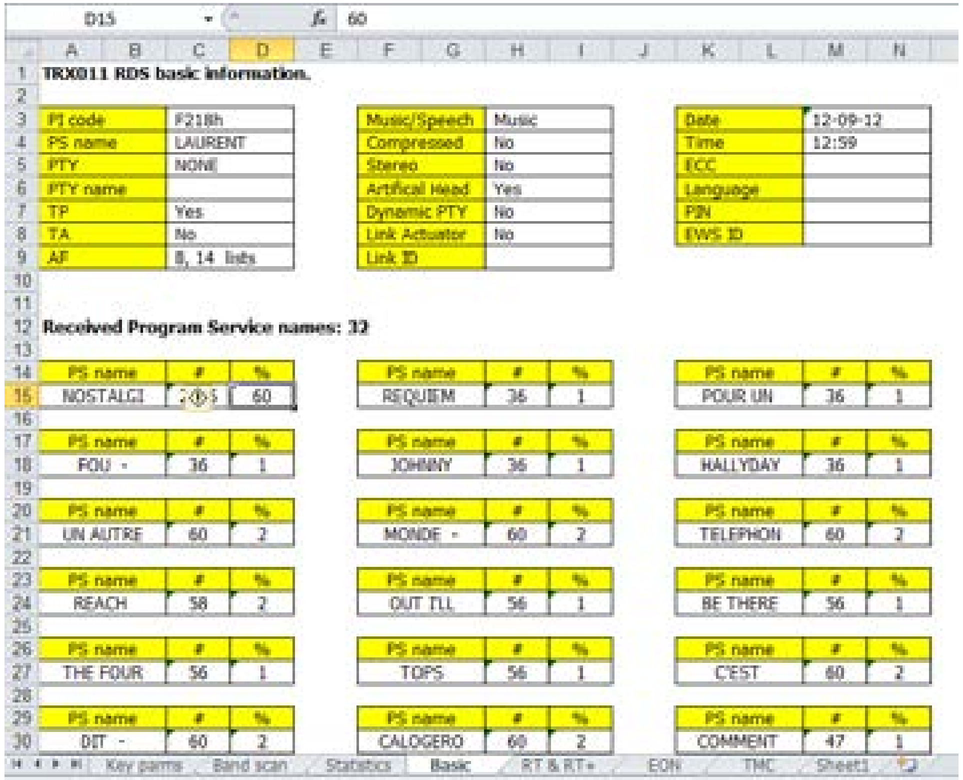
BBC R1, RADIO 21, MUSIQUE, BR INFO.

Here in the Geneva region, where we can receive Swiss and French radio programmes, we have noticed that the majority of FM stations use dynamic text instead of the static PS name identifier required by the RDS standard. Why? The reason is that in RDS for any text transmission one should use the RadioText (RT) feature. However, in the early years of RDS, most car radios did not implement RT for a number of reasons, one being not to distract the driver (responding to a traffic safety statement for moving vehicles, issued by the European Commission – which is the Recommendation 2007/78/EC) and also to save on the need to use a larger display to better present the text information. The latter condition has changed a bit now due to the fact that a large display is needed anyway for a number of other reasons and thus it could also be used for RT, and therefore most newer car radios have implemented the RT feature, but by default and for the above mentioned safety reasons it may be disabled.

It would be for the driver then to switch the RT feature intentionally on or off when appropriate and depending on whether the car moves or not. So, when the car is not moving and for example in a traffic jam, RT might be enabled.

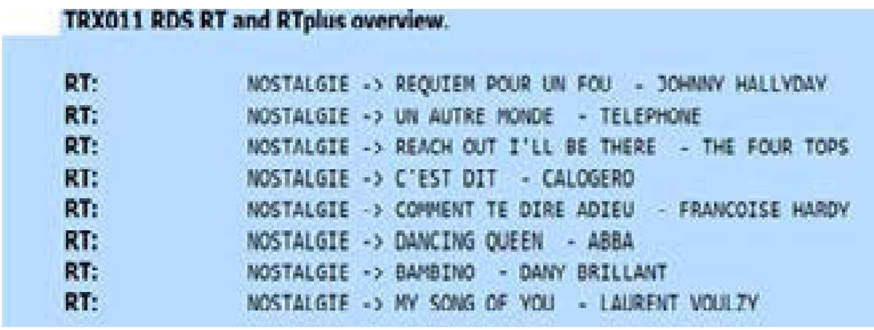
Broadcasters found a way to circumvent those constraints to receiving RadioText in cars and more than 15 years ago already and they started to use PS dynamically to convey short text messages to the driver. However, not always the regulators would tolerate such an abuse of the RDS standard, and for example in the UK this way of operation was simply just not permitted.

In France the dynamic PS as, in 2012, the subject of an experiment with a number of constraints put on the text that the interested broadcasters may implement using the PS feature. No advertising with such text elements was permitted and it had to be totally related to the programme item content on air or to an upcoming programme item. The broadcasters were mostly interested to transmit the music title and the artist name along with any music item. An additional requirement was that at least 50% of the time the PS text should be static and convey the PS name. Additionally, all dynamic text transmitted over the PS feature had to be transmitted using the RT feature, but also more other programme related details could be given in addition.



also that 60% of the time the PS name NOSTALGI was used.

With the TRX011 in RX mode I wanted to check of whether the French radio station NOSTALGI complied with those CSA regulations and we had carried out this analysis as follows: we stayed tuned with the TRX011 to the radio programme NOSTALGI for about 45 minutes and then stored a log of the data received. The wonder box already delivers the log in the form of an Excel spreadsheet where everything of a general interest is already analysed and properly reported. So, what I wanted to know is the proportion of the time used to transmit a static PS name, I just could read that out straight away, i.e 60%. Then 40% was used for dynamic text messages and the ones that were transmitted during the time of my monitoring are all listed as a sequence. I could see that the radio programme gave the PS programme service name followed by the music title and artist name and nothing else.



TRX011 RDS RT and RTplus overview.

RT: NOSTALGIE -> REQUIEM POUR UN FOU - JOHNNY HALLYDAY
RT: NOSTALGIE -> UN AUTRE MONDE - TELEPHONE
RT: NOSTALGIE -> REACH OUT I'LL BE THERE - THE FOUR TOPS
RT: NOSTALGIE -> C'EST DIT - CALOGERO
RT: NOSTALGIE -> COMMENT TE DIRE ADIEU - FRANCOISE HARDY
RT: NOSTALGIE -> DANCING QUEEN - ABBA
RT: NOSTALGIE -> BAMBINO - DANY BRILLANT
RT: NOSTALGIE -> MY SONG OF YOU - LAURENT VOULZY

The TRX011 Excel report gives also the RadioText records for NOSTALGI during the 45 minute interval of monitoring.

Another interesting function of the TRX011 box was its capability to transmit your own audio programme accompanied by RDS data of your choice. This possibility could well be used to test under static receiving conditions any RDS receiver and one could find out which RDS features were implemented in the receiver and whether their usage was correct, or not. Wasn't this a fantastic possibility offered by our wonder box?

One could even test a receiver for a new ODA, still under development, and where the receiver will need to use specially developed software to decode these new ODA messages. Thus it was possible to develop and test with the help of the TRX011 box new applications for RDS, before one would register them as an Open Data Application with the RDS Forum. The ODA registration procedure, described and required by the RDS standard – Part 3, has the aim to ensure that a registered ODA remains worldwide absolutely unique.

The tool TRX011 is also great to check whether RT+ is correctly implemented. One of the more subtle things in RT+ is of course that there exist in the RDS standard very many different kind of tags and not just the two always used for music items, namely "item title" and "item artist". All these other possible RT+ tags are listed in the RDS standard IEC 62106 Part 6.

The interesting question then would be how the TRX011 would identify these "tags"? Will it also give the tag the relevant code number?

The answer is: If one runs the TRX011 software program in demo mode (no TRX011 box yet USB attached), it will play a pre-recorded RDS file. In the receiver tab "Basics", one can find then which tags are being "received" (the name and the number). In the RT presentation "Tag 1" is always colored red and "Tag 2" is colored blue.

Another good feature of the TRX011was that one could transmit one's self-defined RDS signal content. If, for example, one wanted to do that for RT+ and for all those possible 64 tags and be able to test, for example, what any given receiver might be able to decode (if any RT+ at all, most probably only a few of those many tags listed in the RDS standard, and perhaps then only “item title” and “item artist” and apart of these two nothing else), one could then easily imagine that this would be a lot of work to carry out such a test. However, the reality is that it was really not difficult at all to create the complete RT/RT+ file for this kind of test.

In the “Transmitter” tab: “RT(plus)” one could already define eight different RT entries. Each entry could then contain two different tags, thus in total, with only one single setup, one could already make 16 different tags visible. Since there are only 64 tags defined, one would need altogether only four different RadioText pages. In the software program settings these could be saved and restored.

How to make any RT+ textline was also very easy: First enter the RT content (the actual “text”) in one of the eight entries. Then, highlight with the mouse the part that should become tagged 1 (or 2). When you release the mouse button, you will get the options to select tag 1 or 2 and the tag number you want, out of a choice of 64. That’s all then what you would have to do, and this was also just what you would expect from a “wonder box” like the TRX011.

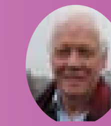
The TRX011 could also be used for a mobile reception test in a car. To do so, one would need an additional VHF/Band II antenna on the roof of the car, preferably a passive rod antenna that could be attached to the car body with a magnet to avoid that it moves during the drive. The antenna cable can be led through the door and on the back seat it can be connected to the TRX011 box which itself is USB connected to a Windows laptop PC that can log the RDS data received during the journey. The Excel report of the log provides you with a complete analysis including the proportion of errors received in the RDS stream.

Up to here I have described only a few obvious tests to be done. To test the FM/RDS r.f. signal performance of any RDS receiver, static or mobile, more tests are needed. To help developers to so, the RDS Forum has developed a measurement standard which was published by the IEC in 2011 as IEC 62634. This standard was conceived for three receiver categories: static home receivers, mobile portable receivers and car radios. The standard describes how to test the RDS performance of the receiver under well-defined strong and weak input signal conditions on co-and adjacent channels. There is also a section describing more tests regarding the TP & TA features. I highly recommend to all receiver manufacturers to make use of this IEC standard to ensure that their products comply with those minimal performance requirements proposed by the RDS Forum.

The later RX014 product from MacBe was ideal to test likewise RDS2. It was the first receiver on the market that was capable to analyse deeply RDS2 signals and in 2025 this is still so .

More detail about the RDS/RDS2 evaluation tools from former RDS Forum member MacBe you find in Chapter 9.

Chapter 6



RDS in the world of Automotive by Frits de Jong

In Chapter 1 we have seen that a replacement from the existing ARI system to a pan-European traffic information system (TP/TA) was an important issue for the car-industry to support RDS. The ARI system was limited to Germany, Austria, Switzerland and Luxemburg and no further plans existed to extend the system to other European countries. In addition the AF feature, which made it possible to follow a radio programme throughout a large geographical area or even an entire country without the need for manual re-tuning, created a lot of enthusiasm. RDS gave a huge contribution to driver safety which was the trigger for the car industry to place RDS radios in their new car models, first in the high-end cars, soon followed by the entire car products range.

BASIC AUTOMOTIVE REQUIREMENTS

In essence safe driving was the focus at the introduction of RDS car radios. Car radios capable to ensure undisturbed listening without the need of manual retuning of the radio programme. Traffic announcements could hardly be missed since TA was cross-linked over the entire network by EON. In other words the mental workload for the driver decreased significantly since RDS did all these things automatically.

PS - Programme service name

The PS is the most obvious visual programme identification. Ideally this name should stay on the display even if RDS synchronization is lost. The RDS sensitivity is generally 10dB lower than the FM sensitivity. In practice one can still listen to the radio programme, while RDS can no longer be received.

In order to ensure that the PS remains visible on the display even when RDS data is lost, the PS is memorized under the radio programme preset button.

Since it started all some 35 years ago, the well-known 8-character programme service name PS is used as a visible identity to the listener. But broadcasters may wish to use more than an 8 character PS. RDS2 allows with enhanced character coding UTF8 a long PS composed of 32 bytes at maximum. This help to serve regions like Asia and China. The increased data capacity of RDS2 by a factor 5 makes it possible to transmit a station logo as an attractive addition to enhance the identity of the programme. The reception of a station logo is not a time critical issue. Once it has been received, it may be stored in memory and linked to the PI code to be displayed immediately once the programme has been recalled.

AF Automatic programme retune

An ideal RDS radio switches over inaudibly and in time to an alternative frequency (AF) with the best audio quality. Variations in sound should not occur. This is easier said than done!

A number of parameters are deterministic for the audio quality of the signal:

- Signal strength

The signal level is the most important parameter to select a new AF with a better audio quality.

► Multipath distortion

Multipath distortion occurs when RF signals reach the car antenna, both in a direct path from the transmitter and via reflections as known in mountainous areas. Signals from reflections arrive with a time delay, which causes an audible distortion.

To reduce the influence of multipath distortion, a system using multiple antenna's has been used: antenna diversity. In this system the tuner can switch to or even combine the signals from multiple antennas in order to reduce the multipath effect.

► Adjacent Channel

In areas with a high density of FM transmitters, a strong adjacent FM station may be present at a distance of +/- 100 kHz of the tuned radio programme. The effect has become less noticeable since the selectivity of car radios has been improved significantly over years.

Dynamic selectivity is almost a standard feature nowadays.

Nevertheless, when driving higher up in the mountains and near the borders, like the Black forest area in Germany or around large metropolitan regions like Paris, distortion of the audio may still frequently occur.

In principle the AF list of a radio programme is regularly validated on the above mentioned parameters. While listening, the tuner jumps shortly to an AF and measures the signal quality. During this short period the radio is muted. This short tuning action takes for modern well designed tuners only 4-6 msec. Although this short update mute is almost inaudible for the listener, it is obvious that AF lists must be kept short in order to manage this AF list update process well.

As a result of this, a new AF will be available to switch to when the currently tuned frequency becomes weaker and the audio quality is degrading. A golden rule after switching to a new AF is checking the PI code. It may happen that an AF from the list is valid in another part of the country or region while the AF at the current location belongs to a local transmitter with a different program. During the PI code check the radio will be muted. This mute period is audible, because it is defined by the RDS system and may take up to 200 msec under good conditions. Clever designed RDS radios will limit the audible PI checks to a minimum by making use of historical and statistical data.

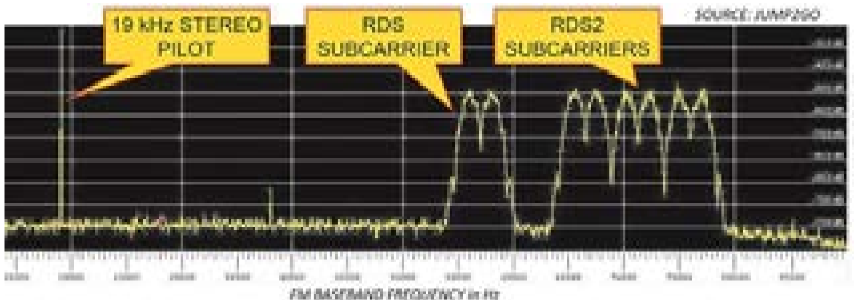
Car radios with RDS2 will continue their programme switching strategy by evaluating the audio quality of the AF's in data-steam 0.

Automotive requirements

The performance of this automatic re-tune system has been considered as a core feature by the car industry. Over the years millions of test kilometers were driven to develop and optimize algorithms to improve the system. At that time car radios were mostly single-tuner products. Undisturbed listening under difficult reception conditions at one hand and a clever AF list update mechanism in order to ensure reliable

AF switching at the other hand were a major challenge. Both tasks had to be done by one tuner. Also compromises had to be made to keep this update process almost inaudible.

RDS2 uses three additional subcarriers higher up in the FM



MPX signal. The RDS propagation in the upper carriers may differ somewhat from the propagation in the 0 carrier.

However in practice the effect is negligible.

In case of a dense FM spectrum with stations at 100kHz spacing, there is the option to use subcarrier 1 and 2 only and not the 3rd one on 76kHz.

RDS test locations

We have seen which parameters are decisive for an optimal reception. A logical choice of areas to test the RDS performance on the road is where these conditions will be continuously available.

Mountainous regions in **Germany** like the Schwarzwald (Black Forrest) and Bavaria near the Austrian border are good examples. These areas are characterized by a number of high power FM transmitters of more than 100 kW and there are also a large number of low-power gap fillers in order to guarantee interference free reception without multipath distortion in small valleys.

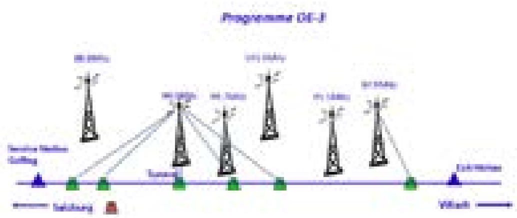
In **France**, the region roughly 25 to 50 km South and East of Paris shows AF lists which are generally spoken rather long with up to 25 AF’s. Sometimes only a few AF’s are relevant and it may also occur that none of these AF’s offers a decent quality. This sets tough requirements on a car radio in order to show a good dynamic performance.

A particular case in **Austria** needs some special attention and is described below.

On the Tauern motorway (Autobahn) A10 from Salzburg, 30 km South of Salzburg in the direction to Villach, where only the program OE-3 is re-transmitted in the numerous tunnels. This programme carries traffic and weather information. Between the tunnels the OE-3 programme can be normally received off air by a number of transmitters. However in the tunnels this programme is available on one frequency only. One can imagine that the propagation changes drastically each time when entering and leaving the tunnel. A sort of “Tunnel detection” mechanism is needed in order to select within less than a second the optimal AF when entering and leaving these tunnels.

The recommended route for testing is between the petrol station Golling, 30 km South of Salzburg, and exit Hüttau.

Below, the figure and the map show this 35 km test-route



TP/TA - Traffic Announcement, Traffic Programme

We have seen already that the TP/TA feature became the pan-European successor of ARI.

For broadcasters it was not attractive to give traffic information on all national or supra regional programmes.

In addition the BBC in the UK had the vision to give traffic information for regions like Kent or Oxford, only regional. These regional programmes have their own transmitters and do not share the national transmitters from BBC Radio 2, 3 and 4.

But how to signal traffic events to a single-tuner car radio then? EON (Enhanced Other Networks) provided the solution. When the car radio is tuned to any programme within the BBC network, then all relevant programme information is distributed by the RDS group type 14A. The receiver is then able to identify the programme which will carry the traffic information upcoming announcements.

When a traffic announcement is sent and properly signaled by a number of 14B groups, the receiver can react immediately and switch-over temporarily to the radio programme currently sending the traffic information.

The feature can be tested and validated well in the areas of Kent and Oxford.

For the UK we have seen that traffic announcements are frequently distributed by regional programmes and cross-referenced via EON to all national programmes. The transmitter towers of the national programmes are not the same as the ones of the regional programmes and are situated on other locations. As a consequence the signal level and coverage of a regional programme and national programme can be different most of the time. In addition the receiver may get 14B groups from a programme launching a traffic announcement which may concern another region, hence not relevant for the traveler. It may even be the case that the traffic announcement cannot be received at all. Thresholds have to be built-in to offer the relevant traffic bulletins only. For this reason it will be obvious that the UK is a mandatory test area for the RDS TP/TA feature.

PTY

Programme TYpe (PTY) has proven to be a popular feature. The PTY search feature was present already in the first generation aftermarket products. The PTY feature became more attractive when PTY codes changed dynamically to represent well the flavor or genre of the radio programme and were cross-referenced by EON in variant 13 of the 14A type groups. The PTY standby mode became a powerful feature. The listener could select a programme type while the receiver was able to signal the start of the programme with the corresponding PTY on either the tuned program or the ones cross-linked via EON.

News and Weather

Two programme types "News" and "Weather" became a special case. There was a strong requirement to signal News and/or Weather as an event like TP/TA. The respective PTY could bring up a short announcement item of up to a maximum of 5 minutes.

It is important that the receiver can switch instantly to the correct programme sending the news bulletin if set in the standby mode for news. For EON, when at the junction of a PTY change at least four and up to eight groups of type 14A, variant 13, are sent in rapid succession for the service whose code is changing. The solution was found by means of the RDS Guidelines to describe this special situation as follows:

"When Broadcasters use Dynamic operation of PTY, two categories (01 - News), and (16 -Weather), are principally expected to be used for short duration reports and announcements.

As such, these codes should not be used to define longer programmes, and a suitable alternative code should be used instead (example code 02 - Current Affairs - should be used for a 30 minute news programme, and code 08 - Science - should be applied to a feature programme about the Weather)."

MULTIPLE TUNER CONCEPTS

RDS background scan

We have seen already that RDS-EON is an extremely powerful feature for single tuner products, when relevant information is instantly required to react on events like traffic announcements.

In the meantime huge progress was made in miniaturization and tuner design. Double and triple tuner concepts have become feasible for in dashboard products.

The car industry in particular identified the strength and added value of multiple tuner products.

Quality checks and processes can be done now fully in the background, which improves the dynamic performance significantly.

Living band

The so called living band feature became rather popular in line-fit products with multiple tuners. A background tuner scans continuously the FM landscape. Products with a large color screen are often used for both, navigation and the radio display, and they can offer the driver within a short glance which radio programmes are available at the driving location. However, due to increased usage (abuse) of the “scrolling PS feature”, this system has lost a lot of its strength as stations are increasingly harder to identify.

An obvious feature for a background tuner in integrated radio-navigation products is TMC (see Chapter 7). TMC may be handled by either a separate tuner or in a time sharing process with other functions to be carried out.

Phase diversity

The phase diversity system is to date the most advanced system to optimize the signal quality which is presented to the user. Two tuners, each with their own antenna are tuned to the same radio programme and an advanced digital system either combines or uses only one of the signals from either tuner.

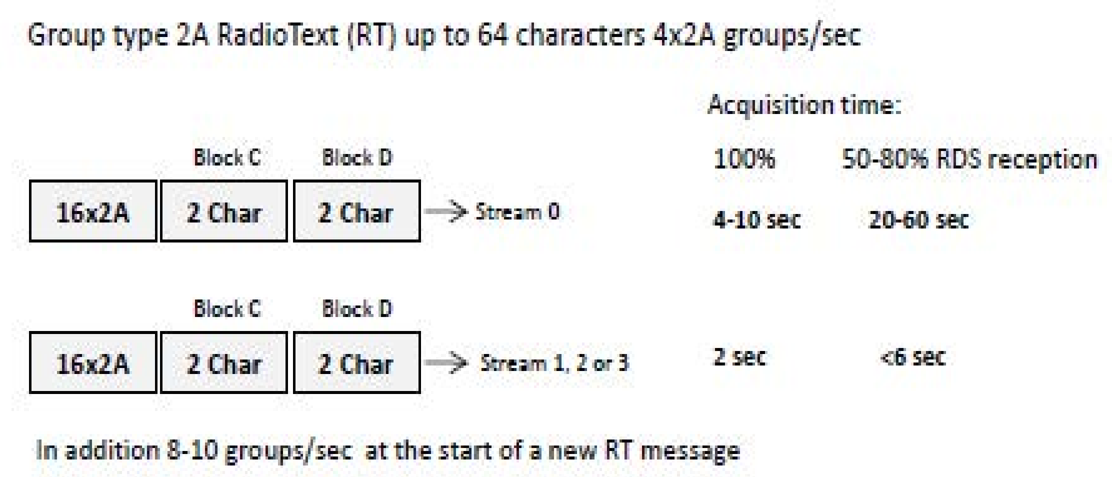
RDS2 improves performance of basic RDS features in automotive

Particularly in automotive applications the reliability of RDS data acquisition remains an important issue to deal with. When driving near the border of the coverage area, where RDS reception is at its limit, we immediately can notice that RadioText (RT) for instance is no longer present. In a few cases some text remains on the display for longer, which does not match anymore the content of the current programme. RDS2 is mainly developed with a focus on new added value applications via ODA and to transmit files with size up to 163 kByte such as a station logo or music cover art images. However, RDS2 is also extremely suitable to improve the reception quality of the well-established programme features such as RT significantly by using the tunneling option.

The example below may visualize the issue . A RadioText message may contain up to 64 characters. 16 groups of type 2A are needed to transmit a complete RadioText message with 64 characters.

When we use 4x2A groups per second on the basic subcarrier 0, it will take at least 4 seconds (64/(4x4)) to receive the complete text message at 100% reliability for correctly received RDS data. It takes 10 to 12 seconds for the receiver to put the text message on screen after it has been received correctly twice.

The reception reliability of RadioText (RT) in a car will drastically increase, if the same information is also sent over one of the upper carriers in RDS2 as can be seen from the diagram below:



RT+

RT+ is a valuable and powerful RDS feature. As an extension on the existing radio text (RT) RT+ offers significant added value particularly for car drivers. The key elements from a radio text message are tagged like track title and artist. This will allow to present to the car driver these elements in a structured and quasi static way without the need to read a 64 character text scrolling to the end.

RT+ is an ODA signaled in group type 3A. The corresponding application group carries the necessary RT+ information. As a minimum requirement the 3A group must be transmitted every 10 seconds and the RT application group every 2 seconds.

About the author: Frits de Jong worked as systems engineer and product manager for Philips Car Systems, Siemens-VDO and TomTom. Now he is a freelance consultant. He is chairman of the RDS Forum since 2016.

Chapter 7

RDS-TMC: The Traffic Message Channel by Mark Saunders

Although RDS was primarily developed by Public-Service broadcasters as an aid to listeners in station selection and identification, RDS has also been widely and successfully used for commercial applications. The most implemented of these is Traffic Message Channel (TMC), where RDS transports densely coded information about driving conditions.

In the early 1990s, RDS became fitted as standard equipment in many new vehicles, especially in Western Europe, and a few years later Satellite-Navigation and route guidance systems started to become realistic consumer devices. Satellite-Navigation systems at their basic level are able to calculate the optimum route between two points, either the shortest route, or the quickest, but only become really useful if they take into account the traffic conditions between the points, and use that information in the route calculation process. Even without the aid of Satellite-Navigation, drivers themselves are able to pick the best route, or at least estimate how long their journey will take if fully appraised of accidents, roadworks, other factors, or simply sheer volume of traffic, that will affect their progress.

Spoken traffic information has for many years been the primary method of imparting information to drivers, but is extremely limited in the amount of information that can be conveyed by an announcer who typically will report ten or so incidents three or four times an hour during peak times, and even less frequently at other times. For drivers, spoken traffic information especially on national or large regional stations, is mostly irrelevant anyway.

The proven reliability of RDS to deliver information to vehicles became an obvious technology to use to deliver a better, more comprehensive and relevant traffic service to drivers.

ESSENTIAL ELEMENTS OF TRAFFIC INFORMATION

Traffic information, however communicated, needs to provide essential elements of information:

- what is being reported;
- where the problem is;
- what the effect is;
- who is being affected;
- how long the situation likely to last; and
- what can be done to avoid or ameliorate the situation.

To communicate this information would require a considerable bandwidth (more than the entire capacity of RDS) if transmitted as text (which would be fundamentally dangerous in a vehicle anyway), so instead the information is broadcast as a series of codes, which consume very little RDS bandwidth, and can be used directly by the in-vehicle systems. When presentation of messages is necessary, as codes rather than text are used, the service is language and unit independent, allowing the end-user his choice of presentation of the information.

TMC transmits the following core 'elements' in every message:

LOCATION: The point at which the problem has occurred, the beginning and end of the road stretch affected, a particular 'link' on the road network (for example an exit slip from a motorway), or an area.

EVENT: This is the part of the message which describes what is being reported; an accident, a road closure, road construction, traffic congestion, dangerous driving conditions, adverse weather conditions etc. Events broadly fall into one of two types – 'flow' which details the average speed of traffic on a road section, either explicitly with a km/h value, or comparatively using phrases such as 'slow traffic' or 'stationary traffic' or 'flowing freely' – or 'incident' which is the non-flow event messages, such as accidents, road construction etc. The incident messages can be split further into 'planned' and 'unplanned' incidents. Road Construction is an example of a planned incident, an accident however is unplanned.

Often, an incident causes a problem, with slow traffic flow being the result, so a message often contains both an 'incident' element and the resulting 'flow'element – an accident (incident) has caused traffic to move at only 20 km/h (flow).

DURATION: With some incidents, especially planned road construction, there is a specific scheduled time at which the incident is expected to have been cleared and conditions returned to normal, so a duration if known is also given or simply 'unknown' is sent.

Most traffic messages need just these three fundamental elements to adequately convey the information required, but TMC also allows several option details to be included when necessary. The most common example is to add specific time information for planned incidents. It is desired to notify in advance a road closure occurring over-night, so the start time of the closure (23:00 Thursday) until the re-opening (05:00 Friday) can be explicitly communicated too.

TMC IN DETAIL

TMC is the most-widely used example of an ODA (Open Data Application) within RDS. ODAs by design make use of one of the many specified 'un-used' RDS group types in a particular transmission, but by de facto, due to the fact that TMC slightly pre-dates the ODA concept, they always use type 8A groups to transmit the data. The necessary ODA type 3A group is of course also transmitted which gives the AID of RDS-TMC - CD46 - or an extension of TMC (as yet not realized anywhere) – CD47. The detail of both the information in the 8A groups and 3A group is given below.

Above was described the two core elements of a message, essentially Location and Event.

They differ is that a Location has geographical relevance, whereas largely an Event (or at least a core set) can occur anywhere. The principle adopted is that all TMC Service Providers use the same standardized 'Event List', but Location codes are determined locally.

Event

The Event List is standardized (ISO 14819-2) and consists of around 1,500 'phrases' that provide descriptions about what is being conveyed. The messages are both for convenience and technical reasons arranged into thirty-nine 'classes' of message, according to their content. Level of Service

- Expected Level of Service
- Accidents
- Incidents
- Closures and Lane Restrictions
- Exit Restrictions
- Entry Restrictions
- Traffic Restrictions
- Carpool Information
- Roadworks
- Obstruction Hazards
- Dangerous Situations
- Temperatures
- Precipitation and Visibility
- Wind and Air Quality
- Activities
- Security Alerts
- Delays
- Cancellations
- Travel Time Information
- Dangerous Vehicles
- Exceptional Loads and Vehicles
- Traffic Equipment Status
- Size and weight Limits
- Parking Restrictions
- Parking
- Reference to Audio Broadcasts
- Service Messages
- Special Messages
- Level of Service Forecast
- Weather Forecast
- Road Conditions Forecast
- Environmental
- Wind Forecast
- Temperature Forecast
- Delay Forecast
- Cancellation Forecast

In each class of message, there exist a few or hundreds of descriptive messages, compounded from a smaller number of 'core phrases'.

Below is an example from the beginning of the 'Level of Service' class

Code	Reference English (Metric)	Code	N	Q	T	D	U	C	R
	EVENT LIST								
	1. LEVEL OF SERVICE								
1	traffic problem	1			D	1	U	1	A50
101	stationary traffic	101			D	1	U	1	A1
102	stationary traffic for 1 km	102			D	1	U	1	A101
103	stationary traffic for 2 km	103			D	1	U	1	A102
129	stationary traffic for 3 km	129			D	1	U	1	A103
104	stationary traffic for 4 km	104			D	1	U	1	A104
105	stationary traffic for 6 km	105			D	1	U	1	A106
106	stationary traffic for 10 km	106			D	1	U	1	A110
130	danger of stationary traffic	130			D	1	U	1	A1D
108	queuing traffic (with average speeds Q)	108		4	D	1	U	1	A2
109	queuing traffic for 1 km (with average speeds Q)	109		4	D	1	U	1	A201
110	queuing traffic for 2 km (with average speeds Q)	110		4	D	1	U	1	A202
131	queuing traffic for 3 km (with average speeds Q)	131		4	D	1	U	1	A203
111	queuing traffic for 4 km (with average speeds Q)	111		4	D	1	U	1	A204
112	queuing traffic for 6 km (with average speeds Q)	112		4	D	1	U	1	A206
113	queuing traffic for 10 km (with average speeds Q)	113		4	D	1	U	1	A210
132	danger of queuing traffic (with average speeds Q)	132		4	D	1	U	1	A2D

- At its most basic, Code 1 simply conveys that there is a 'traffic problem' (no other details being available)
- Code 101 is a little more helpful in that it warns that there is 'stationary traffic'.
- Code 102 adds further detail that the stationary traffic stretches for 1 km.
- Code 108 is slightly different in that here the description is 'queuing traffic'.
- Code 109 adds more detail that the queue length is 1 km. This code and many others allows the addition of the information shown in parentheses ('with average speeds 'Q'') to be added to further quantify the incident. The quantifier (in this case a specific speed) is taken from another table of speed values (the speed value table is table 4 – which is signified by the 4 in the Q Quantifier column.)

The significance of the other columns and values in the table will be explained a little later.

To transmit an event (without a quantifier) by this method of using a look-up code table requires 11 bits, which technically allows for 2048 separate phrases, so with approximately 1,500 phrases defined, there is ample scope to add more phrases should the need ever arise, although the list is already extremely comprehensive.

The code table is standardized in the English Language using SI (metric) units, with TMC Service Providers creating local tables according to need. Below is an example how Code 106 has been translated by HERE Traffic for presentation in some other languages and units.

Code	Language/units	Presentation
106	Reference English (Metric)	stationary traffic for 10 km
106	North-American English (US Units)	Stopped traffic for 6 miles
106	North-American French (Metric)	Embouteillage sur 10 km
106	Latin-American Spanish (Metric)	Tráfico detenido por 10 km
106	Latin-American Spanish (US Units)	Tráfico detenido por 6 millas.
106	Portuguese (Metric)	ráfego congestionado com 10 km
106	Brazilian Portuguese (Metric)	10 km de trânsito parado
106	Russian (Metric)	дорожный затор 10 км
106	Ukrainian (Metric)	дорожній затор на 10 км

Note that the code transmitted is the same everywhere, but the presentation is determined by the end-user, in his selection of preferred language and units. For example, three drivers in the Niagara area of North America all receive the same transmission, but the driver from Quebec has chosen presentation to be French/Metric (km), the American driver has selected North-American English/US Measures (miles), and the Spanish-speaking American has selected Latin-American Spanish/US measures (miles) - each receives the information in the most natural presentation for them from the same broadcast.

Location

Conceptually the location is handled in the same way as the event: a code is sent, and the device retrieves that from a table in the receiver. It is rather more complex than this simple description infers, in that Location Tables are more than a list of phrases; they contain geo-referenced data that allow precise alignment with digital maps on which satellite-Navigation systems operate.

Location Tables themselves are not standardized as such, but how the Location Tables are compiled is, and ISO specification 14819-3 provides the methodology by which Location Tables have to compiled, and maintained.

A Location Table is specific to a particular geographical area, and in essence every: road junction; link within a junction (e.g. the link between two highways); and area is allocated a code. Each Table can contain 64,000 codes, smaller countries needing just one Table, larger countries requiring several. (USA/Canada uses 33 Tables). The Table itself is identified by a combination of Location Table Number (LTN) and Location Table Country Number (LTCC), the combination of which provides a theoretical 942 valid unique Location Table identifiers.

Below is a simplified extract from one of the Location Tables – this one is LTCC=C, LTN=07, one of the tables used in the UK.

The columns indicate respectively:

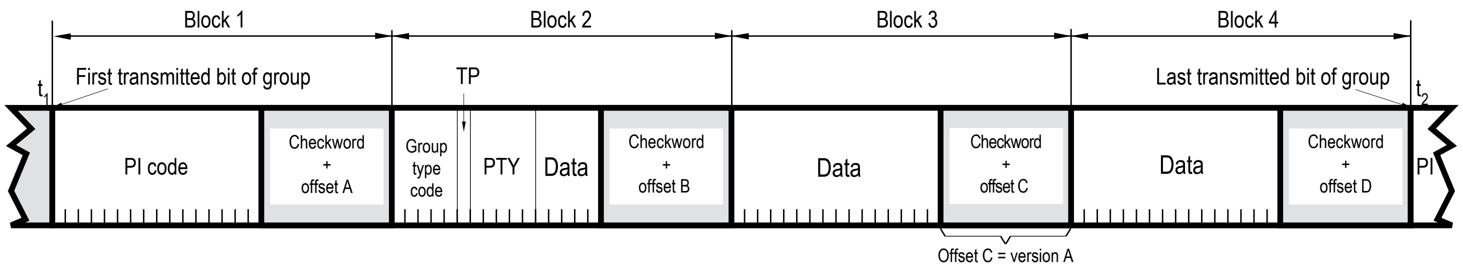
- The Location Code within this table;
- The type of location represented – L is a 'Link', P is a 'Point', A is an 'Area'.
- The location is described using the Road Number, and Road Names
- Precise Latitude and Longitude co-ordinates.
- Area and Linear References place each Location Code in context to other roads in the area.
- Negative and Positive offsets are pointers within the database to the next locations in both directions from any point. The need for this is explained below when the transmission of Location within TMC is described.

LOCATION CODE	TYPE	ROAD NUMBER	FIRST NAME	SECOND NAME	AREA REF	LINEAR REFERENCE	NEGATIVE OFFSET	POSITIVE OFFSET	LAT	LONG
314	L2.1	M25	LONDON ORBITAL DARTFORD		00004					
1091	L3.0	M25	DARTFORD CROSSING	J3 SWANLEY	00003	00314	01103	01092		
3274	P1.0	M25	J1A DARTFORD		00029	01091	03306	03275	51.453	0.24234
3275	P1.1	M25	J1B SWANSCOMBE		00029	01091	03274	03276	51.4379	0.23888
3276	P1.3	M25	J2 A2 INTERCHANGE		00029	01091	03275	03277	51.4263	0.2384
3277	P1.3	M25	J3 SWANLEY		00029	01091	03276	03278	51.3885	0.19386
1092	L3.0	M25	J3 SWANLEY	J5 SEVENOAKS	00003	00314	01091	01093		
3278	P1.3	M25	J4 BROMLEY		00029	01092	03277	03279	51.3468	0.1564
3279	P1.1	M25	J5 SEVENOAKS		00029	01092	03278	03280	51.2914	0.14306
1093	L3.0	M25	J5 SEVENOAKS	J7 M23 INTERCHANGE	00003	00314	01092	01094		
3280	P1.3	M25	J6 CATERHAM		00049	01093	03279	03281	51.2589	-0.0641
3281	P1.1	M25	J7 M23 INTERCHANGE		00049	01093	03280	03282	51.264	-0.1279
1094	L3.0	M25	J7 M23 INTERCHANGE	J10 BYFLEET	00003	00314	01093	01095		
3282	P1.3	M25	J8 REIGATE		00049	01094	03281	03283	51.2587	-0.1982
3283	P1.0	M25	J9 LEATHERHEAD		00049	01094	03282	03284	51.3092	-0.3245
3284	P1.3	M25	J10 BYFLEET		00049	01094	03283	03285	51.3221	-0.4504
1095	L3.0	M25	J10 BYFLEET	J12 M3 INTERCHANGE	00003	00314	01094	01096		
3285	P1.3	M25	J11 CHERTSEY		00049	01095	03284	03286	51.3749	-0.5091

To transmit a single Location Code requires 16 bits and a further 10 bits are needed to identify the Location Table identifier (LTN and LTCC) in which the code exists. Further, the majority of traffic messages require the use of two locations to mark the beginning and end of the road section being - these are termed the 'Primary Location' and the 'Secondary Location'. By agreement and for technical reasons, the Primary Location is the point furthest from the driver as he approaches the section of road (e.g. the point at which an accident has occurred), and the Secondary Location marks the point at which the driver will first encounter the resulting tail-back of traffic, caused by the accident.

CODING WITHIN AN RDS GROUP

An over-riding principle of RDS is that data integrity within a single group is excellent, and wherever possible data should not be split across groups. All RDS groups comprise 64 data bits, of which the first 27 have fixed defined usage, leaving 37 bits available for use application-specific use.



Identified above is that an EVENT code is 11 bits, and the Primary and Secondary LOCATION codes each require 16 bits, and the Location Table identification requires a further 10 bits. Event and Location codes therefore alone would require a total of 53 bits, with additional bits needed to code DURATION and START and STOP times and QUANTIFIERS etc. It becomes clear that several RDS groups sent in succession would be needed to transmit just a simple single message – with the need for the receiver to perfectly several RDS groups in succession before a complete traffic message could be received. For reliability of reception and data efficiency therefore it is necessary to reduce the number of bits sent to 37 or less such that message can be generally transmitted in a single RDS group.

The EVENT code cannot reasonably be reduced, so the majority of bit savings come from the LOCATION code. Firstly, within any area (in a single transmission) it is most usual that all locations will be from the same Location Table, so rather than transmit these 10 bits Location Table Identifier with each message, it is sent only periodically, and considered to apply to all messages subsequently transmitted. On occasions where a transmission area covers roads in two or more Location Tables there is a special mechanism to handle this relatively rare occurrence.

LOCATION CODE	TYPE	ROAD NUMBER	FIRST NAME	SECOND NAME	AREA REF	LINEAR REFERENCE	NEGATIVE OFFSET	POSITIVE OFFSET	LAT	LONG
3282	P1.3	M25	J8 REIGATE		00049	01094	03281	03283	51.2587	-0.1982
3283	P1.0	M25	J9 LEATHERHEAD		00049	01094	03282	03284	51.3092	-0.3245
3284	P1.3	M25	J10 BYFLEET		00049	01094	03283	03285	51.3221	-0.4504
1095	L3.0	M25	J10 BYFLEET	J12 M3 INTERCHANGE	00003	00314	01094	01096		
3285	P1.3	M25	J11 CHERTSEY		00049	01095	03284	03286	51.3749	-0.5091

The need to transmit 16 bits for each of the Primary Location and Secondary Location codes is also not necessary, as the location of the Secondary Location will be relatively close to the Primary Location – typically further along the same road. The design of the Location Table therefore is not random, and in general each road is coded from one end to the other on successive lines in the database. In the example above, the M25 in the UK has been coded starting at junction 1A, then 1B, junction 2, junction 3… sequentially along its length. Rather than using 16 bits to transmit the Secondary Location explicitly, it is given as an 'offset' from the Primary location in the number of 'steps up' or 'steps down' (termed Positive or Negative direction) in the table.

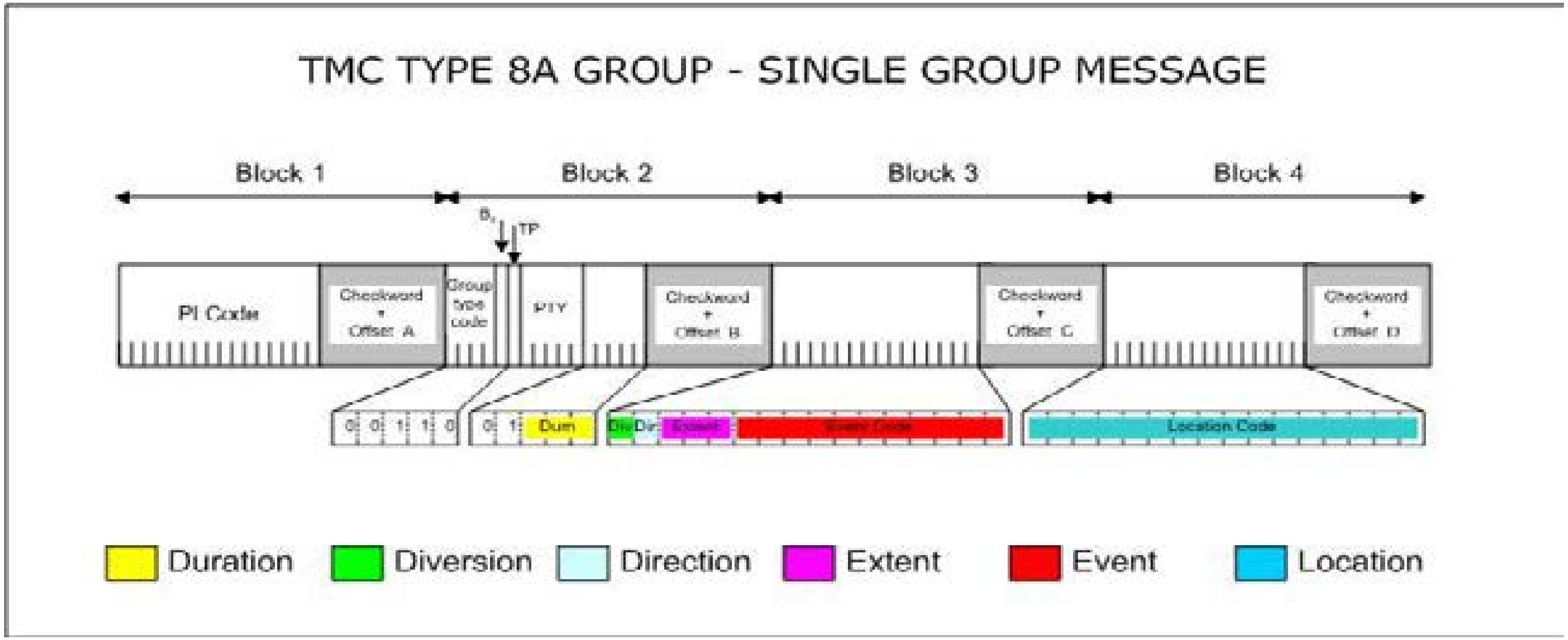
So to code an accident that has occurred on the M25 close to Junction 9 Leatherhead, causing slow traffic back to Junction 11 Chertsey, the Primary Location code 3283 is sent, an EXTENT code with value 2 and a Positive Offset bit.

The receiver determines the Secondary Location by stepping two locations in the database from the Primary Location in the positive direction. From the Table reproduced above, it can be seen that one step positive from primary location 3283 gives location code 3284 (Junction 10 Byfleet), and a second step from this point gives code 3285, which is Junction 11 Chertsey.

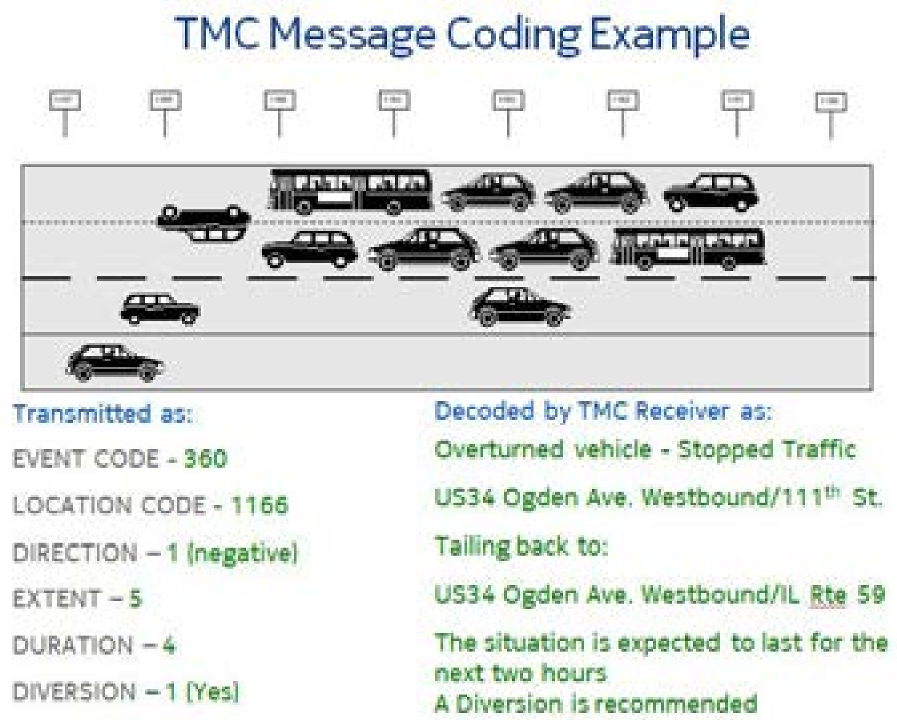
By this method of transmission, only four bits are needed to describe the Secondary Location: three bits provide an offset (of up to seven steps) from the Primary Location and a single bit is used to indicate either the positive or negative direction. This saves twelve bits in the coding of the Secondary Location reducing from sixteen to just four.

The fundamental elements needed for a TMC message, EVENT and LOCATION, together require therefore just thirty-one bits (Event-eleven bits, Primary Location-sixteen bits, Extent-three bits, Direction-one bit) which fits with six bits to spare into the thirty-seven available within the RDS 8A group. Three of these six bits are used to code one of eight DURATIONS, as defined in yet another look-up table, one bit is used to 'highlight' if the incident is so severe that a DIVERSION is necessary because the road is impassible, and the two remaining bits are used to indicate if this group has the complete TMC Message (a Single-Group-Message (SGM)) or if additional information for the incident (e.g. START TIME and STOP TIME, QUANTIFIER etc.) is in a subsequent 8A group, spreading the complete message across more than one group, becoming a Multi Group Message (MGM).

Standard ISO 14819-1 details the precise coding that TMC uses; below is illustrated how a Single-Group-Message uses the available bits.



Shown below is an example of the compactness of the coding achieved by RDS-TMC, using the basic six elements in the single group message.



More Information

When a traffic report is heard on the radio, spoken by an announcer, he or she can impart a sense of urgency to some messages; can indicate if an incident is affecting traffic travelling in just one or in both directions; advise if the problem is actually occurring 'now' or is 'forecast' to happen (e.g. there is expected to be traffic congestion later because there is a concert), can give an indication of whether the incident is a short-term event (an accident for example), or a major road construction project lasting many months; as well as imparting other information including advising of a specific diversion route.

All the above are possible with RDS-TMC, and every TMC message includes an indication of:

- Urgency;
- Now or Forecast;
- Affecting traffic in one direction or both; and
- Whether the incident is short-term (termed 'dynamic') or 'long-lasting'.

To avoid sending all this information for every message, which would certainly make every message a Multi Group Message, the above parameter information is implicit, with each pre-determined for each event code by default.

Below is another extract from part of the Event list, to illustrate this principle. To the right of each descriptive phrase are a number of columns – these indicate the 'default' values for the parameters listed above.

- Column N indicates: if blank, the event is happening 'now': if it has an 'F' the event is 'forecast'
- Column T indicates: if 'D' the event is 'dynamic': if 'L' then the event is 'long-lasting'
- Column D indicates: if '1' the event affects just one direction of traffic: if '2' affects both directions
- Column U indicates: if blank, 'normal urgency': if 'U' indicates 'urgent': if 'X' indicates 'extreme urgency'.

Code	English (UK) Plural Noun (Q>1)	N	Q	T	D	U	C
904	storm damage			D	2		12
986	storm damage. Danger			D	2	U	12
972	storm damage expected	F		D	2		12
905	(Q) fallen trees		0	D	1		12
906	(Q) fallen trees. Danger		0	D	1	U	12
973	fallen power cables			D	2		12
989	fallen power cables. Danger			D	2	U	12
907	Flooding			L	2		12
900	flooding expected	F		D	2	U	12
908	flooding. Danger			L	2	U	12
974	sewer overflow			L	2		12
990	sewer overflow. Danger			L	2	U	12
909	flash floods			D	2	U	12
910	risk of flash floods			D	2	U	12
991	flash floods. Danger			D	2	U	12
911	Avalanches			L	2		12
992	avalanches. Danger			L	2	U	12

So, by design, each message has implicit assumptions about to whom the message is targeted (drivers on one carriageway or both), the urgency of the message, and time frame to which the message applies.

If the assumptions implicit by the default values are not correct on any occasion, then by the use of 'control codes' in a Multi Group Message, then these can be changed for this particular occasion. By way of an example, code 905 details that there is a fallen tree, which by default is said to affect just traffic on one side of the road ('1' in the D column): if in this case the tree has fallen across both carriageways, a control code is sent to 'over-write' the default condition for this particular occasion.

Notice that code 905 also has a value in Column Q. This shows which 'quantifier table' this event uses; in this case it is table 0, which is a table of integer values allowing optionally the ability to send that there are a particular number (quantity) of fallen trees (e.g. three fallen trees). The value in Column C shows which 'class' the message is in – this is important to the message updating process explained later – the values in columns Q and C can't be changed.

The detail of the structure of the 2nd and subsequent groups of a Multi Group Message is outside of the scope of this article, suffice to say that these contain a series of labels, values and control codes, which are used to add quantifiers to certain messages, change default values, and add extra detail (specific diversion routes, start and stop times, extend the length of route affected, advise of temporary speed limits etc.).

3A Group Usage

Being an Open Data Application, RDS-TMC uses the 3A group to indicate the AID for TMC (CD46) using type 8A groups, (and optionally an extension with AID=CD47 using another group type), and also has a few 'application-specific' bits as well. In TMC, the application-specific bits are used to indicate the Location Table Country Code (LTCC) and Location Table Number (LTN) that by default this transmitter uses, as well as a Service Identifier (SID) which identifies the Service Provider for the TMC. A number of additional bits are defined, to indicate the 'depth' of the service – essentially if the service provides information is for all roads in the area, or (more likely) only motorways and other major roads. The information in the 3A group is static data, so needs to be repeated only every five seconds or so, and is used by the device only when first finding a service or as a check after changing frequencies.

Tuning Information

In the same way that it is a basic requirement for receivers to be able to 'follow' an audio programme from one transmitter to the next, which the audio RDS receiver does by using the Alternative Frequencies information in the 0A group, so too is it necessary for the TMC device to follow the TMC service. In some cases it may be that the network of transmitters used for TMC is the same as used for audio, but in most cases the TMC service will use fewer, more, or different transmitters to the audio service. Consequentially the TMC service can transmit its own 'Tuning Information' entirely independently of the audio AF list.

The frequencies on which the same (or even a different TMC service) can be found in adjacent areas are transmitted using the Tuning Information variants within the 8A group. Tuning Information contains the frequency information for a device to follow to an identical TMC service (another transmitter in the same region) or to a different TMC service in a neighbouring country or region when not only is the frequency indicated, but also the Location Table Identifier and Service Identifier and the other parameters the device will need. This information too is considered static, and sent only infrequently, the TMC receiver storing the Tuning Information, which is uses to check frequencies at it moves, in the same manner as an audio RDS receiver evaluates the transmitted AF list.

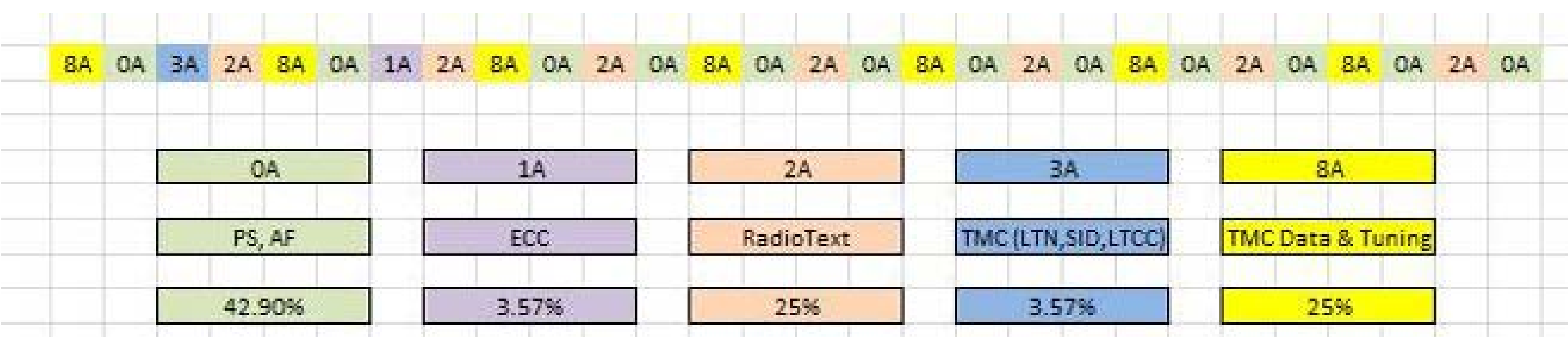
Encryption

To provide a high quality TMC service requires considerable expenditure for the Service Provider. The cost of mapping the country or region, of creating the specific Location Table, and the collection, processing and transmission of the TMC data, all are costly. For these reasons all the premium quality TMC services are operated commercially, with the Service Provider selling its TMC service, either directly to the end-user, or more usually to a device manufacturer who sells his devices to end-users.

The coding of RDS-TMC is in the public domain and as it is a broadcast service, any device that understands the coding can make use of the data. To protect and control the usage of the broadcast TMC service either of two mechanisms is used. The simpler one is that the Location Table is licensed for use by the Service Provider, as clearly without access to the Location Table, all information is worthless. The downside of this approach is that there becomes a multitude of different Location Tables in areas where there is more than one TMC service. Each table has to be integrated into the digital map and stored within devices. The TMC device manufacturers were not happy with this approach, so instead a method of encrypting the TMC data was standardized. The process is easy to explain, and again uses the simple premise that without Location information, all other data has no value. In TMC encryption the sixteen bits that are used to transmit the Location Code are transformed using a three-stage bit manipulation process, using one of 256 sets of values The 256 values are described by an Encryption Identifier (ENCID) and a Service Key (SVK). Although the 256 sets of values are standardized, they are not made public, and the particular SVK a Service Provider chooses to use is NOT broadcast and only exchanged in confidence between a Service Provider and his customers (device manufacturer). Information in the 3A group indicates the TMC service is encrypted, so the device knows it has to apply the decryption algorithm (the inverse of the encryption process) in order to produce correct information – the values used for encryption may change daily giving added levels of protection.

Group Sequence with TMC

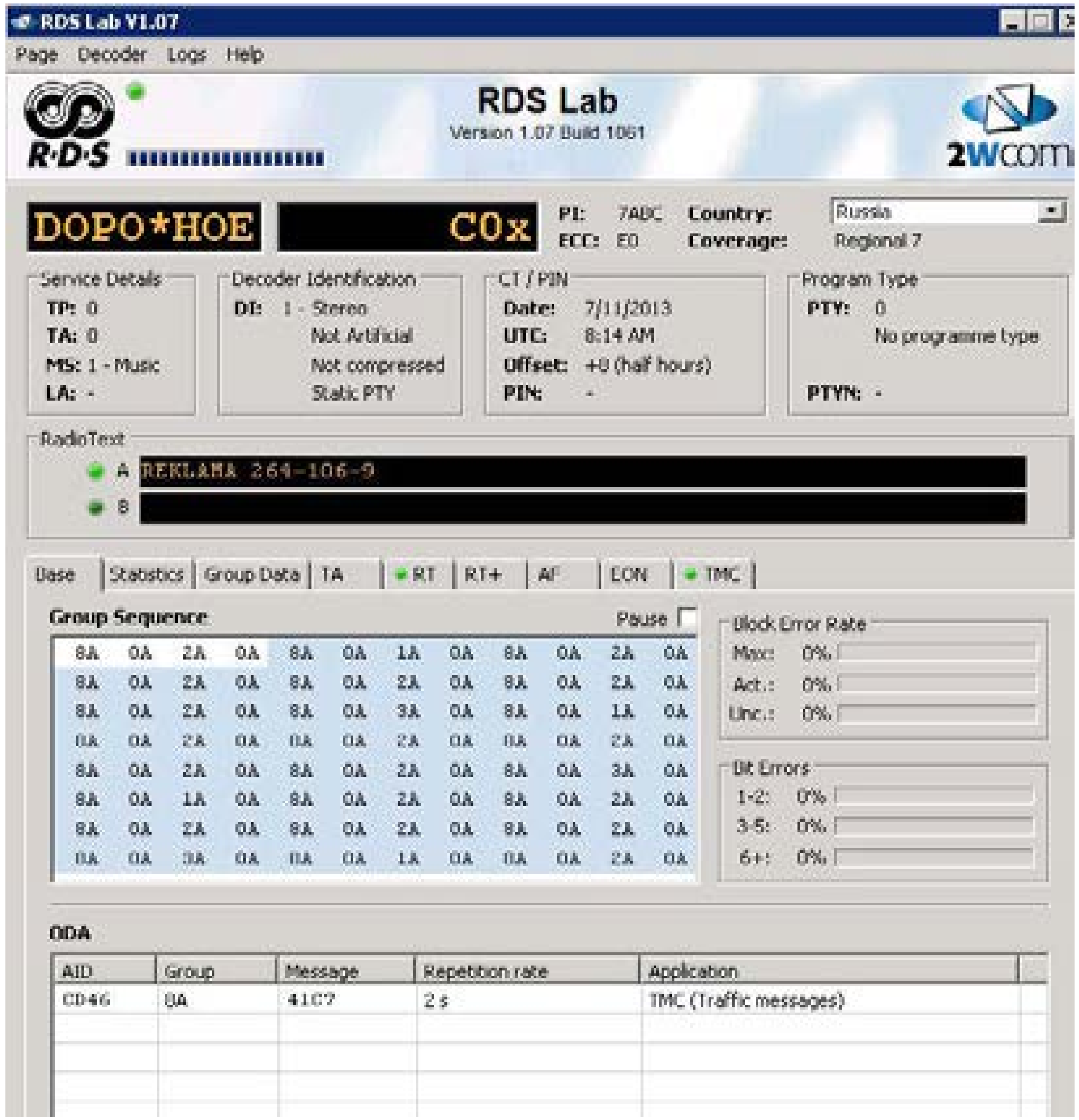
The maximum rate allowable for 8A TMC Data groups within an RDS stream is one TMC data group per four RDS groups (i.e. every fourth RDS group is an 8A) – this equates to 2.85 x 8A groups/second. Whether this rate will be possible is entirely dependent upon if there are any other ODA applications in use, or if heavy use is made of for example EON. However assuming a typical RDS transmission using the Basic 0A group and 2A RadioText, and a 1A group to provide ECC, this maximum 8A TMC insertion rate is easily possible: below is a typical group sequence to be programmed into the RDS encoder. This sequence achieves the objective of maximum TMC data groups, each variant of the 3A ODA group being sent in less than 5 seconds, a realistic throughput of RadioText, and a complete PS transmission is less than 1 second – all in accordance with the guiding principles in the RDS specification, and fully in conformance with the TMC specification. The encoder will automatically insert a 4A (Clock Time) group into the sequence at the top of each minute.



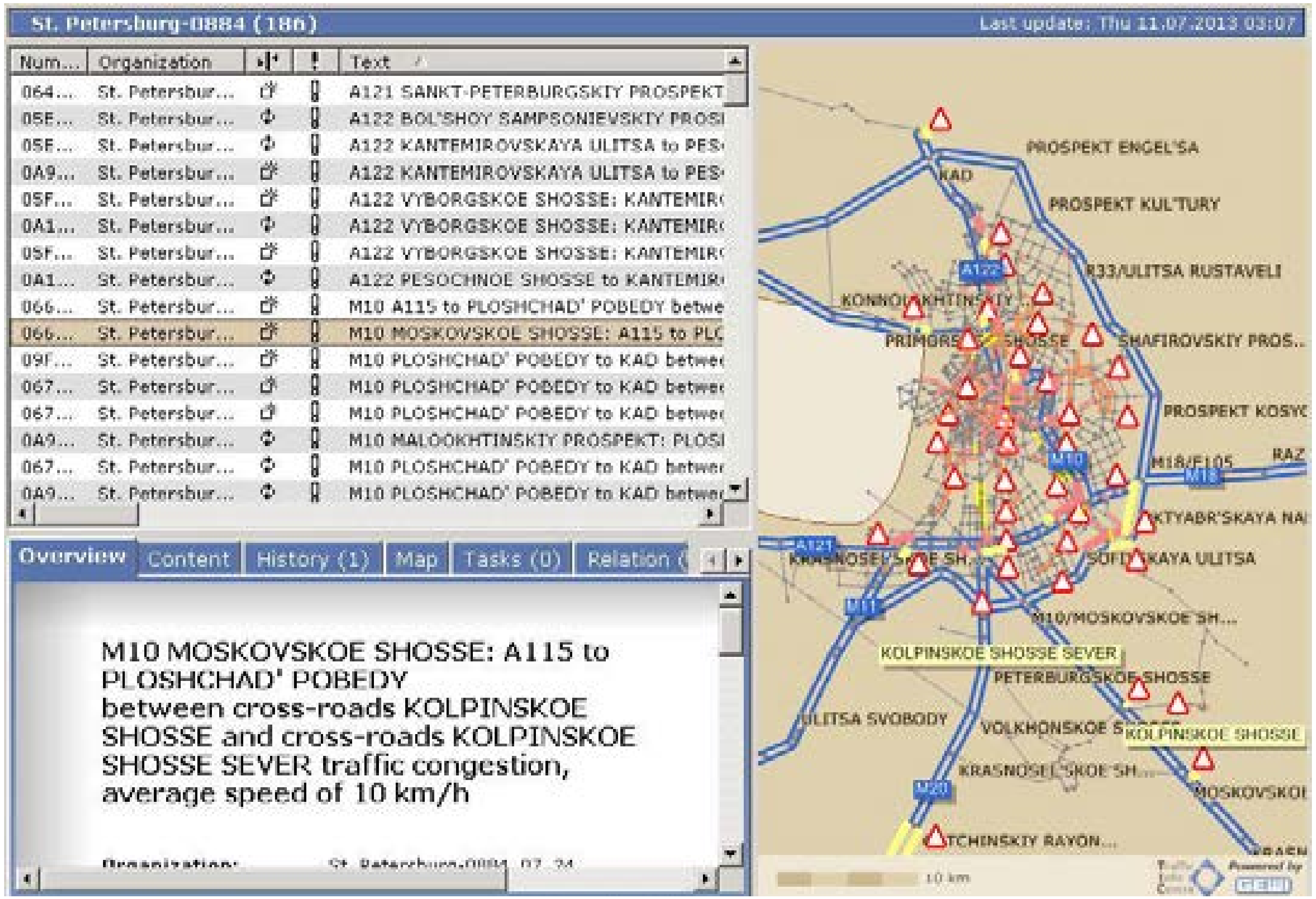
Note also that in this sequence the 8A groups are sent precisely every fourth group – this isn't just for cosmetic reasons – but is a useful factor in receiver design. As explained above, it is essential for the TMC tuner to follow the TMC service across transmitters as the vehicle moves, and by providing predictable gaps between TMC groups – in this case a three group gap – the gap can be exploited by the receiver for checking the Alternative Frequencies for the TMC service. The three-group gap between successive 8A groups (approx. 300 ms.) is more than ample time to sample the signal strength and check the PI code of one or more of the frequencies contained in the Tuning Information. Using these gaps for frequency evaluation means that no TMC data is lost during the process. Although of course the receiver is able to determine the gap size from observation of the group sequence, it is also explicitly given in the 3A group information.

Although RDS is robust with good error detection, in poor reception conditions errors can occur, as witnessed by an occasional incorrect character in a PS or RadioText message. Errors in PS or RT are not too important, but in TMC, no errors at all can be tolerated, as a single bit error can for example, show a serious accident on the wrong carriageway or in a completely wrong location. For this reason the same TMC message is sent more than once: preferably three times in total but certainly at least twice, with the receiver having to receive the same message identically twice before presenting and using the data. So in practice it takes three 8A groups to transmit a single (Single Group Message) TMC event. At this maximum insertion of TMC data groups into the RDS Group Sequence (25%), 171 x 8A groups/minute are transmitted, so a theoretical total of 171/3 = 57 TMC messages per minute are possible. In practice as some 8A groups carry Tuning Information, the practical throughput of TMC messages is realistically 50 messages per minute. It is the aim to update information at least every five or six minutes, so each transmitter can broadcast up to 300 TMC messages in total, before updating the information.

The screen-shot below shows the 2wcom RDS Lab monitoring software, decoding the information from one of their C02 model RDS encoders configured for RDS TMC, providing the HERE Traffic service to Russia.



The second screen-shot below is using GEWI's TIC software to fully decode the TMC information and display by means of road colouring and icons the TMC information.



Updating information and Message Management

It is important that changing road conditions are communicated quickly to the driver and his navigation system, with messages updated or cancelled efficiently.

The principle in TMC is simply that a new message overwrites an old message in the receiver memory as soon as it is received. When a message arrives that matches in regard to Primary Location, Direction, and Message Class, a message already in memory, the new information simply replaces the old message. Similarly each class has its own 'cancellation message' which causes a message to be deleted from memory. The Message Class is important, as at times there will be two messages at the same location (for example an Accident (class 3) and the resulting congestion (class 1)) and it is necessary to update or cancel just one of these messages.

Although the TMC receiver is usually expected to receive updates and cancellation messages, there is no certainty that it will, as the receiver could momentarily drive out of coverage area, or be switched off – perhaps when the vehicle stops to re-fuel – meaning the message is not updated or cancelled. To prevent messages remaining indefinitely in memory, it is required that messages automatically expire in the receiver after a period of time. The best approach is that simply a message is deleted from a receiver fifteen minutes after it was received. Of course, if a cancellation message is received before the fifteen minute period, it is deleted immediately, but the fifteen minute serves as a useful 'back-stop' to ensure the receiver does not retain old information.

Summary

The above is a comprehensive but simplified description of how the Open Data Application has been used by the Traffic Message Application to provide detailed real-time traffic information to millions of in-car fitted and portable PND devices worldwide.

Although RDS is considered by some to be a relatively low-tech way of getting data into vehicles, it has stood the test of time well, and although there are now fewer RDS-TMC services on air in 2025 than there were at the peak between 2005 and 2020, services still exist across the world, and given that vehicles produced in the 2020s will still be on-the-road well into the 2030's RDS-TMC services are expected to continue well into that decade

Broadcast technologies (RDS, DAB) have clear cost advantages over connected solutions, as the latter require end-users to buy all-inclusive data plans from their cell-phone providers, and in addition require the Service Provider to continually add more servers and processing power for each new customer. Although in terms of data rates possible, there is a clear advantage over RDS in the capacity on DAB, the design of DAB is such that it is engineered to provide nationwide (or at least supra-regional) coverage, so as such the DAB technology is fundamentally at odds with the need to provide any service with local content, including traffic and weather information. In other words, on a national DAB multiplex, the majority of information transmitted will be irrelevant for the end-user. RDS in comparison is broadcast using transmitters with a smaller coverage footprint, each providing only information relevant to the transmitter coverage and reasonable driving range beyond. Sensibly implemented therefore, the combined capacity of a network of FM transmitters can easily exceed that of the capacity available to allocate for traffic information on DAB.

The low cost and low power consumption of RDS chipsets mean that RDS-TMC devices are inexpensive to produce, and as such have spread, and will continue to spread, to less-affluent consumers, especially in developing countries where there are no plans to replace FM broadcasting because of the high costs of alternatives.

TMC and RDS2

In order that the ‘basic’ (PS, AF, Radiotext etc.) features of RDS are transmitted with regularity, not more than 25% of the capacity on the main RDS subcarrier can be devoted to TMC; and as stated above this imposes a maximum of about 50 TMC messages per minute per transmitter. This may seem a substantial number, but as in recent years traffic information providers have details of traffic movement along all roads, not just Motorways and Highways, and there is more information available than there is capacity on the main sub-carrier to transmit.

RDS2, with its additional sub-carriers offers a terrific opportunity for TMC. A realistic scenario is that the whole of one of the additional sub-carriers could be used exclusively for TMC.

TISA is the organization that standardizes the coding and use of TMC, and in 2018, two options were suggested to them as to how an upper sub-carrier could be used.

1. TISA could advise that the upper sub-carriers could be used for TMC, using the same protocol as the main sub-carrier (i.e. retaining the 37-bit structure, 'tunnelled' into a Type 'C' group. This would be easy for both a Service Provider and Device Manufacturer to implement as the structure remains the same on both the main and additional sub-carriers. Using just a single upper sub-carrier in its entirety for TMC would give an immediate four-fold increase in TMC message throughput – 200 messages per minute per transmitter.

2. A further option could be to define a different protocol for use on the upper sub-carriers, taking advantage of the 56 bits available there (the main sub-carrier has only 37 bits available). The 50% extra coding space available on the upper sub-carriers could be used to simplify the TMC coding, eliminating for example most cases where a 'multi-group-message' needed to be transmitted, further increasing message throughput. The disadvantage is that the new coding utilizing 56 bits would have to be defined – relatively easy – but manufacturers would also have to apply different protocols for the main and upper subcarriers.

Either option could be used to enhance existing RDS-TMC services: there would be no change to the existing service and coding on the main sub-carrier, so that all existing receivers would continue to work unaffected. New devices capable of using the upper sub-carriers would additionally gain details of traffic flow and incidents on the urban and secondary roads, this information, which for reasons of capacity limitations on the main sub-carrier are filtered out, would be transmitted on one of the upper sub-carriers.

In 2018, TISA was re-submitting its TMC specifications (ISO 14819 series) for re-standardization by ISO and TISA were encouraged to consider both options to include in the re-submissions. There was unfortunately no decision taken by TISA. A number of manufacturers were quite opposed to any enhancement of TMC which they felt was unlikely to expand significantly and without a Service Provider committing to introduce a service using an upper sub-carrier, were unwilling to even consider options; so the use of TMC on the upper sub-carriers is not even mentioned in the updated TISA and ISO specifications. Whether RDS2 upper sub-carriers are used for TMC will consequently be driven by an agreement between a Service Provider and its customers, and the method chosen will become de-facto, rather than by TISA.

Regardless of no decision being taken by TISA, the use of RDS2 sub-carriers provides a tremendous low-cost option for the broadcasting of densely-coded real-time traffic information that easily competes and, in most cases, surpasses possibilities offered by other broadcast bearers and protocols.

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Chapter 8

The Future of FM radio with RDS by Dietmar Kopitz

During the past 30 years, the usage of RDS in FM radio receivers has tremendously increased.

Nevertheless, specifically among some European public broadcasters, there is an attitude now that FM and RDS are “not alive and kicking” any longer. I think, on the contrary, that in spite of their age FM radio, which is now over 70 years old and RDS, which is over 40, in combination, both remain very attractive and totally mature radio broadcast technologies that can, but must not necessarily be replaced by digital radio. This is in Europe already confirmed by the fact that DAB had compared with FM/RDS radio, within the 30 years since DAB is available, only a relatively limited market acceptance. Still DAB is not used by all European countries, and this in spite of all the ongoing digital radio promotion

The RDS Forum holds the view that the RDS technology is firmly established nowadays with RDS2 being added to the worldwide RDS standard IEC 62106 (all parts) . Within the industry and for FM radio broadcasters it still has many attractions to offer, particularly now in the mobile environment with smartphone and tablet devices and by using the possibilities offered by using the new RDS2 options Station logo, Slideshow and Internet connection, which includes the radio programme service following option for mobile devices over IP when the connected car receiver is out of the initially tuned FM radio service range.

In the years 2005 to 2008 the RDS Forum had added to the RDS standard two new RDS - Open Data Application (ODA) features: RadioText Plus (RT+) and enhanced RadioText (eRT).

The use of the ODA feature means in RDS that the new function is backwards compatible with old receivers. Any new RDS-ODA feature will not disturb them, as it cannot be decoded. But new ODA features can then be used by newly designed receivers that intend to implement the innovation. RT/RT+ can only use the RDS character set, but with eRT/eRT+ the same functions can be used with UTF-8 character coding anywhere in the world.

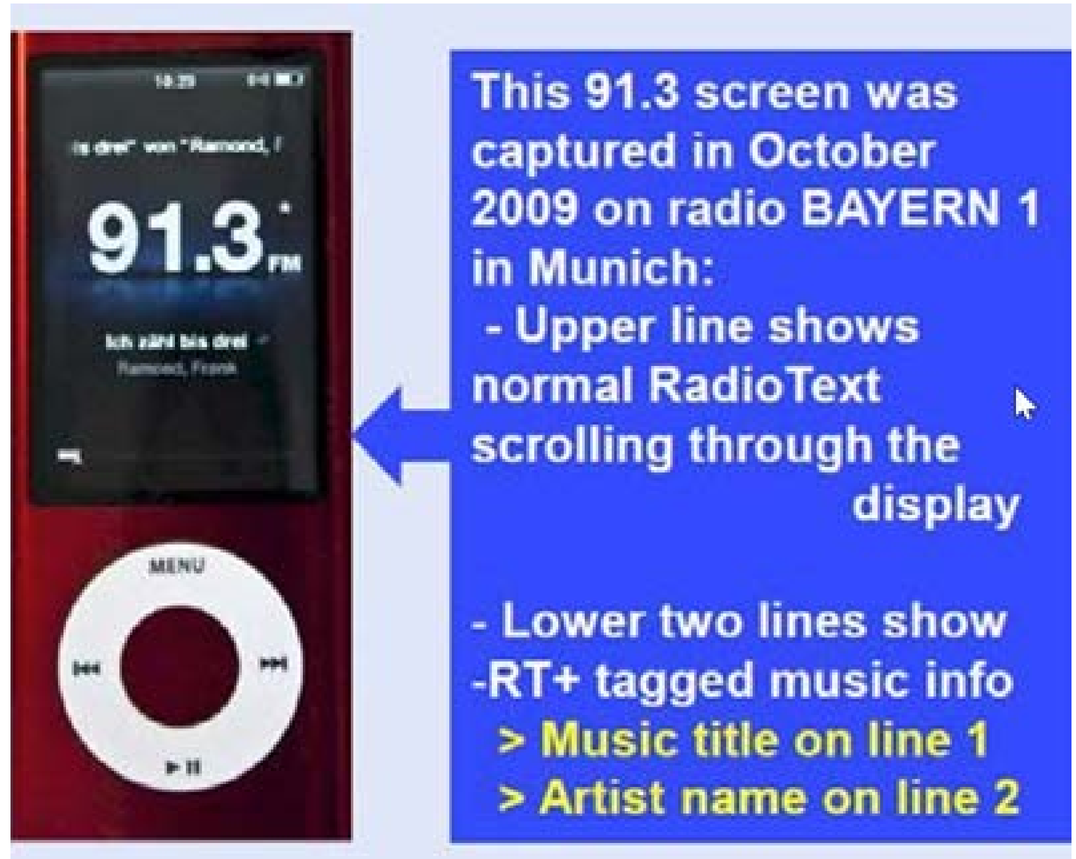
There is not yet the majority of FM receivers on the European market that supports RT+, simply because broadcasters do not yet widely use RT+ and thus the market is not yet big enough. However, in the USA broadcasters increasingly have used RadioText Plus to tag ‘music titles’ and ‘artist names’.

The digital radio systems DAB+ and HD radio can do this as well.

Since September 2009 the Apple iPods nano (5G, 6G and 7G) had an RDS FM radio incorporated and it had the RT+ feature well implemented, so that it could display ‘music title’ and ‘artist name’. However in 2017 the iPod music player was retired, given the fact that music listening has become fully integrated into smartphones using Internet streaming services such as Spotify etc.

In Germany the public broadcasters have implemented RT+. Up to 25 regional FM programmes use RadioText Plus.

In the USA over 450 stations implemented RadioText Plus nationwide since 2008, which created an important market.



Apple had well implemented its music player iPod nano 5G (also 6G, 7G) which had an FM/RDS receiver incorporated with the RDS-RT/RT+ feature for the display of broadcast "Music titles" and "Artist names." These RT+ tags are much used by broadcasters in Germany and the USA. In 2017, the iPod nano line was discontinued. As the iPod nano was relatively inexpensive, it was a quite attractive RDS receiver product that one could use to monitor broadcasts using the RT+ feature. It is still possible to purchase those old iPod nano models on eBay, if needed.

Many small portable RDS devices also can transmit now on FM, within a short-range distance of a few metres, audio and RDS data to the car audio system, an application covered by the RDS standard. In 2008, the RDS Forum agreed this implementation option, in order to avoid that the industry outside the Forum uses RDS for this particular application in an uncontrolled manner.

When RDS Forum Members exchange their experience about RDS, one important issue which often comes up, is the correct usage of RDS. Sometimes corrective action in respect of the broadcasters can be taken with quick success. Often the manufacturers within the RDS Forum take the initiative to point out what is wrong with the signals on air. The listener will only blame the product maker and not the broadcaster, if something is wrongly working.

In March 2024, RDS turned 40 - not the RDS Forum, which started only in 1993 (so it just got 30). The first RDS specification, was published by the EBU in March 1984.

RDS has been and still is a 'silent revolution' and not all broadcasters are fully aware of its success.

Nowadays, 40 years after that technology was created, nearly all FM radios in Europe use RDS. ICs have become available that have an FM receiver and an RDS decoder on the same chip and the price for such a chip, if bought in quantities, is now extremely low, say to give the magnitude, less than one USD. The trend of this price is still falling and the quantity of such chips sold on the world market is still much increasing, nowadays over one billion units per year.

Applications of RDS are now within mobile phones and portable network devices. The more traditional car radios may still have a separate RDS decoder IC, but nowadays RDS decoding is also very often an integral part of a dedicated multi-purpose digital signal processing DSP, even necessary for products without RDS. In software defined radio products the RDS and the optional RDS2 function price is then almost zero, as it is done in software only and RDS2 can be equally supported, without significantly increasing the price of the micro-processor's circuit board. The RDS Forum member NXP is a forerunner in this technology.

Like RDS, also RDS2 was created since 2014 as an open technology and for using it there is no license fee to be paid.

In Europe at least, it was actually RDS that made FM broadcasting very successful and extremely widespread. Thus RDS technology will continue to live as long as FM broadcasting. Thanks to the RDS2 development the RDS Forum is convinced that FM has regained its firm position in the radio broadcast world.

Radio listening is still a very popular activity – everyone listens to the radio on average two to three hours per day. It is entertaining and a secondary activity so that the listener can do other things while being entertained, which is not at all the case for TV. In the USA and in 2024 AM/FM radio is the most important (59%) entertainment option for consumers when considering their car purchase, according to a DTS connected car report.

The freely available data capacity with RDS, not using RDS2, is relatively low.

In an FM broadcaster network, up to 40% of the RDS capacity is mandatory programme information like PI, PS, PTY and AF lists, all in the 0A type groups. When in addition RadioText RT and EON information are transmitted, only about 25% of the data capacity can be used for services carried by ODAs, such as TMC.

Often then choices have to be a trade-off and must be made between those applications that can be implemented in one RDS channel. For example, to choose between a rich RadioText (RT) service or a full TMC service, it is not always possible to have both simultaneously in the same FM radio programme.

However, with RDS2 this issue can now be solved completely.

ODA groups on the upper carriers will be using a specific byte-oriented ODA data transfer protocol (C-type group coding) which is great for the development of future applications. To transfer files the RFT (RDS2 file tranfer) protocol exists since 2018 and in 2021 it was added to the RDS standard Part 2.

Thus, a real milestone was taken within the RDS Forum 2018 with the development of the RDS2 file transfer procol RFT. The file transfer protocol was designed to have nothing to do with the content of what is being transferred, just as with the well-known Internet FTP protocol. One can compare this with the action when you press a download button on some web page to download a file. A “mechanism” will retrieve the file and store it somewhere on your system. Your OS will not know what to do with this file until you call an application (ODA) like Word, ... to open the file. These future RDS2 ODA applications will thus know the structure of the downloaded file and deal with the content accordingly.

The RDS Forum now considers the following use cases for file transfers and it is foreseen to validate them for vehicle reception as soon as possible:

- station logo,
- programme logo,
- cover art for music items,
- weather information
- alarm messages, etc.

Why not use all the features that RDS and RDS2 can now offer? For example, as described earlier, RadioText Plus with music titles and artist names and also CD cover art and Station logo as an image. All these latter are now attractive features of digital radio, but RDS/RDS2 permit to implement just the same for FM radio.

When RDS was in its infancy, there were only few data links between broadcast studios and transmitters, but with the onset of DAB, HD Radio, digital satellite radio and the Internet these data links exist now for most broadcasters' stations, and so it has become very easy to offer many dynamic RDS programme features now, see also the chapter on MPX and microMPX.

In their car radio displays BMW had implemented RT+ very well. In this RT message two eleents are tagged: "James Blunt" is tagged as ITEM.ARTIST and "Bonfire Heart" as ITEM.TITLE.

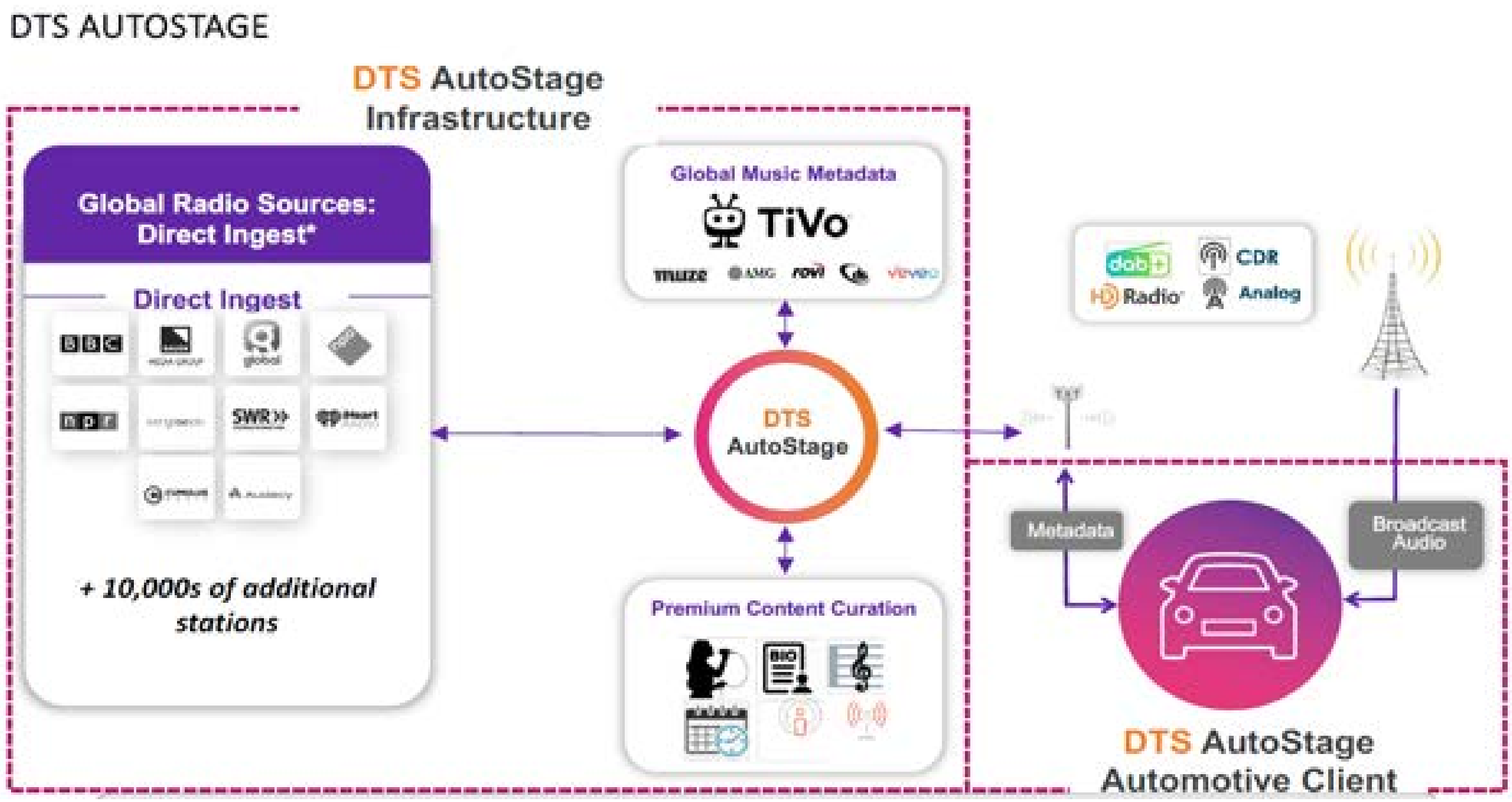
The same technology options are used for digital radio, DAB+ and HD radio. They are all internationally agreed, but remain so far almost totally unused on FM radio, probably because broadcast managers often believe that digital radio could do it anyway, but if it did, it would do it in a very similar way as FM radio can do it now.

I share the view with most RDS Forum members that FM and digital radio will thus co-exist still for a long period of time.

The left image shows a test receiver designed by David Jaillet from former Cameon, now Biyotee, for Radio France with the image received by the RDS2-ODA Slideshow on FM. The right image is received with the LG-K520 smartphone of 2017, the only mobile phone so far that was available in Europe with a DAB+ and an FM radio with RDS, now discontinued.

For receiving Internet streamed radio broadcasters have developped their own applications; this one from NDR in Germany shows their play list of music items.

Car infotainment systems now use for the connected car a very large screen to display information received from the Internet. Then such radios could be sent by RDS the URL of the broadcaster's web site. The radio can thus display right away complementary content to the audio signal on air. This mode of operation, also called "Hybrid Radio", is simple and will definitely enhance the radio programme content, specifically for a younger audience. RadioDNS uses this and RDS Forum member XPERI offers an attractive car radio service called DTS AutoStage. With the IP connection being bi-directional, information about what radio programme is being listened can be collected and being fedback to the broadcaster in the form of audience statistics. The RadioDNS hybrid radio concept with visual radio, interactivity and an electronic programme guide can also definitely enhance the FM radio listening experience for receivers using a large display.



XPERI proposes this hybrid connected car radio concept for North America and Europe as from 2025. Reference: RDS Forum document R24/025_1.

With hybrid radio smartphones, like here the Samsung Galaxy, and Tablets can be used as mobile radio receivers. The display can provide by means of an appropriate “App” a lot of complementary information to the programme on air. Specifically younger audiences will find this attractive. Radio France had started some years ago, nationwide, a hybrid radio trial called “Hybradio” on its FM radio programme “France Inter”.

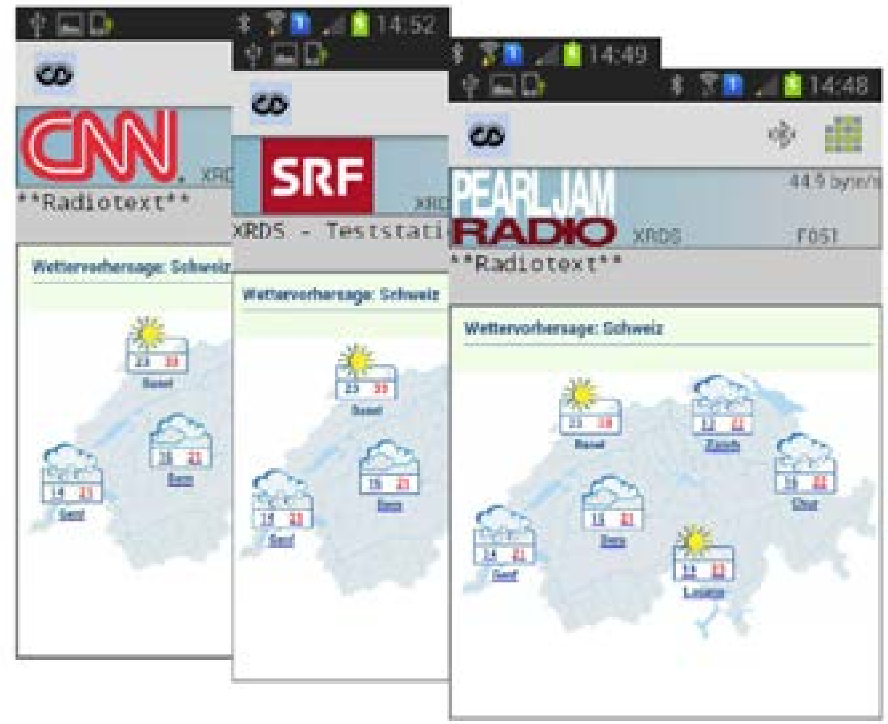
When will RDS2 be ready for the market? This question is not yet easy to answer. The speed of that new development will clearly depend on the magnitude of interest that it can generate among broadcasters and industrial partners involved. If they all would push that technology to deploy it quickly on the market, then 2-3 years as from 2023, when everything required was standardized, appear to be realistic for to be ready on the transmission and on the receiver side.

In 2018 one RDS Forum member (WorldCast Systems in Bordeaux) launched an RDS2 encoder already for almost the same price as their normal RDS encoder, but now fully supporting also the three additional subcarriers for RDS2.

The RDS Forum has been adapting the UECP, standard IEC 62106-10 from from 2021, to include everything needed to transmit all the RDS2 possible options.

To make RDS2 quickly happen, it will be also necessary to promote widely the new possibilities offered by RDS2. The RDS Forum is prepared to give its full support to this task.

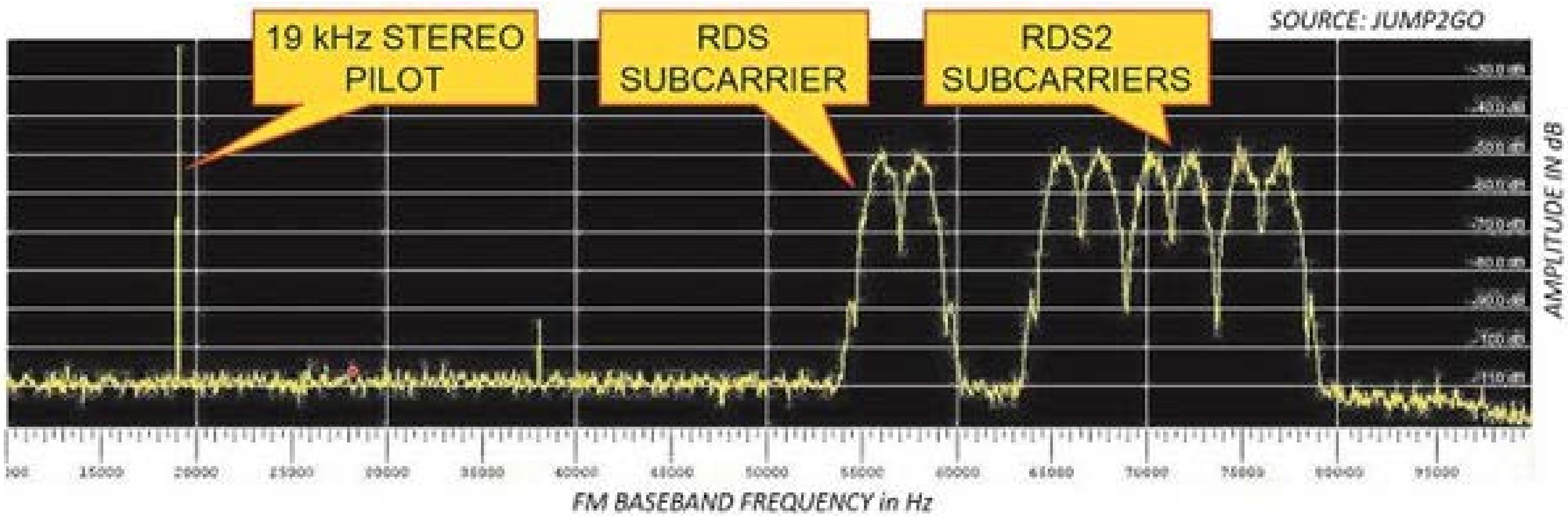
More information on the ongoing RDS2 development is available on the RDS Forum's web site.



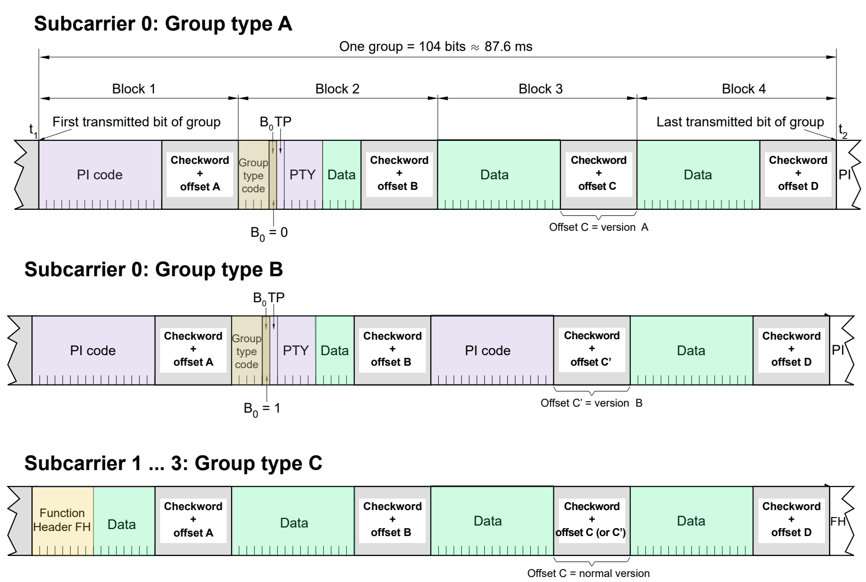
At the RDS Forum 2013 examples were considered about what kind of data could be used by broadcasters to serve receivers with a large display such as on smartphones or those now increasingly used in vehicles. Here we see how attractive programme logos could be used and how one could present the weather information with RDS2.

RDS2

R·D·S RADIO DATA SYSTEM



RDS2 - The modulation and demodulation characteristics as defined in the RDS standard since 1984 are also valid for the three additional carriers. Both sidebands around 57 kHz with RDS are repeated up to a maximum of four in total. These are centred on additional carriers higher up in the FM multiplex. The technique to achieve this is simple: Just duplicate the RDS data stream a few times and use for the coding of the additional capacity, primarily for the ODA feature with the new byte-oriented RDS group type C, as shown below. Each group type C can carry 7 bytes with data for the ODA.



Comparison between previous RDS (previous standard versions) and current RDS/RDS2 (standard version 2023)

Feature	Previous RDS	New RDS/RDS2
Alternative Frequencies /AFs	87.5 to 108 MHz	Extended: 64 to 108 MHz
Programme Service name (long)	PS 8 characters max	LPS: up to 32 Byte, UTF-8 coded
File transfer	No	Yes - Any file format up to 163 KByte size
Service Following	FM & Digital Radio	FM & Internet Radio streaming
Enhanced Radio Text / eRT	Up to 64 characters / Latin based or UTF-8 coded	Up to 128 byte / UTF-8 coded / Multilinguistic
Enhanced Radio Text Plus / eRT+		RT and eRT can be used at the same time
Traffic Message Channel / TMC	Few messages (max. 50 messages/minute) Consequence mainly motorway oriented	Many more messages (using a second subcarrier about 250 messages/minute) More detailed TMC based on more road classes
Open Data Application / ODA	ODA - 21 and 37 bit structure Types A and B	Types A and B can be tunnelled in new 7 byte ODA structure with “C” groups
New RDS2/ODA - 7 byte structure (new group type C)		Open for many new applications
Number of subcarriers	one	up to 3 additional ones
Number of parallel active Open Data Applications	up to 20 (8-Type A; 12- Type B)	up to additional 64 (Type C) (of which 16 are reserved to transfer files using the RFT protocol
Implementation cost	low	Insignificant increase
IPR free	yes	yes
Backwards compatibility 1)		yes
Open for future applications and Program features	Limits of available RDS data capacity reached	Open for added value programme features and many new applications by ODA

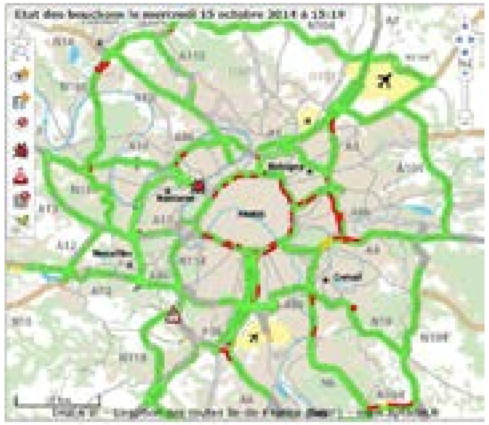
All existing features PI, PS short, Traffic Programme and Traffic announcement TP; TA; Clock Time and date CT, Program Type and Programme Type name PTY and PTYN, Radio Text (Up to 64 Latin based characters)and Radio Text plus (tagging of RT elements) RT; RT Plus and Enhanced Other Network EON remain unchanged.

Obsolete and no longer part of the RDS standard are: MS (Group 0A) certain DI codes (mono/stereo, artificial head, compression), Language code, and PIN. Coding for the following applications is no longer detailed in the RDS standard as these can use in future the ODA concept: EWS, TDC, IH and RP.

For this decade it will definitely be FM-RDS radio that will remain and dominate the market.

Why?

The technology is well established, works perfectly and is much less expensive to maintain. Therefore, under these particular circumstances, RDS2 would have a good chance and the RDS Forum could well help to make it happen. From a technological point of view RDS2 appears to be a very attractive extension in the mature FM-RDS landscape.



The first illustration on this page shows well the future potential of RDS2 for using on a good and inexpensive portable radio a station logo or a graphic label for the programme item on air (in 2025 available only with DAB+ and for FM only with RT). The second illustration on this page indicates that by using RDS2 tunnelling more detailed local traffic information with RDS-TMC can be distributed on the upper subcarriers. The unanswered question remains of course of whether broadcasters and data service providers will go for this option.

In the USA - will FM radio with RDS also continue there?

Yes - without any doubt as there are no digital radio switch-over plans at all yet. DAB is not being used in North America and HD Radio is the preferred solution there for digital radio.

HD Radio uses a wide-band data stream that is part of the FM multiplex and thus it is complimentary to FM radio, then providing the possibility to offer additional radio programmes and data services. The technology used since over 20 years is very mature and over 3000 FM stations in the USA, which is 20% of all US FM stations, use it with in 2025 more than 110 million car receivers already sold in North America and supported by the whole automotive industry with 60% of all cars being delivered with line-fitted HD radio capable receivers, or otherwise available as a consumer option. FM radio with RDS will continue there for long as well.

RDS character coding and decoding

by Joop Beunders, Dietmar Kopitz and Attila Ladanyi

Coding of PS, EON-PS, RT and TMC provider name

Very often the software developers of tools to control RDS features like RT (RadioText) and PS (Programme Service name) make a mistake and don't do the conversion of the characters from the special RDS one-byte character set to ISO two-byte character or UTF-8 codes. Thus, there are then RDS receivers and RDS monitoring software or devices having the wrong character set implemented. This also concerns the software used for the RDS server that communicates with the RDS encoders, but not the latter ones as they transmit the one-byte character codes as received through the UECP.

So, what is the problem here?

The basic RDS character set to be used is specified in the RDS standard IEC 62106-4, Table 4. This matrix of 256 symbols using only one byte per symbol was defined by the European Broadcasting Union in the early days of RDS, which was in the early eighties. Below code 127 the matrix uses ASCII characters. There is no problem with those, but above code 127 all the characters used are special ones as one can see in Table 4 of IEC 62106-4. These symbols in the upper range of Table 4 represent the special characters used by many languages in Western Europe (German, French, Spanish, Swedish, etc.) except Greek. Western Europe is to be understood in the sense of that time, namely west of the so called "iron" curtain.

No display will support these specific RDS character codes of course. To use them for display purposes they must be transformed to ISO UCS-2 two-byte codes or to UTF-8. This can easily be done using Table 5 of the RDS standard, IEC 62106-4.

Table 1, below, shows the matrix of the special RDS characters with their corresponding UCS-2 ISO code which is not transmitted of course, and which is to be used for the transformation to be done in the RDS decoder/receiver.

0x80	0x81	0x82	0x83	0x84	0x85	0x86	0x87	0x88	0x89	0x8A	0x8B	0x8C	0x8D	0x8E	0x8F	RDS
á	à	é	è	í	ì	ó	ò	ú	ù	Ñ	Ç	Ş	ß	¡	Ĳ	
00E1	00E0	00E9	00E8	00ED	00EC	00F3	00F2	00FA	00F9	00D1	00C7	015E	00DF	00A1	0132	ISO
0x90	0x91	0x92	0x93	0x94	0x95	0x96	0x97	0x98	0x99	0x9A	0x9B	0x9C	0x9D	0x9E	0x9F	RDS
â	ä	ê	ë	î	ï	ô	ö	û	ü	ñ	ç	ş	ğ	ı	ĳ	
00E2	00E4	00EA	00EB	00EE	00EF	00F4	00F6	00FB	00FC	00F1	00E7	015F	011F	0131	0133	ISO
0xA0	0xA1	0xA2	0xA3	0xA4	0xA5	0xA6	0xA7	0xA8	0xA9	0xAA	0xAB	0xAC	0xAD	0xAE	0xAF	RDS
ª	ɑ	©	‰	Ğ	ĕ	ň	ő	π	€	£	$	←	↑	→	↓	
00AA	0251	00A9	2030	011E	0115	0148	0151	03C0	20AC	00A3	0024	2190	2191	2192	2193	ISO
0xB0	0xB1	0xB2	0xB3	0xB4	0xB5	0xB6	0xB7	0xB8	0xB9	0xBA	0xBB	0xBC	0xBD	0xBE	0xBF	RDS
º	¹	²	³	±	İ	ń	ű	µ	¿	÷	°	¼	½	¾	§	
00B0	00B9	00B2	00B3	00B1	0130	0144	0171	03BC	00BF	00F7	00B0	00BC	00BD	00BE	00A7	ISO
0xC0	0xC1	0xC2	0xC3	0xC4	0xC5	0xC6	0xC7	0xC8	0xC9	0xCA	0xCB	0xCC	0xCD	0xCE	0xCF	RDS
Á	À	É	È	Í	Ì	Ó	Ò	Ú	Ù	Ř	Č	Š	Ž	Đ	Ŀ	
00C1	00C0	00C9	00C8	00CD	00CC	00D3	00D2	00DA	00D9	0158	010C	0160	017D	00D0	013F	ISO
0xD0	0xD1	0xD2	0xD3	0xD4	0xD5	0xD6	0xD7	0xD8	0xD9	0xDA	0xDB	0xDC	0xDD	0xDE	0xDF	RDS
Â	Ä	Ê	Ë	Î	Ï	Ô	Ö	Û	Ü	ř	č	š	ž	đ	ŀ	
00C2	00C4	00CA	00CB	00CE	00CF	00D4	00D6	00DB	00DC	0159	010D	017E	017E	0111	0140	ISO
0xE0	0xE1	0xE2	0xE3	0xE4	0xE5	0xE6	0xE7	0xE8	0xE9	0xEA	0xEB	0xEC	0xED	0xEE	0xEF	RDS
Ã	Å	Æ	Œ	ŷ	Ý	Õ	Ø	Þ	Ŋ	Ŕ	Ć	Ś	Ź	Ŧ	ð	
00C3	00C5	00C6	0152	0177	00DD	00D5	00D8	00DE	014A	0154	0106	015A	0179	0166	00F0	ISO
0xF0	0xF1	0xF2	0xF3	0xF4	0xF5	0xF6	0xF7	0xF8	0xF9	0xFA	0xFB	0xFC	0xFD	0xFE	0xFF	RDS
ã	å	æ	œ	ŵ	ý	õ	ø	þ	ŋ	ŕ	ć	ś	ź	ŧ		
00E3	00E5	00E6	0153	0175	00FD	00F5	00F8	00FE	014B	0155	0107	015B	017A	0167	0020	ISO

Table 9-1: Special RDS characters and how they can be transformed to conform to ISO.

Below, in Figs. 9 - 1 is an example. This screenshot shows those special one-byte RDS characters in the range 128 to 255 transformed to two- byte ISO characters, displayed in the Consolas font.

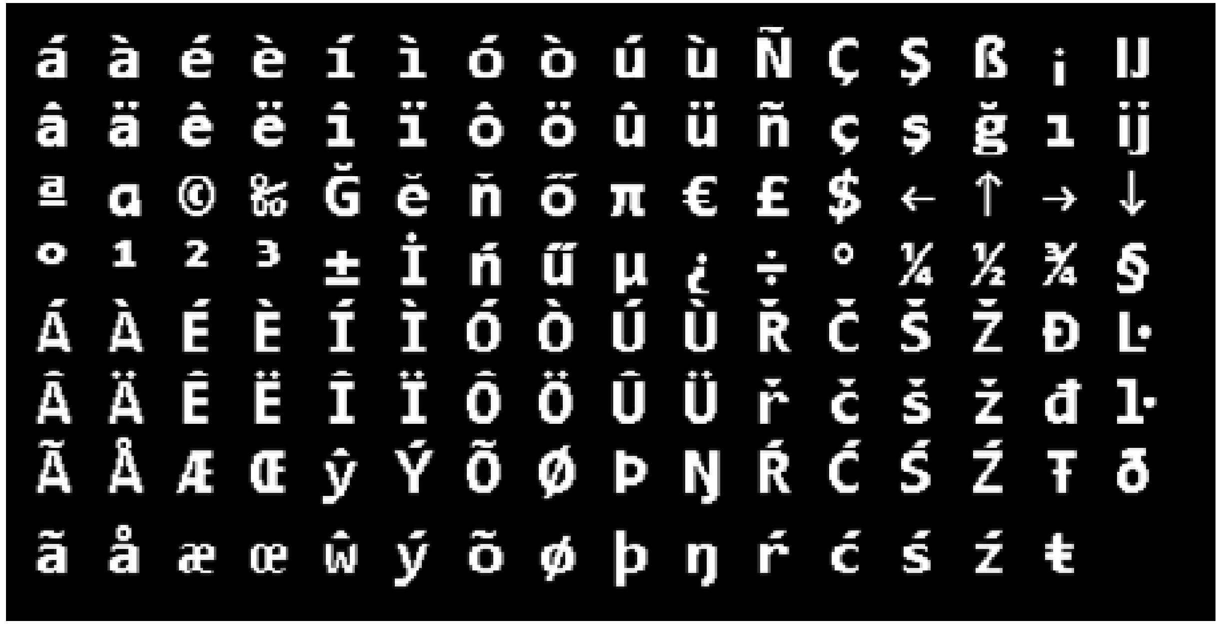


Figure 9 - 1: This shows a screenshot of an implementation from MacBe using the Consolas font

Coding of LPS and eRT in UTF-8

We are no longer in 1984, 10 years before Internet, and the time when RDS was first specified by the EBU. In the latest RDS standard version of IEC 62106:2018 are defined LPS (Long Programme Service name of 32 byte maximum) and eRT (enhanced RadioText of 128 byte maximum) to be exclusively coded in UTF-8, which is the ISO character set used now on the Internet. This gives us a continuous character set which is applicable to all languages. Receiver designers should now use this character decoding as well, specifically for the displays in car infotainment systems and radio stations should transmit text of this kind, because if not used, the industry will of course not develop products that would support those new possibilities.

In comparison to the old RDS specification from 1984 this has led to a big improvement created by the RDS Forum in its effort to adapt the RDS standard to the communication options used today. LPS and eRT coded in UTF-8 can now use the characters of languages such as Greek, Russian, Arabic, Chinese, Korean etc, just to give a few examples.

Here, in Fig. 9 - 2 one can see an example of a screenshot display from a relatively recent car radio. This speaks for itself. Do you realise now the possibilities that RDS can now offer since the new RDS standard version has been published in 2018? These will for sure enlarge the market for RDS enabled FM receivers and software that will help to supply the corresponding information in the broadcast studio environment.

Figure 9 - 2 – Display screenshot of eRT coded in Urdu and Hindi using UTF-8 character decoding

Figures 9-3 and 9-4 on the next pages, show more examples with enhanced RadioText eRT and eRTplus coded with UTF-8.

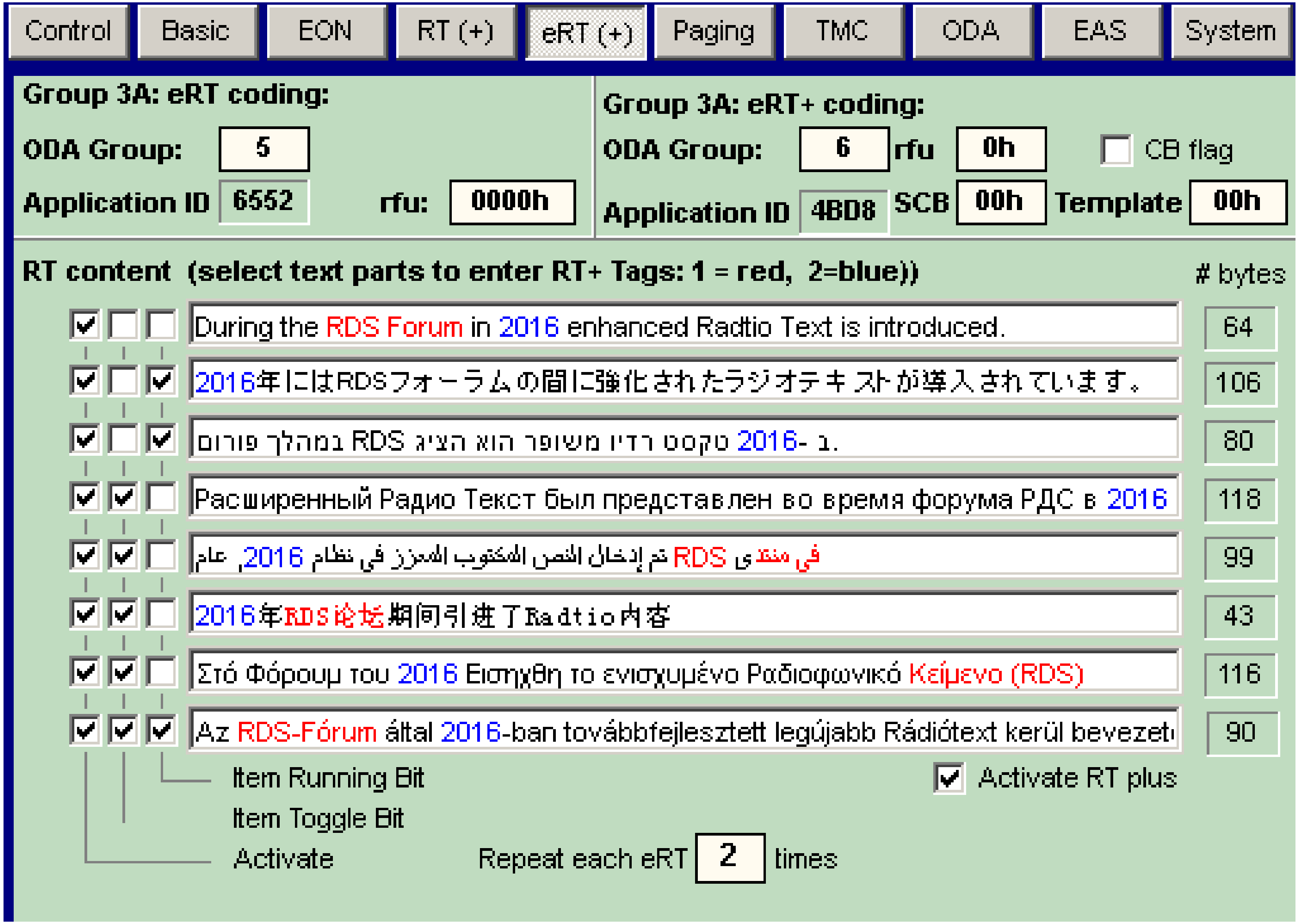


Figure 9 - 3: This is a screeshot from MacBe's TRX011 in TX mode. It can transmit eRT, UTF-8 coded, as shown by the various examples. eRT+ can be used as well to tag elements of the text: Red is used to mark Tag1 and blue is used to mark Tag 2.

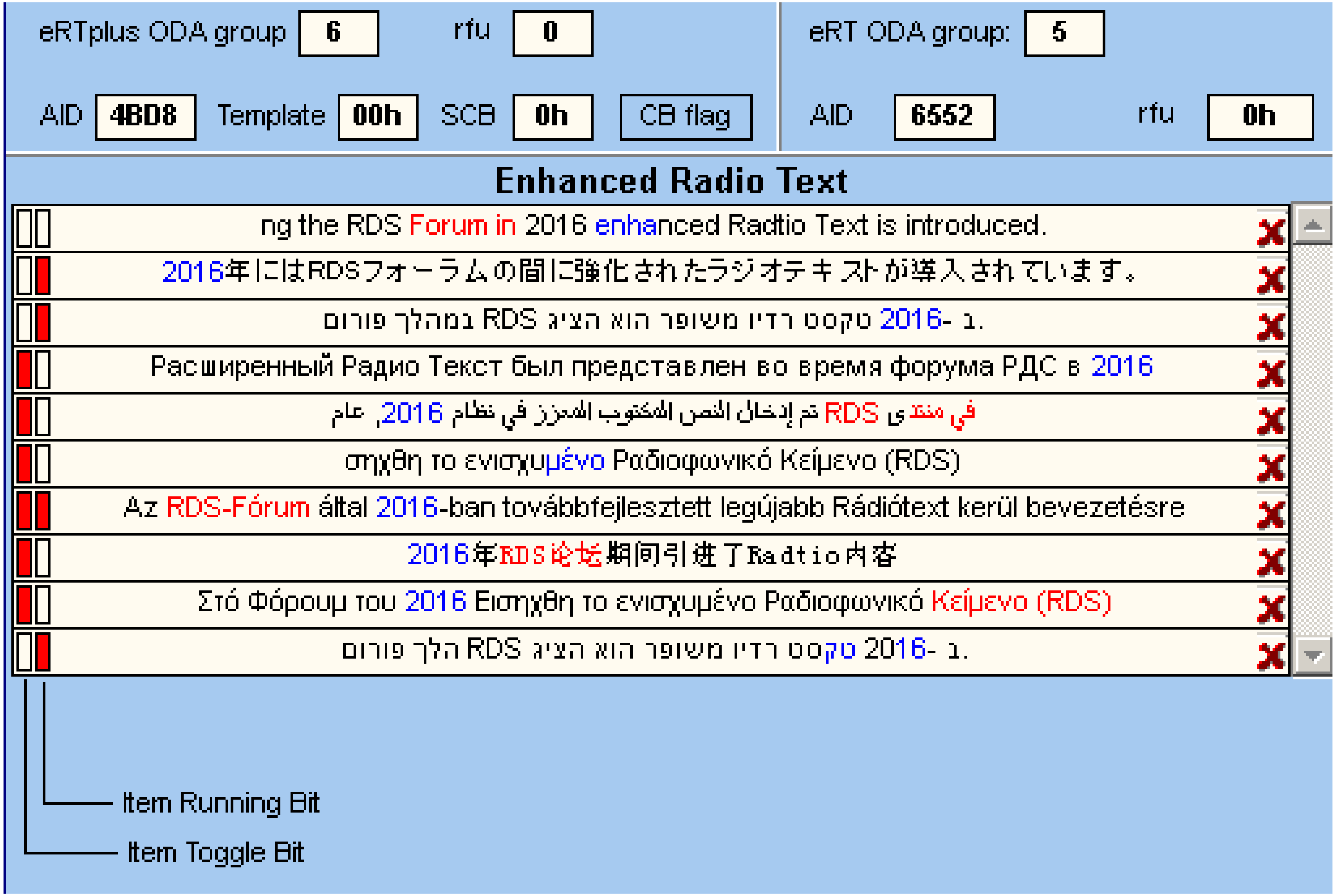


Figure 9 - 4: This is a screeshot from MacBe's TRX011 in RX mode. It can receive eRT and eRTplus, UTF-8 coded. The various examples shown on the previous page as transmitted with the TRX011 in TX mode are decoded and analysed in RX mode.

Use of RDS control characters

The only control codes used in RDS are 0x0A 'line feed' and 0x0D 'carriage return'. The first is used in RT and eRT and the latter is used to mark the end of text in RT, eRT and LPS. All other control codes in the range 0x01 to 0x1F are not assigned.

Conclusion

Car manufacturers should check whether the car infotainment devices proposed from their respective OEM suppliers conform to the RDS standard in this particular respect and for the market concerned.

Such a test is very easy to do by using for example the TRX011 and the RX014 from MacBe, which both fully support the basic RDS character set with all the special characters in the upper range of the character table.

For more details on the TRX011 see here http://www.trx011.com/home/buildpage.php.

With this device you can transmit and receive RDS features over a short distance. You can use it for testing PS and RT. In TX mode enter into the fields a text string composed of the special characters in the range 128 to 255 of IEC 62106-4, Table 4 showing the basic RDS character set. With the same device in RX mode scan the band and find an FM frequency not used in your location. Enter that frequency using the transmitter part. Tune the car radio you want to test to that frequency and check on the display whether the PS and RT correctly display the special character string that you had chosen to input for the test.

***

UTF-8 – a brief history, what it is and an example

The following text is an extract from information published by Wikipedia contributors [1].

UTF-8

UTF-8 is a variable width character encoding capable of encoding all 1,112,064 valid code points in Unicode, ISO/IEC 10646, using one to four 8-bit bytes. The encoding is defined by this Unicode standard. The name is derived from Unicode (or Universal Coded Character Set) Transformation Format – 8-bit. It was designed for backward compatibility with ASCII. Code points with lower numerical values, which tend to occur more frequently, are encoded using fewer bytes.

The first 128 characters of Unicode, which correspond one-to-one with ASCII, are encoded using a single octet with the same binary value as ASCII, so that valid ASCII text is valid UTF-8-encoded Unicode as well. Since ASCII bytes do not occur when encoding non-ASCII code points into UTF-8, UTF-8 is safe to use within most programming and document languages that interpret certain ASCII characters in a special way, such as " /" in file-names, " \" in escape sequences, and "%" in printf.

UTF-8 has been the dominant character encoding for the World Wide Web since 2009, and as of March 2018 accounts for 91.0% of all Web pages (many of which are simply ASCII, a subset of UTF-8; the next-most popular multibyte encodings, Shift JIS and GB 2312, have 0.7% and 0.6% respectively. The Internet Mail Consortium (IMC) recommended that all e-mail programs be able to display and create mail using UTF-8, and the W3C recommends UTF-8 as the default encoding in XML and HTML. Since the restriction of the Unicode code-space to 21-bit values in 2003, UTF-8 is defined to encode code points in one to four bytes, depending on the number of significant bits in the numerical value of the code point.

The first 128 characters (US-ASCII) need one byte. The next 1,920 characters need two bytes to encode, which covers the remainder of almost all Latin-script alphabets, and also Greek, Cyrillic, Coptic, Armenian, Hebrew, Arabic, Syriac, Thaana and N'Ko alphabets, as well as Combining Diacritical Marks.

Three bytes are needed for characters in the rest of the Basic Multilingual Plane, which contains virtually all characters in common use including most Chinese, Japanese and Korean characters.

Four bytes are needed for characters in the other planes of Unicode, which include less common CJK characters, various historic scripts, mathematical symbols, and emoji (pictographic symbols).

Some of the important features of this encoding are as follows: Backwards compatibility with ASCII and the enormous amount of software designed to process ASCII-encoded text was the main driving force behind the design of UTF-8. In UTF-8, single bytes with values in the range of 0 to 127 map directly to Unicode code points in the ASCII range. Single bytes in this range represent characters, as they do in ASCII.

Example

Consider the encoding of the Euro sign, €. The Unicode code point for "€" is U + 20AC. According to the Table 1, above. This will take three bytes to encode, since it is between U + 0800 and U + FFFF. Hexadecimal 20AC is binary 0010 0000 1010 1100. Because the encoding will be three bytes long, its leading byte starts with three 1s, then a 0 (1110...) The four most significant bits of the code point are stored in the remaining low order four bits of this byte (1110 0010), leaving 12 bits of the code point yet to be encoded (... 0000 1010 1100). All continuation bytes contain exactly six bits from the code point. So, the next six bits of the code point are stored in the low order six bits of the next byte, and 10 is stored in the high order two bits to mark it as a continuation byte (so 1000 0010). Finally the last six bits of the code point are stored in the low order six bits of the final byte, and again 10 is stored in the high order two bits (1010 1100). The three bytes 1110 0010 1000 0010 1010 1100 can be more concisely written in hexadecimal, as E2 82 AC.

History

By early 1992, the search was on for a good byte stream encoding of multi-byte character sets. The draft ISO 10646 standard contained a non-required annex called UTF-1 that provided a byte stream encoding of its 32-bit code points. This encoding was not satisfactory on performance grounds, among other problems, and the biggest problem was probably that it did not have a clear separation between ASCII and non-ASCII: new UTF-1 tools would be backward compatible with ASCII-encoded text, but UTF-1-encoded text could confuse existing code expecting ASCII (or extended ASCII), because it could contain continuation bytes in the range 0x21– 0x7E that meant something else in ASCII, e.g., 0x2F for '/', the Unix path directory separator, and this example is reflected in the name and introductory text of its replacement.

Dave Prosser of Unix System Laboratories submitted a proposal for one that had faster implementation characteristics and introduced the improvement that 7-bit ASCII characters would only represent themselves; all multibyte sequences would include only bytes where the high bit was set. The name File System Safe UCS Transformation Format (FSS-UTF) and most of the text of this proposal were later preserved in the final specification. In August 1992, this proposal was circulated by an IBM X/ Open representative to interested parties. A modification by Ken Thompson of the Plan 9 operating system group at Bell Labs made it somewhat less bit-efficient than the previous proposal, but crucially allowed it to be self-synchronizing, letting a reader start anywhere and immediately detect byte sequence boundaries. It also abandoned the use of biases and instead added the rule that only the shortest possible encoding is allowed; the additional loss in compactness is relatively insignificant, but readers now have to look out for invalid encodings, to avoid reliability and especially security issues. Thompson's design was outlined on September 2, 1992, on a placemat in a New Jersey dinner with Rob Pike. In the following days, Pike and Thompson implemented it and updated Plan 9 to use it throughout, and then communicated their success back to X/ Open, which accepted it as the specification for FSS-UTF.

UTF-8 was first officially presented at the USENIX conference in San Diego, from January 25 to 29, 1993. In November 2003, UTF-8 was restricted by RFC 3629 to match the constraints of the UTF-16 character encoding: explicitly prohibiting code points corresponding to the high and low surrogate characters removed more than 3% of the three-byte sequences, and ending at U + 10FFFF removed more than 48% of the four-byte sequences and all five- and six-byte sequences. Google reported that in 2008, UTF-8 (labelled "Unicode") became the most common encoding for HTML files.

[1] Wikipedia contributors - Focus On: 90 Most Popular Encodings: Code, QR Code, SOS, UTF-8, ISO 4217, Leet, Ten-code, Binary Code, Tire Code, Handkerchief Code, etc. (Kindle Locations 1983-2016). Focus On. Amazon Kindle Edition.

Testing, monitoring and analyzing RDS/RDS2 data using MacBe devices

by Joop Beunders

This innovative RDS tool was first presented to the RDS Forum 2012. Now, in 2025 it is no longer available. Regretably its developper Joop Beunders passed away in December 2023. However, this article is kept in this eBook to encourage the creation of a similar product, which has the concept of being unique and extremely useful for testing RDS implementations in the laboratory. Former RDS Forum member Joop Beunders had decades of design experience with RDS and he knew like nobody else what was needed to create well performing products using RDS/RDS2.

TRX011 - RDS Transceiver

This universal RDS transceiver can receive and decode all RDS transmissions worldwide.

The received data can be stored, analysed, presented in a very convenient way, in an .xls file, and can also be transmitted, at low power, for other tests.

It is possible, with the supplied control software, to compose RDS signals according to the most recent RDS standards. All RDS features such as ODA, RT+ and TMC can be constructed according to the latest specifications

The TRX011 unit is an extremely powerful tool for everyone who is professionally involved in RDS or RBDS. The TRX011 unit

connects to the host via USB and does not require additional power. The software runs on all Windows platforms.

Many of the latest features of RDS (not RDS2) which are described in the RDS standard IEC 62106:2018 have been implemented in the TRX 011, such as LPS (Long Programme Service name coded in UTF-8), eRT and eRT+, also coded in UTF-8.

This very innovative RDS tool was available since early 2015. However, since 2025 it is no longer commercially available, because its devellopper Joop Beunders passed away in December 2023. We keep the description to encourage the development of an equivalent product.

RX014 - RDS receiver evaluation tool

In June 2015, the RDS2 feature was added to the RDS specification. In short, RDS2 adds three RDS carriers, giving the overall RDS system a much greater bandwidth, allowing transmission of graphic images such as album covers, station logos, advertisements and much more. Alarm and/or Emergency systems can benefit as well, because much more detailed information can be presented to the user in a much shorter amount of time.

Until recently, high quality test and diagnostic tools for receiving and analyzing RDS characteristics were expensive and unwieldy. The RX014 is small, powerful, and very portable. It uses a world-class NXP receiver chipset, modified by Catena Radio Design, that meets the most demanding car radio requirements to extract detailed information for monitoring the reception conditions in real time. Not only is the Received Signal Strength Indicator (RSSI) displayed, but also ultra-sonic noise (USN), multipath (also known as Wide band AM or WAM) and IF offset are shown in a clear graphical format.

The RX014 is ideally suited to be used as a reference receiver during road tests. An ultra-fast scanner is built in which will do a full band scan in one second on a 100 kHz grid to show a full RSSI picture of the entire FM band, so signal conditions can be monitored continuously. The locations of the alternative frequencies are shown simultaneously.

RX014 is a very powerful tool to monitor and fully decode all broadcast RDS/RDS2/RBDS data. The data is presented in an easy to understand way and also includes statistics on received data quality.

All received data can be stored in a file and played back later for further analysis.

The RX014 is also ideally suited for ODA development for the new RDS2 system. Using the recording and playback functions, new ODAs can be fully tested without having to use live, on-air transmissions. To that end, the RX014 is build upon an open and freely available API, allowing software developers to design their own application programs to control and receive data from the RX014. When used as a stand-alone, your app will communicate using the HID USB protocol and when used in combination with the DS016, you only need to interpret and send serial data using the TCP/IP protocol.

The RX014 supports UTF-8 character coding and decoding: Many of the latest features of RDS which are described in the RDS standard IEC 62106:2018 are already implemented in the RX014 such as LPS (Long Programme Service name coded in UTF-8), eRT and eRT+, also coded in UTF-8 and decoding of tunnelled RDS data transmitted on the upper RDS carriers.

The DS016 gives you the ability to monitor an RX014 FM stereo RDS/RBDS/RDS2 receiver remotely, via an internet connection.

As shown in Fig. 9-5 the RX014 no longer needs to be plugged into a PC to work; the DS016 replaces the expensive and bulky PC and can connect to the internet via an Ethernet cable or using its internal Wi-Fi. Once configured, the DS016 runs autonomously and recovers automatically from power or internet failures, thus providing you a highly reliable TCP/IP interface to the Internet. On the next pages some typical RX014 monitoring screens are shown to give an idea about the possibilities.

Figure 9 - 5 shows the RX014 directly connected to the DS016 box which transmits the monitored RDS data via TCP/IP over the Internet to permit to montor the data on a PC at a remote location. In addtion the data can also be monitored on a PC locally.

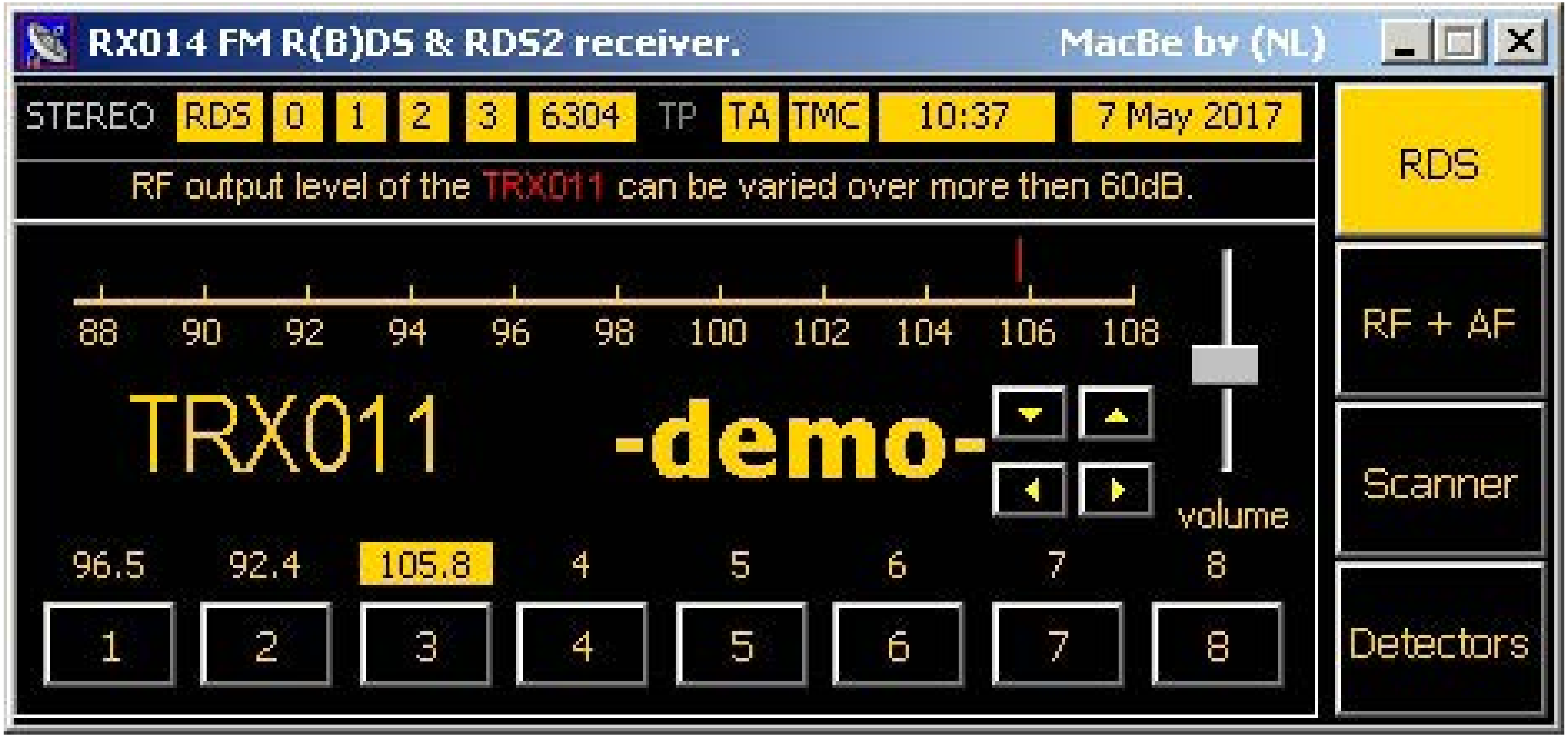


Figure 9 - 6 shows the main window. It is shown when the the RX014 program is started. From this window all RX014 features can be accessed.Tuning is accomplished in various ways: manual entry (type-in the frequency), search tuning, step tuning, selecting a frequency from the tuning bar or selecting one of the 8 presets. A frequency is tored when a preset key is pressed for about 1 second. Normally the tuner will be on grid (100 or 200 kHz), but by using manual entry a tuning resolution of 10 kHz may be used. As in the Basic window, Fig. 9-6, a number of widely used RDS features are shown in this window and also which streams are being received. With the buttons on the right, specific programme windows may be opened. A comprehensive overview of all capabilities can be found in the user manual of the RX014, which may be freely from the RDS Forum Office.

Figure 9 - 7 shows the RX014 basic window where the most important features of the R(B)DS system are displayed, such as PI code, Programme Service name (PS and the last 20 different variants), Programme TYpe code (PTY) and Programme TYpe Name (PTYN). Traffic indicators (TP and TA) and date and Time (CT) and also for backward compatibility a number of features which are no longer in the RDS specification. All received AF lists can be looked at and also the Long Program Service name (LPS) is presented (in the above picture in Chinese using UTF-8 coding). In the Radio Text field a selection can be made between standard RadioText and Enhanced Radio Text, of course both with colored markings for RadioText Plus and Enhaced Radio Text Plus (RT, eRT, RT+ and eRT+). By clicking on the PI code indicator the display toggles between call letters (RBDS) and PI code.

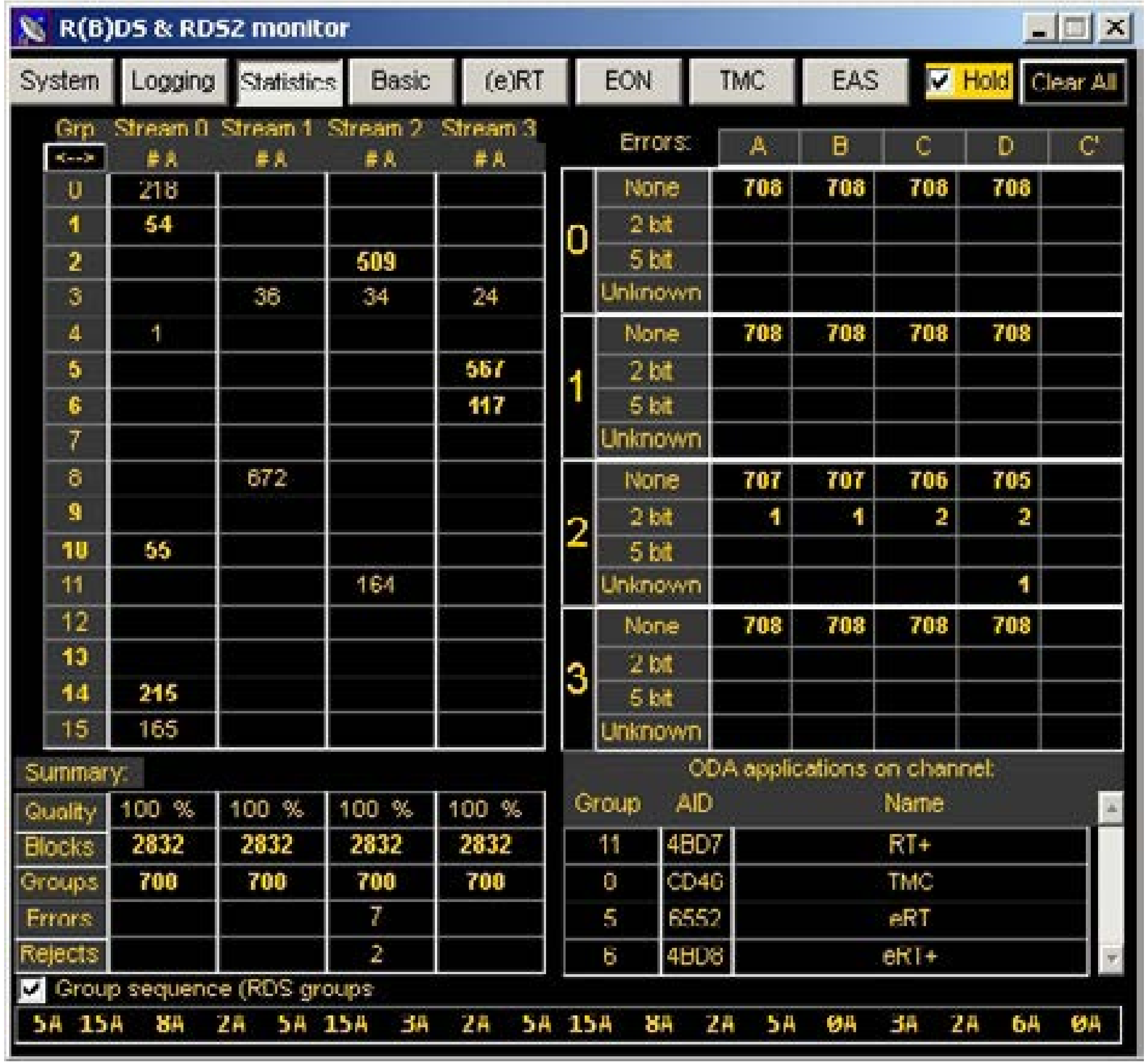


Figure 9 - 8 shows the RX014 statistics window. An overview is given of all received data expressed in number of blocks, groups or in percentages. The type of errors are reported and in case of RDS2 tunneling RDS data (as in the picture above) the group types in each stream are shown. Most of the known ODA Application IDs (AID) are shown together with the groups where the respective data may be found. At the bottom of the window the sequence of the received groups is shown.

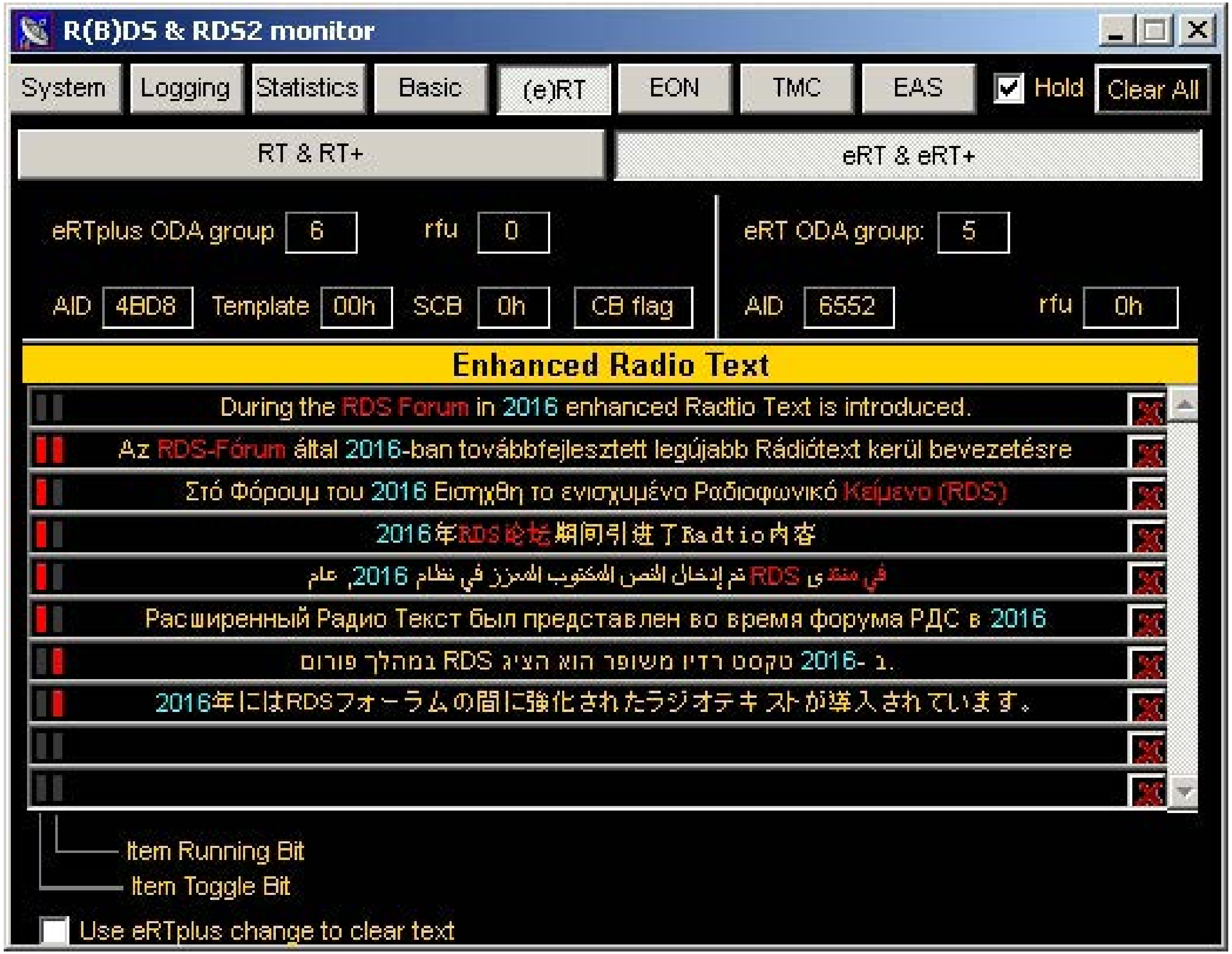


Figure 9 – 9 shows the RX014 RT and eRT window. The last 10 (enhanced) RadioText strings are shown together with the other data that belongs to these features. For both RT, as eRT, buffers of 250 entries are reserved. Separate tabs are created to check RT or eRT. For both features the tagged information is shown in different colors. When an entry is checked, the RT+ (eRT+) details are shown. All eRT entries convey the same message, however in different languages.

Figure 9 - 10 shows the RX014 TMC window. The details of all received messages are shown in a textual format. The program will buffer the last 500 received unique messages. Several display options are available as well as different tabs for the various features of the TMC system. The exact content of the groups may be found in the TMC specification.

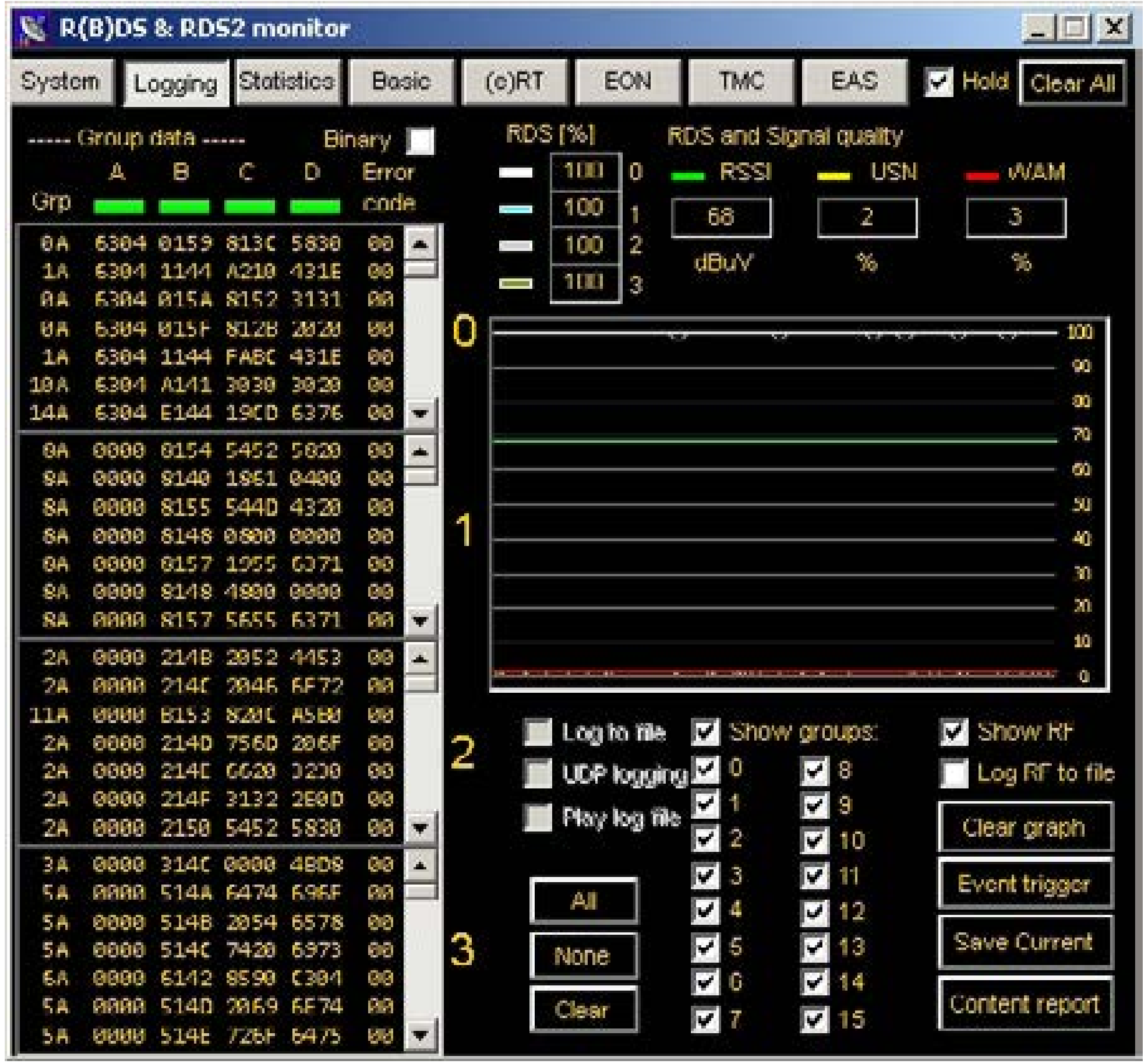


Figure 9 - 11 shows the RX014 logging window. The user has a view on the incoming data and RF conditions. When RDS2 reception is active, the group window is split into four sections, so every stream can be observed separately. Also, a selection of groups to be shown (recorded) can be made. Logging to file or to a remote host using the UDP protocol may be activated from this window. Another option is the event trigger: using this trigger, the user can set a special group event mask when to start or stop the recording. A content report allows the creation of an Excel sheet, containing all R(B)DS statistics and a picture of the FM landscape.

Testing, monitoring and analyzing RDS/RDS2 data using the FM MC5 from WorldCast Systems

by Olivier Soulié

An overview of the possibilities

The Audemat FM MC5 is not only an RDS/RDS2 analyser but much more. It is a quite complete FM & test measurement platform. The system offers both mobile RF coverage measurement and extensive modulation analysis in a single comprehensive system. It is engineered for several user profiles such as broadcasters & operators, regulation authorities, manufacturers.

The Audemat FM MC5 includes an extensive list of functionalities, not only on the analyser side, but also on the signal generator part that is needed in an FM test environment. The available functions are:

- **Spectrum analyser,**
- **FM analyser,**
- **Audio analyser,**
- **MPX analyser,**
- **FM band scanner,**
- **Oscilloscope,**
- **FM generator,**
- **MPX generator,**
- **Audio generator,**
- **RDS2 analyser and RDS2 generator.**

The Audemat FM MC5 enables on-site measurements, drive tests and factory tests and if we focus deeper on the RDS2 capabilities, with the RDS2 generator, users can generate RDS data and the additional RDS2 upper subcarriers. RDS data are fixed, but RDS2 data can be either only 0 or only 1, or alternate 0/1 or a counter. The RDS2 analyser will decode and record all RDS data received. It logs all RDS2 data and it is an RFT decoder. During a drive test the Audemat FM MC5 enables visualization of automatic RDS retuning with AF switching and it shows the RDS2 error rate areas.

More information is available from here:

www.worldcastsystems.com/en/c166p37/test-mesure/audemat-fm-mc5-fm-modulation-analyzer

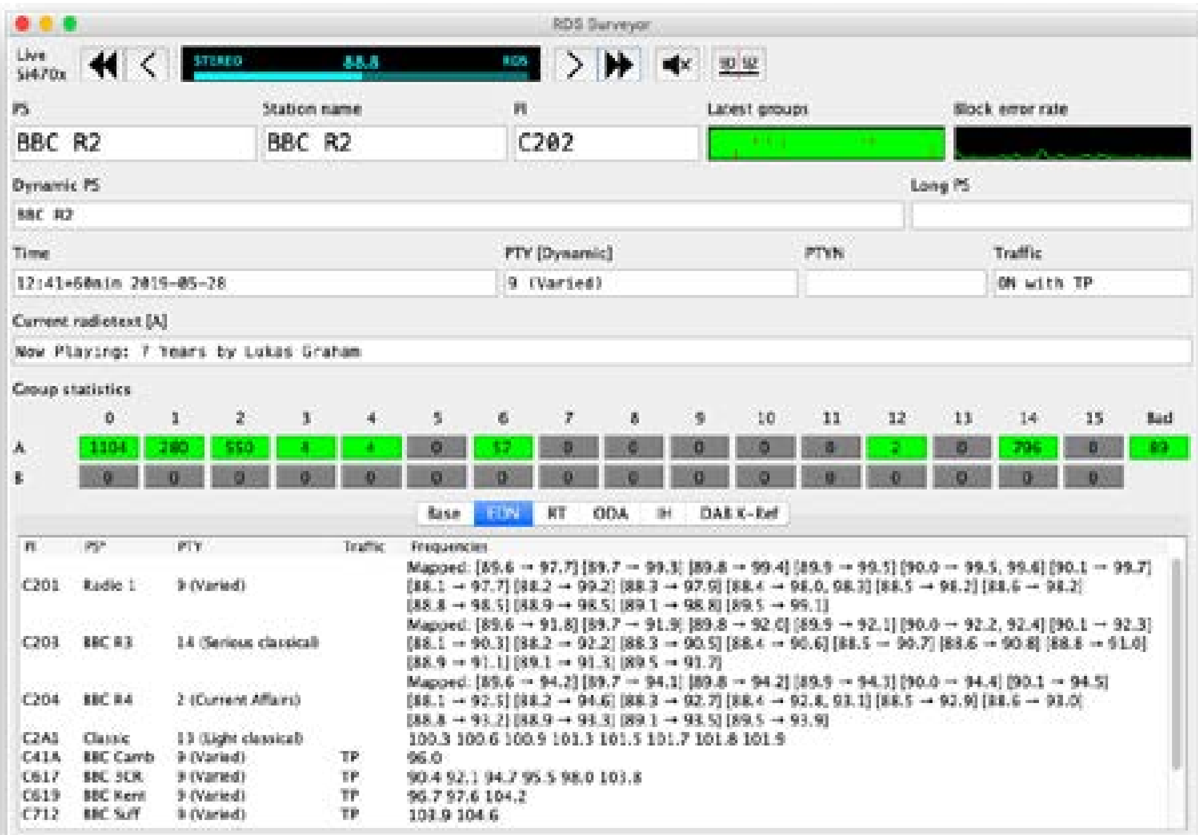
Testing, monitoring and analyzing RDS data using freeware

by Dietmar Kopitz

RDS Surveyor

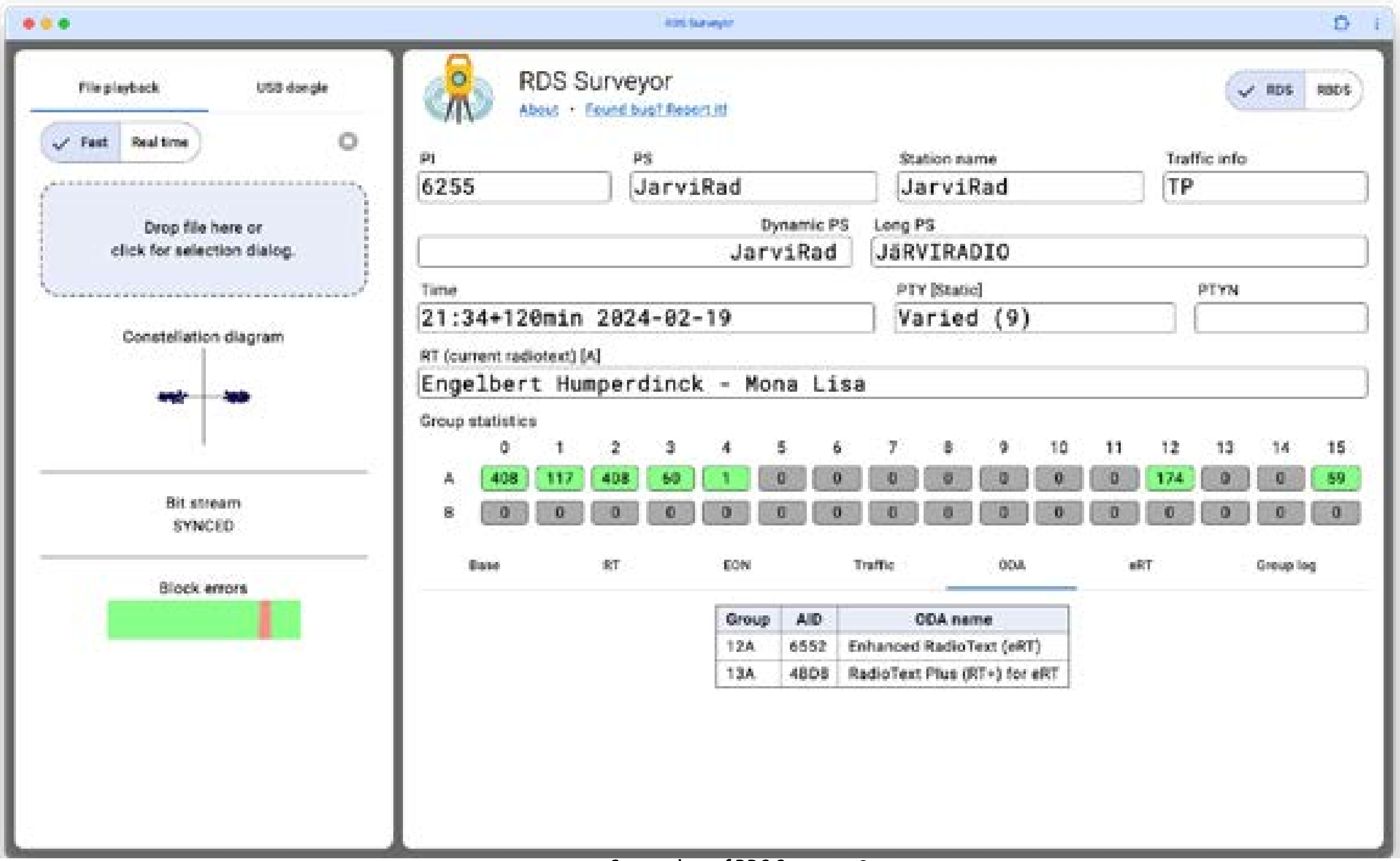
Reference: https://rds-surveyor.jacquet.xyz/

This is an open source program: everyone can use it free of charge, as well as study the source code, reuse it or modify it to suit their needs. Contributions to the project are welcome. The program is constantly updated by Christophe Jacquet in Switzerland. He participated in the RDS Forum meeting 2024 where he presented the tools under his development (ref.: R24/017_1).



Screenshot of RDS Surveyor 1

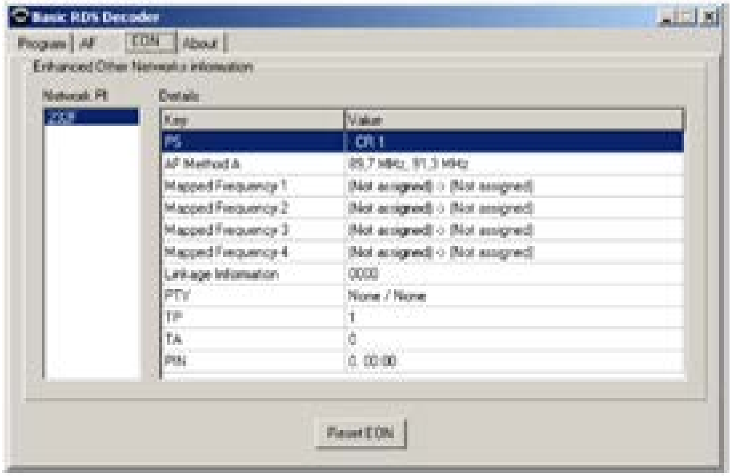
Two completely different versions, Version 1 and Version 2, of the RDS Surveyor exist. The traditional Version 1 is the one constantly updated since 2009. It is a Java code based app for Windows or MacOS. Version 2 is the newer concept, only web based and running in a web browser (Chrome or Edge), not yet as complete in comparison to Version 1, because it is still under development, but all effort is now put into Version 2 to bring it up at the end to decode even RDS2 apps. As a tuner a USB dongle with Si47xx or RTL.SDR is required to receive the RDS data stream.



Screenshot of RDS Surveyor 2

FM/RDS transmitter using the Raspberry Pi

Reference: https://github.com/ChristopheJacquet/PiFmRds



Screen shot from RDS Spy

Screenshot from RDS2 RFT file receiver

RDS Spy and RDS2 RFT file receiver

Reference: https://rdsspy.com/
This is freeware created since 2010, constantly updated, by Jan Kolar in the Czech Republic.
RDS Spy analyses RDS data being broadcast and Magic RDS 4 uses UECP data sent to the encoder. The latest version of RDS Spy from 2022 integrates both applications.
RDS2 RFT file receiver is a plug-in (2024) for RDS Spy Version 1.08 (2022) or later, permitting to decode the Station logo.
RDS encoders with RDS2 and logo support for radio stations are available at https://pira.cz/rds/

Magic RDS 4

Reference: https://www.pira.cz/rds/show.asp?id=magic_rds_4
This is a Windows program to control RDS from the radio studio using the UECP.

RDS decoder for Windows from Esslinger

Reference: http://www.esslinger.de/rds/rdsdec.htm
This is free Windows software created in 2003 by Esslinger, a German consultant company.

Software for an innovative bandwidth saving digital distribution of the MPX stereo pilot tone signal with RDS

by Frits de Jong

Introduction

A recent breakthrough in FM and RDS broadcasting technology is the introduction of µ MPX and APTmpX. This innovation allows the composite FM MPX signal to be processed directly in the studio. By leveraging advanced algorithms and compression technology, the entire FM MPX signal can now be more cost-effective transfered over a low-bit IP connection to the transmitter.

This method offers in addition significant cost savings at the transmitter site, as it eliminates the need for sound processing, stereo encoding, and in certain cases even RDS encoding at the transmitter. All these tasks can now be handled efficiently in the studio, streamlining the broadcast process and reducing overall infrastructure costs.

Which companies belong to the frontrunners?

Thimeo

Thimeo, a Dutch-based company, specialized in audio processing solutions. They are known for developing advanced software tools for broadcasters, streaming services, and audio professionals.

MicroMPX fully supports the transmission of RDS data within the composite signal. This integration ensures that all RDS information, such as station identification and song metadata, is accurately conveyed from the studio to the transmitter without the need for separate RDS encoders at each site. Recently RDS2 was integrated, which allows to use enhanced features like Station logo.

A key product is Stereo Tool, widely used for real-time audio processing, including loudness control, stereo enhancement, noise reduction, and broadcasting optimization. It also supports RDS and RDS2 datastream generation.

WCS - Worldcast Systems

WorldCast Systems is selling a software called APTmpX. This is an MPX/composite compression algorithm, described in more detail in the article about APTmpX v2 below from Hartmut Foerster. It is designed to reduce network bandwidth requirements while preserving a high quality audio in an MPX signal (with RDS, if required). This technology enables the transmission of the final MPX/composite signal at bitrates as low as 300, 400, 600 kbps, making it suitable for cost-effective IP connections. Regarding the different bit rates. The audio quality is best at 600 kbps (in theory). Listening tests have shown that the difference between 400 and 600kbps is not predictable. Even the 300 kbps is perceived to be superb. The main differences are: 300 kbps = 16 bit quantization and 400/600 kbps = 24 bit quantization. APTmpX v2 transports the full MPX signal with the RDS modulated 57 kHz subcarrier and there is no RDS data group generation within this software. So, all RDS content is transported transparently as delivered by the RDS source, either an RDS encoder or an appropriate audio processing software (such as that for the Omnia.9).

APTmpX v2

by Hartmut Foerster

Introduction

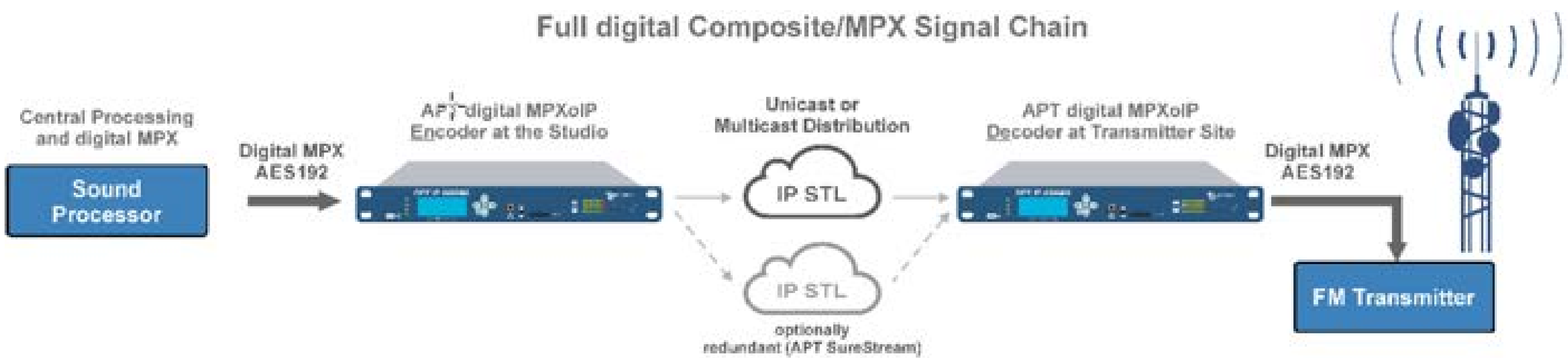
Did stereo FM give rise to the MPX signal, or was it the other way around? Either way, the multiplex (MPX) signal remains the essence of radio production, merging artistic and technical efforts into a single electrical signal.

Digitization revolutionized MPX processing with the AES192 format – the AES/EBU standard sampled at 192kHz. This allows the entire MPX spectrum, including RDS or RBDS data, to be transmitted digitally.

A key advantage of digital MPX transmission is centralizing signal processing in the studio. The sound processor, a costly but essential component, was often omitted at smaller transmission sites, leading to inconsistent audio quality. By keeping MPX processing in one location, broadcasters ensure a uniform and high-quality listening experience.

The digitalization of the MPX signal enables its uncomplicated and robust distribution in IP networks. The signal fidelity of the digital MPX remains undiminished at every transmitter location.

Really, at every location? What about the less essential locations that only have IP bandwidths suitable for baseband audio? Linear digital MPX in 24-bit resolution requires approximately 3.4Mbps for a single program and the RDS/RBDS signal. A high-quality audio signal (L/R) compressed with enhanced aptX (E-aptX) requires only about 420kbps (24Bit), including the embedded RDS/RDBS data. – Further innovation was required for a truly comprehensive MPX transmission.



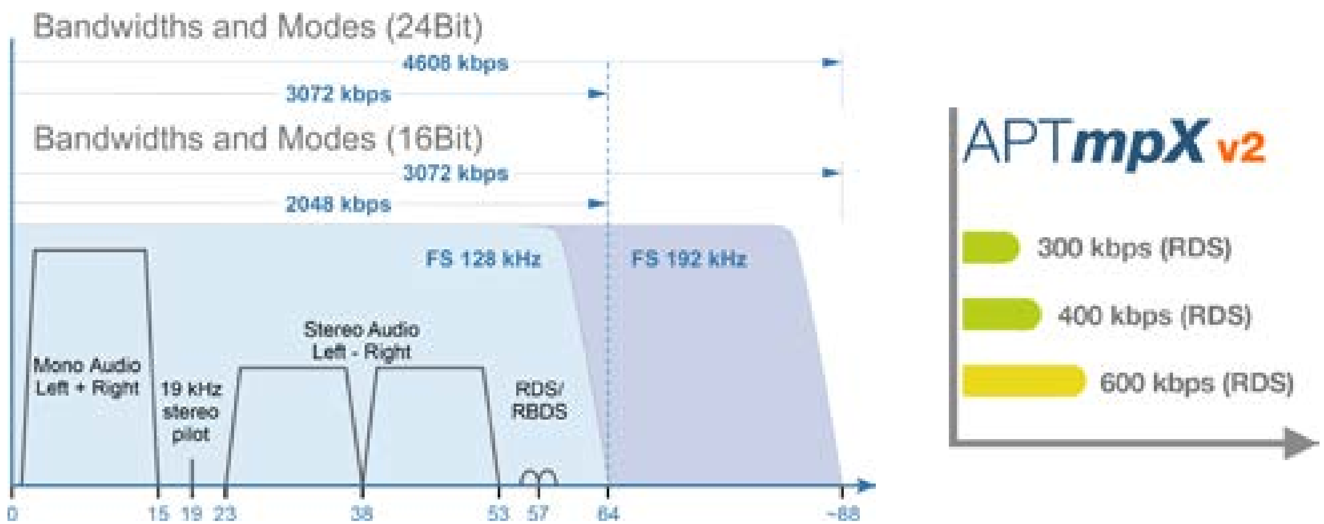
APTmpX – Optimizing the MPX transmission

As established, the MPX signal encapsulates all aspects of radio program production. While digitization introduces minimal, negligible quality loss, compressing the MPX signal is far more critical. Any distortion in phase or level balance can audibly degrade signal fidelity, stereo imaging, and carrier frequency deviation.

To address these challenges, APT (a WorldCast Systems brand) developed APTmpX, enabling a seamless transition from base-band IP audio to IP MPX transmission. The key driver was bandwidth reduction, but equally crucial were:

- Highest Signal Fidelity – preserving audio integrity and stereo imaging.
- Low Coding Delay – ensuring minimal latency (a core APT principle).
- Robust IP Transmission – simple, efficient packet structures like linear PCM over IP.
- Stable Bit Rates – essential for metered satellite links.
- Multiple Modes – offering flexibility between bit rate and signal fidelity.
- Complete Integrity – ensuring all signal components, including RDS/RBDS data, are accurately transmitted.

Another development goal was to design the APTmpX format as a lean, "lightweight" format that would allow integration with CPU categories commonly used in audio codecs.

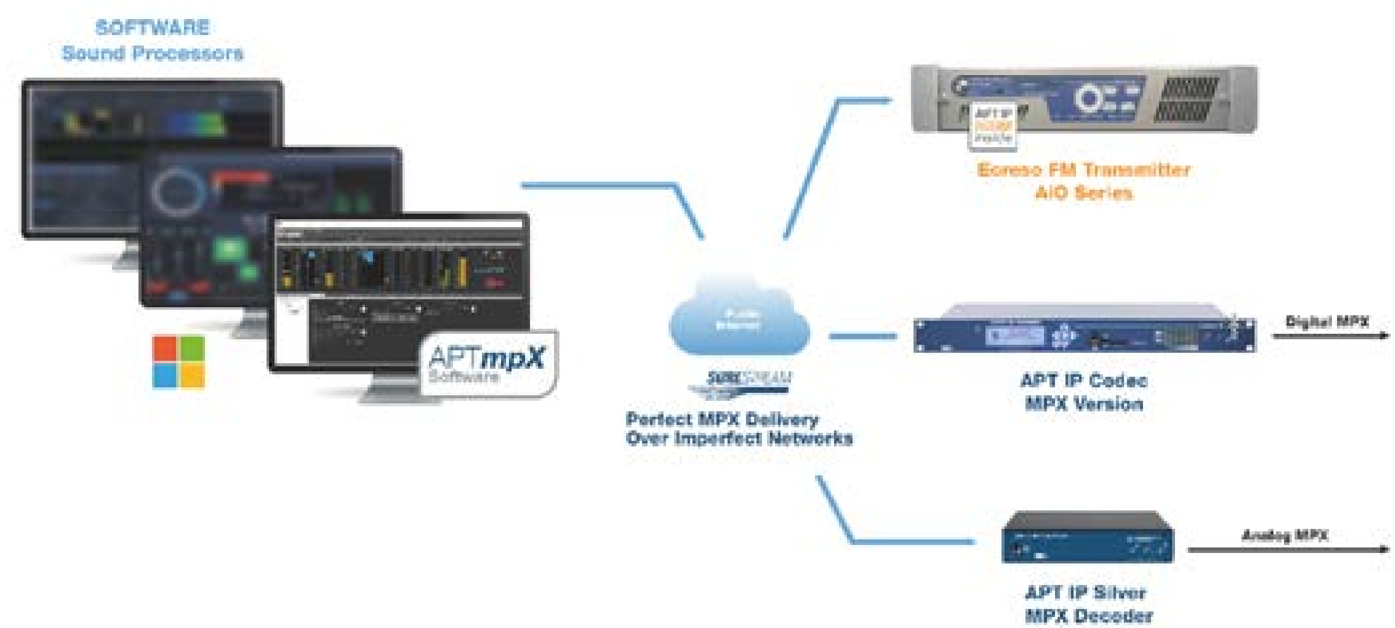


APTmpX and RDS data

The second version of the APTmpX format now includes the 57 kHz subcarrier, seamlessly integrating RDS transmission with minimal data overhead at the nominal bit rate. Embedding RDS data directly into the multiplex signal at the source can eliminate the need for a separate RDS encoder at the transmitter site. APTmpX ensures a highly stable stereo pilot, resulting in a consistently stable subcarrier. RDS data blocks are transmitted with optimal efficiency, and APTmpX is ready to support additional RDS standards (RDS2) as demand evolves.

APTmpX Software

The APTmpX as an application is an essential tool for modern broadcasters looking for a simple-to-implement, high-performance MPX solution at an accessible price. It is designed for effortless installation on Windows platforms and it ingests MPX over AES67. It also provides seamless integration into existing studio infrastructures with an audio sound processing software, such as the Omnia.9 software. With a software FM sound processor, broadcasters can rely on APTmpX to transport their MPX content to the transmitter site, offering flexibility for various configurations. If required, the sound processor can embed the RDS data directly into the APTmpX output signal.



The APTmpX software is an application on a Windows installation that connects to a sound processor.

Open Data Applications ODA transmitted on the basic RDS subcarrier of 57 kHz - Design principles

by Dietmar Kopitz

Introduction

The ODA feature is conceived to be used in RDS for data services that would be developed after publication of the RDS standard, i.e. future applications to be added and remain at the same time backwards compatible with all RDS features already defined in the RDS standard. It started all with the objective to facilitate the development of RDS-TMC (within the ISO standardisation processes). But since then other use cases have rapidly emerged—some were service provider wishes aiming to make use of public ODAs, and others where for service details to be kept private, because these services could be offered as subscribed and encrypted services. The public ODAs so far defined, except for RDS-TMC, are all compiled in the RDS standard Part 6, IEC 62106-6. These are the ODAs for RT+, eRT, eRT+ and an optional ODA for the coding of AF lists in the frequency range 64.1 to 107.9 MHz.

Concept of the ODA feature for legacy RDS

Under "legacy" RDS we understand RDS defined for the basic subcarrier 57 kHz and not RDS2 for the upper three subcarriers. The ODA feature, short the "Application", specified in IEC 62106-2 and 3, permits a number of predetermined groups types to be used, and these have to be indicated in any RDS transmission using the ODA application and group identification specified in group type 3A, see Figure 9 -12.

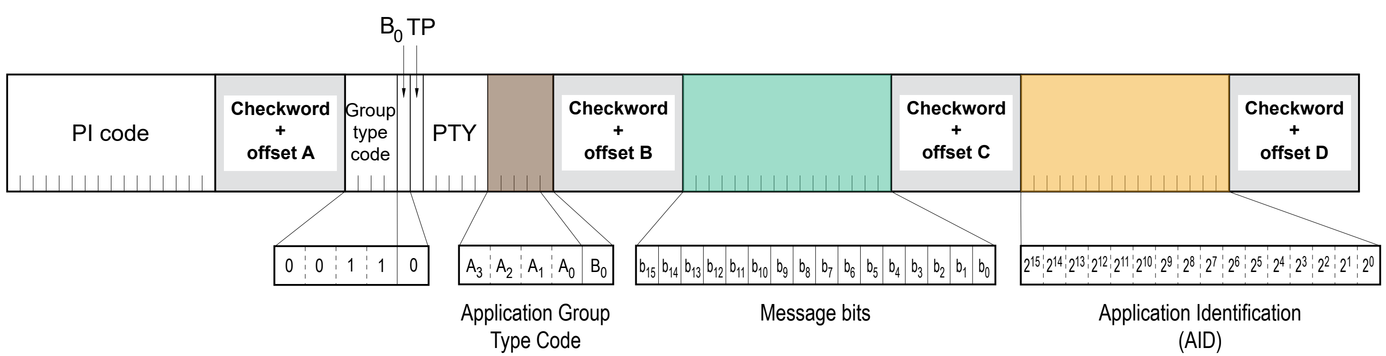


Figure 9 - 12: Group type 3A - Application identification in block 4 and application group identification in block 2 and 16 bit of application data in block 3.

The 3A group is to be used as a kind of beacon signal. It must be inserted at least every five seconds into the RDS data stream. The corresponding application group (type A or B, see Fig. 9 -13) is signalled in block 2 of the 3A group and it shall be transmitted more frequently of course and as often as necessary to make the application viable. This often conflicts with the data capacity available on the basic subcarrier. However, with RDS2 it is possible to tunnel (see below) such legacy ODAs on the upper subcarriers, where much more data capacity would be available.

The AID – application identification allows decoders to monitor the presence of a specific application and then permit to decode the relevant data carried in the application group being signalled in the 3A group. Only one application group is permitted to be used with any given AID.

A wide variety of application groups are available for use with ODA data services, and the respective application group to be used may be selected by a transmission operator or broadcaster. The A or B group types that are available for ODA applications are shown in Table 1 of IEC 62106-3.

Each ODA-AID must be internationally registered to ensure that the AID code for any specific application is worldwide the same and of course unique. The registration procedure to be used is detailed in IEC 62106-3.

The application data are carried, apart from the 16 bit in the 3A group, in the application group signalled in block 2 of the 3A group. As only one application group per application can be used, i.e. there are only 37 additional bits that can be specified for group type A and only 21 for group type B. This is not very much, but the possibilities can be enlarged by defining group variants. RDS-TMC coding is a very good example for using efficiently the limited possibilities with a number of variant groups. Normally one would use the 5 bits in block 2 for identifying the possible variants, 32 with 5 bits.

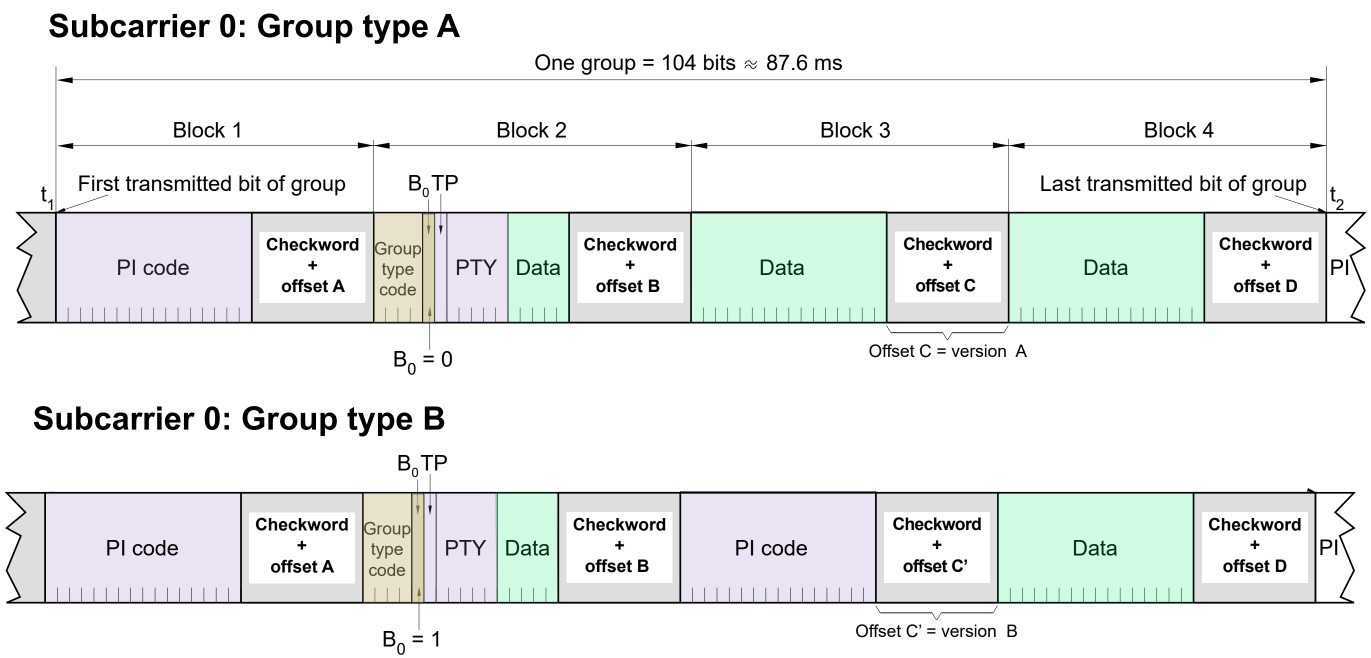


Figure 9 - 13: Application group types A and B - These carry 37 bit or 21 bit of ODA data each.

To ensure reliable data reception - for example, in the mobile reception conditions - it is recommended that application data groups be repeated at least three times. The received blocks can then be compared bit-by-bit for acceptance, or if the message spans over several blocks or groups, one can use in addition a two-byte cyclic redundancy checkword CRC-16 to be placed in the last block of the whole message. If one byte in each group is reserved for message identification and as a counter, the groups could be mixed in any order and still be correctly decoded.

Example for ODA coding the application “eRT – enhanced RadioText” on the basic subcarrier 0

Just to be re-called – What is RadioText – RT? With RT we can transmit text of 64 characters at maximum using the basic RDS character set. A flag is toggled when the text string changes.

So, what do we want to enhance with the eRT application? First, we do not want to use the basic RDS character set and instead we want to use UTF-8 text coding. Second, we want to enlarge the text string and achieve more than 64 characters and in short, we want now 128 bytes at maximum. If we use the ASCII characters only, then we achieve 128 characters in the text string at maximum, because one character in UTF-8 is just one byte. If we code the text in Russian, Greek or Arabic, then we need with UTF-8 encoding two bytes per character.

We registered this ODA at the RDS Forum Office at Geneva using the registration form given in IEC 62106-3. If the application were designed in North America, then it will have to be registered by the NAB in Washington D.C. using the respective form from the RDS standard IEC 62106-3.

The assigned ODA-AID for this application is 0x6552. This AID code is to be distributed in block 4 of the 3A group together with the ODA group used for this application. Which group specifically, depends on which group type is not yet used by the broadcaster. Additionally, one has to choose a group type that is conforming to the RDS standard available for ODA applications, see IEC 62106-3 and use Table 1. The 3A group to be used for this application is specified in IEC 62106-6, Annex C, see below the Figure 9-15.

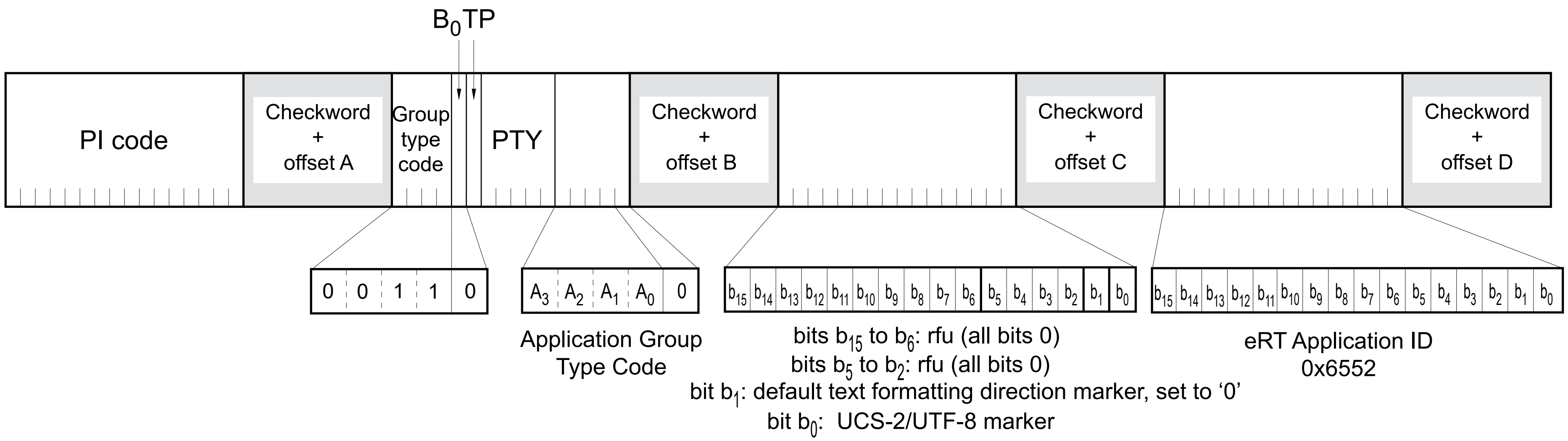


Figure 9 - 15 – Group type 3A: Application identification in block 4 and application group identification in block 2 and 16 bit of application data in block 3.

The meaning of the application data bits in block 3 of group type 3A is as follows.

a) Marker for UCS-2 /UTF-8 coding (bit b_0):

Set to ‘0’– for UCS-2 encoding, or ‘1’ for UTF-8 encoding. This option is no longer permitted to be used nowadays, but is kept for reasons of backwards compatibility with previous RDS standard versions.

Set to ‘1’ (now mandatory) – for UTF-8 encoding. The reason is that this has become the most popular character coding method on the Internet. Therefore, also with RDS we shall give this method now our preference so that we are future proof.

b) Marker for text formatting direction (bit b_1):

Set to ‘0’, which means transmission of the byte string is always from left to right.

c) Bits b_2 to b_5 are all set to ‘0’ for the reason of backwards compatibility with the earlier eRT specification (rfu).

d) rfu – bits b_6 to b_{15} are all set to ‘0’.

Figure 9-16 shows the coding of message bits of the application group.

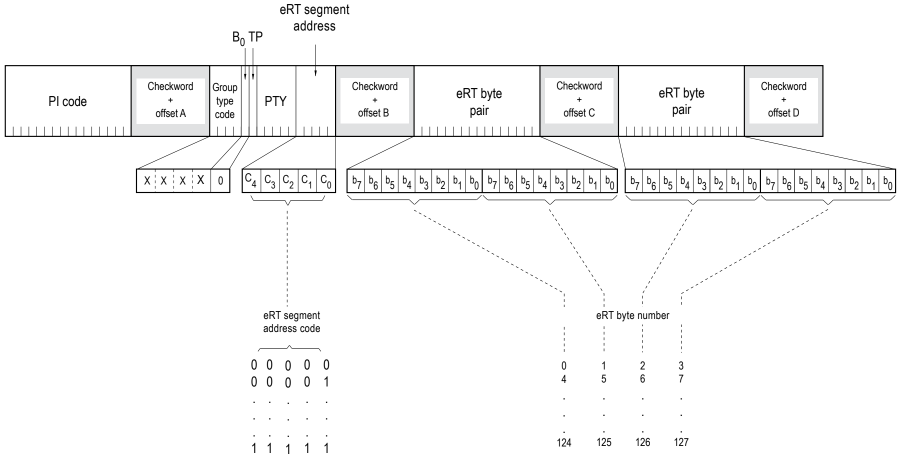


Figure 9 - 16 – Coding of the message bits of the application group type A.

The 5-bit segment address in block 2 defines the current byte number within the eRT text string, in terms of four bytes each, contained in the third and fourth blocks. The text string increases from left to right and the most significant byte is transmitted first.

A new text shall start with the segment address ‘00000’ segment and there shall be no gaps up to the highest used segment address of the current message. The number of text segments is determined by the length of the message, and each message shall be ended by the control character ‘carriage return’ 0x0D, if the current message requires less than 128 bytes. The bytes left unused in the same segment address shall also be filled with 0x0D.

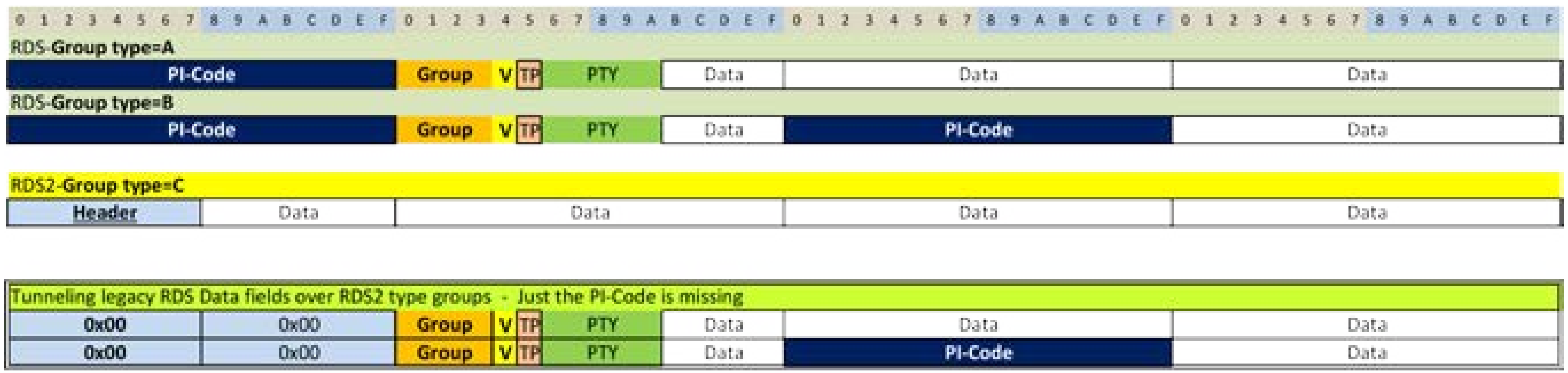
To ensure an enhanced RadioText message that is no longer valid is cleared from the display, the broadcaster should send a blank message only containing the 0x0D control character. The bytes left unused in the same segment address shall also be filled with 0x0D.

The toggle bit for changed text used in RT (group type 2A/B) is not used with eRT. The reason is that this toggle bit is not really required, because a change of text can easily be detected with the receiver’s decoding software. The function of that toggle bit is to clear the text display for the new text to be shown. When a text change is detected, then the display has to be cleared to be ready to display the new text.

Tunnelling legacy RDS Data fields over RDS2 type groups on the upper RDS subcarriers

by Dietmar Kopitz

All legacy data and ODAs designed for data-stream 0, using group types 0 to 15 with versions A or B, can be transmitted using the upper data-streams 1 to 3, being tunnelled within group type C, which is the only group type that can be used on the upper data-streams. The method to be used is specified in IEC 62106-2. To achieve this, the RDS2 encoder replaces the two bytes of the PI code in block 1 of each A or B group by two bytes of 0x00 each. In doing so it encapsulates the data carried by legacy A and B type groups into C-type groups.



The C-type group structure used for tunnelling is shown above. You see, how the A-type (V=0) and B-type (V=1) groups are then mapped into C-type groups. In the decoding process the A- and B-type can be reconstructed, adding the PI code in Block 1.

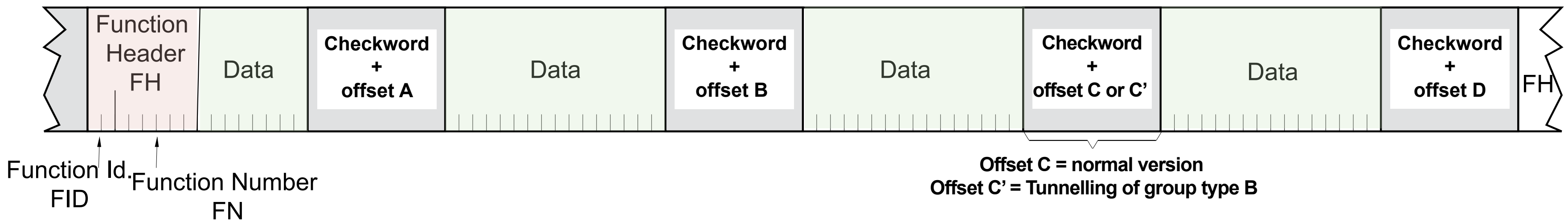
The upper subcarriers 1 to 3 can only use C-type groups. Tunnelling is an option where A or B type groups can be packed into C-type groups, so that ODAs designed for the basic subcarrier can be transmitted faster on the upper subcarriers.
The tunnelling groups are identified by the two Function header FH bytes set to equal 0x00.

Open Data Applications ODA transmitted on the upper RDS subcarriers - Design principles

by Dietmar Kopitz

Introduction

The upper data streams are to be used exclusively for ODAs except for tunnelling, see above. For this purpose, a new group type C to be used on the upper subcarriers only, has been defined. Figure 9-17 shows the format of group type C. It can carry seven data bytes. One byte, the first one in block 1, is used to define the function of this group type. This first byte is called the Function Header FH and it is composed of two elements, the Function Identifier FID (2 bits) and the Function Number FN (6 bits). The public ODAs so far defined for RDS2 are all compiled in the RDS standard Part 6, IEC 62106-6. These are the ODAs for Station logo, Slideshow and Internet connection options.



NOTE 1: The Function Header (FH) is composed of a 2 bit Function id FID and a 6 bit Function number FN, and both together fully determine the function of the group.

NOTE 2: Offset word C' is only used for tunnelling B type groups.

Figure 9 - 17 – Group type C structure.

Functions of Group type C

There are in total four kind of group type C identifiers possible with the 2-bit FID. The group type C function identification is a combination of the 2bit-FID and the 6bit-FN. Four group type C function identifications are so far defined, see Fig. 9-18:

1. Groups used for tunneling legacy group type A or B designed for subcarrier 0, FID=00 / FN=000000.

2. Groups used to carry the RDS2 ODA data in at max. 64 channels of which the first 16 ODA channels are reserved to carry additional file associated data using the same channel as a pipe for file transfer and if needed also other associated information, all with an FH composed of an FID=01 and a FN=yyyyyy, where FN is the respective channel number yyyyyy, 0 to 63 and where channels 0 to 15 are reserved for ODAs using files, even if these are used only occasionally.

3. Assignment groups that carry also some file associated ODA data, FID=10 / FN=000000. There exist four different assignment methods, see below in Table 1. But note this well, if an ODA uses a file or files to be transmited with the RDS2 File Transfer protocol RFT (see below), then only the Method 1 assignment group with 16 variants (and of which variants 0 and 1 are already defined to be used with the RFT) is permitted be used.

4. RTF groups that carry the file data, FH = (FID=00) + (FN=10yyyy) in at max.16 channels that become during the file transfer “pipes”. The “pipe” is thus embedded in an ODA channel. It is the RFT data stream that has to be accompanied by the Method 1 assignment group using the mandatory variants 0 and 1, if the latter is applicable. During the time when the channel serves as a pipe, only RFT data and the respective Method 1 assignment groups shall be transmitted. If the RFT data transmission is terminated, the channel can be used again for the transmission of associated ODA data groups and if there are none to be transmitted, the channel is used all the time as a pipe for the transmission of RFT data.

   When a file is transmitted the corresponding pipe has the same number, in the range 0 to 15, as the channel that carries the associated ODA data. The Method 1 assignment group variants 0 and 1 are to be transmitted in sync with their respective file (what is meant is during the time interval when the file is transmitted) and they must use variants 0 and 1 (if the latter is applicable).

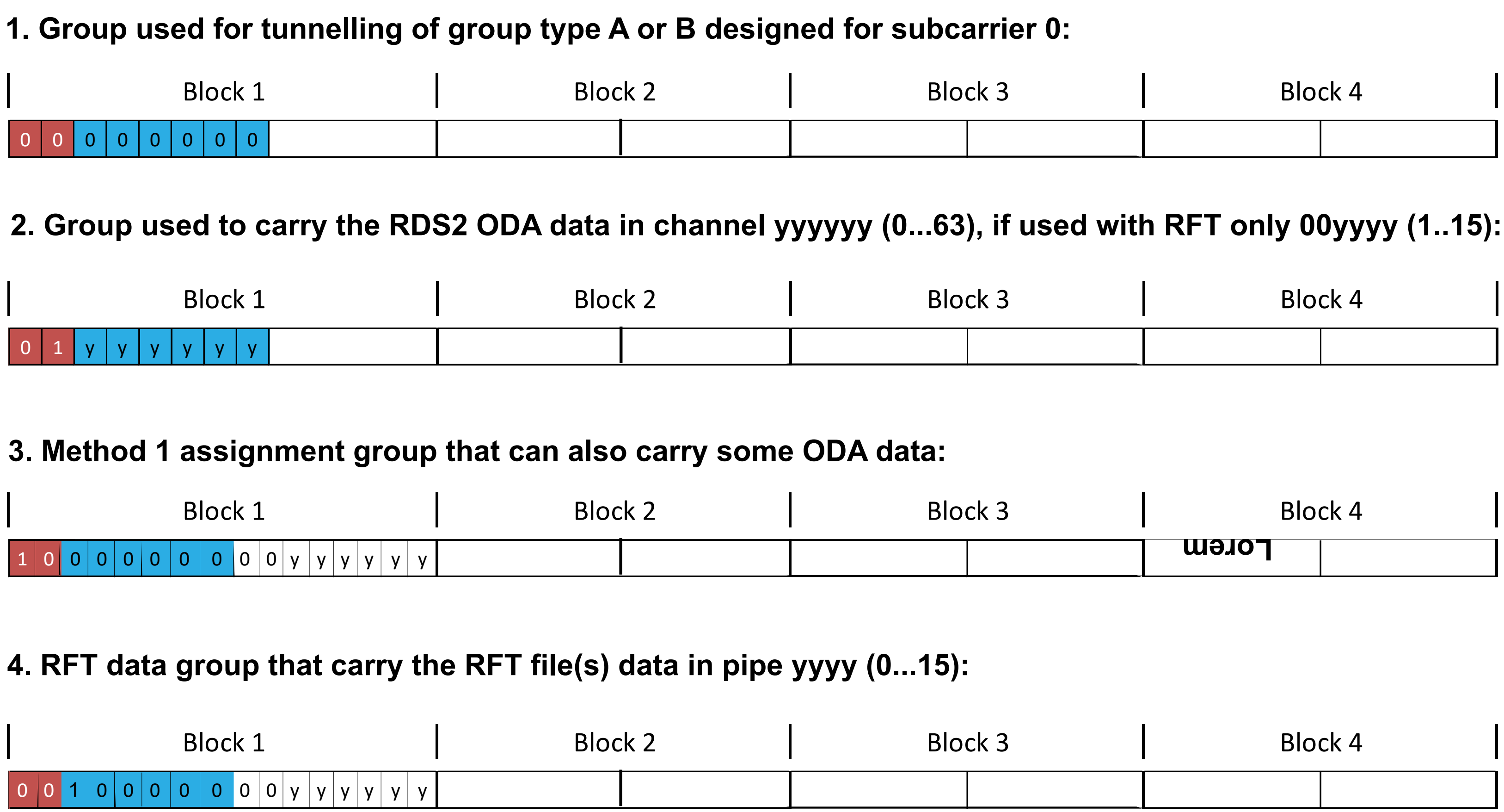


Figure 9 - 18 – Four different group type C identifications are used on the upper subcarriers.

Assignment groups that can carry also some ODA data

FID = 10 / FN = 000000

Across data-streams 1, 2 and 3 there are in total 64 channels. Four methods exist to assign AIDs to channel numbers, see Table 9-2 and Table 9-3.

Method 2, 3 or 4 from Table 9-3 all use successive channel numbers with an auto-increment function.

Table 9 - 2 – Group type C assignment methods used to connect channel numbers with one or more AIDs

Method	Function Header	Variant + Channel id.	AID connection with data channel
	Block 1		Blocks 2, 3 and 4
1	10 000000	00 yyyyyy	Connect data channel yyyyyy with a 16-bit ODA AID in block 2 and provide in addition four application data bytes in blocks 3 and 4.
2	10 000000	01 yyyyyy	Connect two successive data channels (yyyyyy and yyyyyy+1) with a 16-bit ODA AID in block 2 and a second ODA AID in block 4, respectively, and provide in addition two application data bytes in block 3 for the first ODA.
3	10 000000	10 yyyyyy	Connect two successive data channels (yyyyyy and yyyyyy+1) with a 16-bit ODA AID in block 2 and a second ODA-AID in block 3, respectively, and provide in addition two application data bytes in block 4 for the second ODA.
4	10 000000	11 yyyyyy	Connect three successive data channels (yyyyyy, yyyyyy+1 and yyyyyy+2) with a 16-bit ODA AID in block 2, a second ODA AID in block 3 and a third ODA AID in block 4, respectively.

Table 9 -3 shows the four methods described in Table 1 in more detail.

Table 9 - 3 – Assignment of up to three successive channel numbers to multiple AIDs

Method	Block 1	Block 2	Block 3	Block 4
1	10 000000 00yyyyyy	AID	Data (for AID)	Data (for AID)
2	10 000000 01yyyyyy	AID1	Data (for AID1)	AID2
3	10 000000 10yyyyyy	AID1	AID2	Data (for AID2)
4	10 000000 11yyyyyy	AID1	AID2	AID3

EXAMPLE: When using method 4 in and yyyyyy equals 16 then AID1 is connected with channel 16, AID2 with channel 17 and AID3 with channel 18.

NOTE: For ODAs with files, even only occasional ones, using one of the channels in the range 0 to 15, the assignment method 1 is the only one applicable and assignment methods 2 to 4 cannot be used here.

An ODA that requires additional associated file data transferred using the RFT protocol (see below), uses only method 1 assignment groups. Since the channel number equals the pipe number, the channel number is implicitly determined through the pipe number, which is assigned in every method 1 assignment group. Should the file being transferred need additional file data in the definition phase then, like the data in the C-block of the 3A group with RDS on subcarrier 0, one or more variants in the range 2 to 15 of the method 1 assignment group may be used. However, during the file transfer interval the variants 0 and 1 (if applicable) of the method 1 assignment group will be mandatory, but not exclusive. The general concept is that each pipe carries the data of a file or a sequence of files and its file data in those variants 0 and 1. Variant 1 is applicable only if a CRC-16 is used for the file transfer.

RDS2 file transfer RFT using a pipe in the range 0 to 15

The RDS2 file transfer protocol RFT is designed for the transport layer. There are some important objectives to be achieved for receivers:

a. Be able to quickly identify the AID.

b. After identification it is known whether the specific AID is supported or not.

c. No buffers to be reserved for not supported AIDs.

d. Being able to assemble a file even when groups go missing using the repetitions.

e. Use a toggle bit to avoid mixing groups from different files.

f. Make the file transfer independent of its content, i.e. the file type.

The receiver should be able to assemble a file even when a single group or a several groups go missing, because it can be received later during the repetitions without requiring the groups before or after to be received correctly. Instead of a requirement to receive a sequence of groups with no errors, the RFT allows for a single group to be restored later, if it was dropped earlier in the transmission.

Pipes are used for the file transfer. The channel number (range 0-15) of the ODA is same number as the pipe number in which a file belonging to the respective ODA is transferred, the pipe being then a transformation of a channel during the RFT file transfer process:

- 16 pipes are reserved to transfer files.
- One pipe serves only one ODA and its specific file or files.
- The file transfer pipe and its ODA channel are signalled by the method 1 assignment group, variant 0 -15 with variant 0 and 1 being mandatory during the file transfer interval and in sync with the file sequence.
- Variant 0 contains the information describing the file being transfered.
- Variant 1 is to be used only in case a CRC is needed for the file transfer.
- Variants 2 to 15 of the method 1 assignment group are free to be defined by the ODA design process and they shall be used only when ODA data use the respective channel.

Variant 0 is used to describe the file in terms of file id (6 bits), file version (3bits) and file size (18 bits). An additional bit indicates whether a CRC-16 is used, or not. All 16 possible method 1 assignment group variants are shown in Figures 9-19a, b and c.

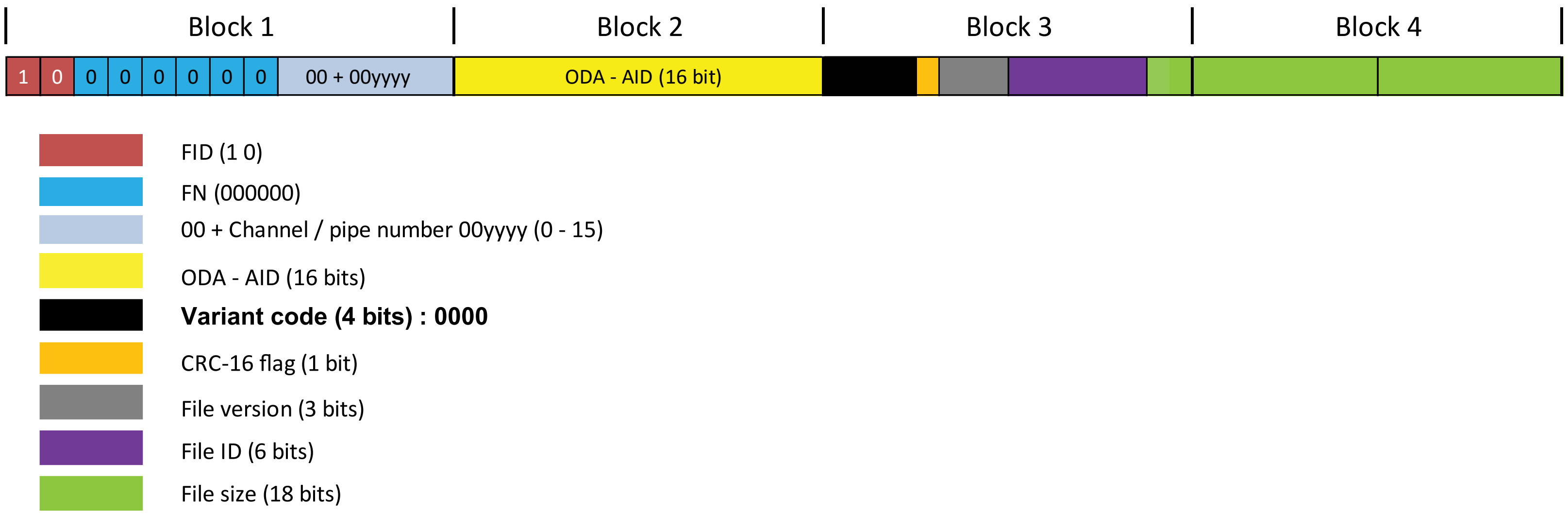


Figure 9 - 19a – Method 1 assignment group variant 0 is used to describe the file.

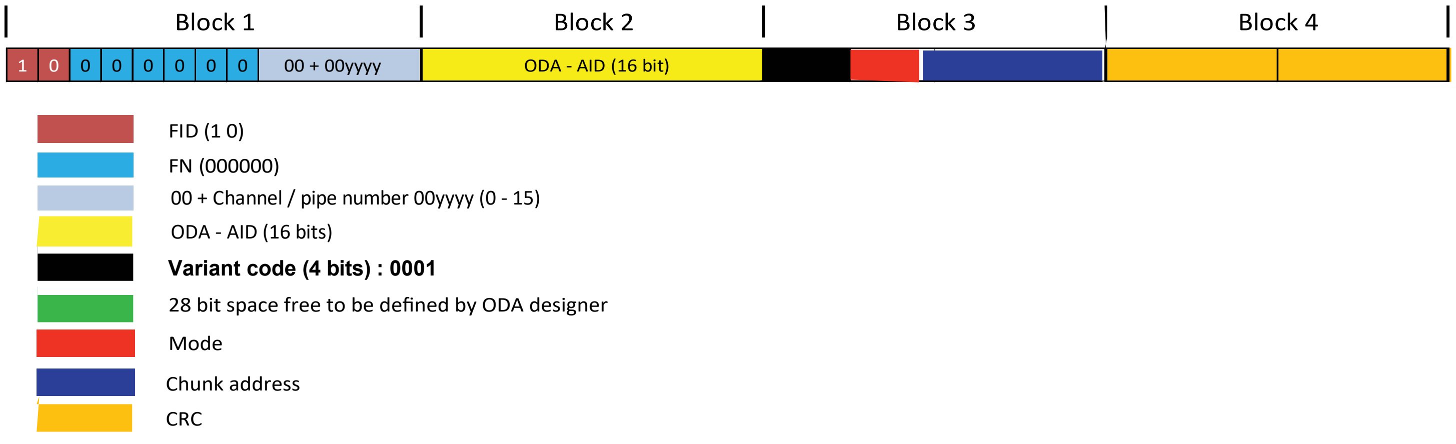


Figure 19b – Method 1 assignment group variant 1 is only used by the RFT protocol when a CRC is used for the file transfer.

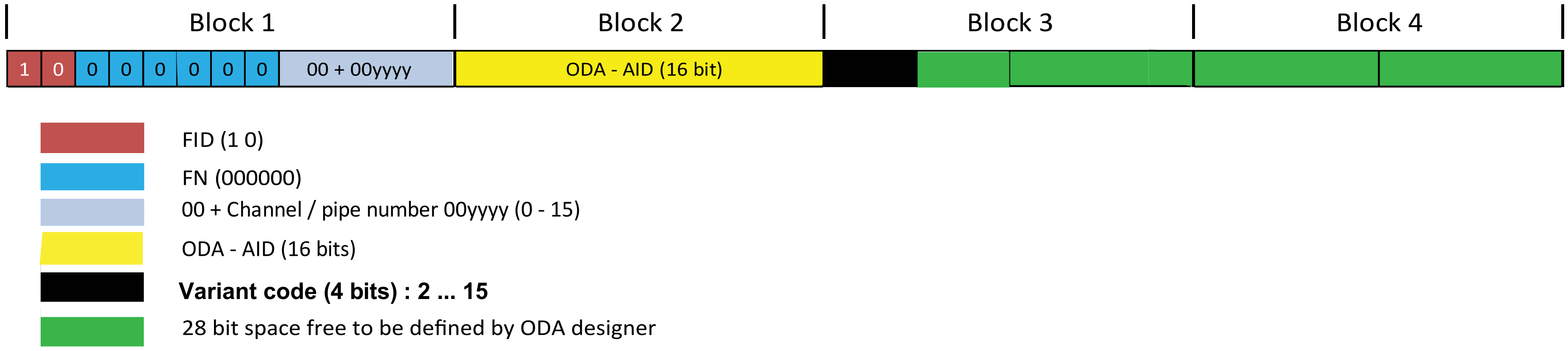


Figure 19c – Method 1 assignment group variants 2 to 15 can be used by the ODA protocol to carry on the respective channel additional ODA data.

Variants 2 to 15 are an option that the ODA designer can use to transfer additional ODA data.

Option: Using a CRC-16 in the file transfer

Variant 1, see Figure 3b, is used only and it is also mandatory, if a CRC-16 is present, as shall be indicated in variant 0 with the CRC flag set to 1.

To calculate the CRC over the entire file is not a method being efficient. Instead chunks of groups should be used for the CRC calculation as indicated below.

Variant 1, CRC-mode 0 shall be entirely generated by RDS/RDS2 encoders. CRC-mode 7 is an automatic selection mode for RDS/RDS2 encoders based on file size. It shall be the default mode for RDS/RDS2 encoders in the absence of any other definition.

The coding of variant 1 is as follows:

$c_{15}..c_{12}$: Variant code: 4 bits (msb first)

$c_{11}..c_{9}$: CRC-mode, 3 bits (msb first)

CRC mode:

000 (0) – CRC-16 calculated over the entire file

001 (1) - CRC-16 calculated over chunks of 16 groups, file size (bytes) <=40960

010 (2) - CRC-16 calculated over chunks of 32 groups, file size (bytes) > 40960 and <=81960

011 (3) - CRC-16 calculated over chunks of 64 groups, file size (bytes) >81960 and <=163840

100 (4) - CRC-16 calculated over chunks of 128 groups, file size (bytes) >81960 and <=163840

101 (5) - CRC-16 calculated over chunks of 256 groups, file size (bytes) >81960 and <=16840

0110 (6) – rfu

111 (7) – Automatic selection among mode 1 to 3 => based on file size

For CRC mode = 111 (7) the chunk size is automatically selected by encoders of either being mode 1, 2 or 3 based on the file size. This is also the default CRC mode for encoders in the absence of any other definition. The CRC mode effectively transmitted in RDS data shall be the mode 1, 2 or 3 selected by the encoder.

$c_8..c_0$: Chunk address, 9 bits (msb first)

$d_{15}..d_0$: CRC-16 code, 16 bits (msb first)

The chunk size will be influenced by the maximum file size to be transferred and the valid chunk address range, as shown below:

Chunk size (in groups)	Max. file size (bytes)	Max. chunk address
16	40960	0..511
32	81920	0..511
64	163840	0..511
128	163840	0..255
256	163840	0...127

An RFT data group chunk is defined to consist of 16 to maximal 256 data groups where each group carries 5 bytes of file data, from 80 if mode=1 is used up to maximum 1280 bytes if mode=5 is used.

For the last RFT data group chunk, the CRC-16 is calculated on the remaining bytes.

While the variants 0 and 1, see Figures 3a and 3b, carry file associated data, it will be up to the ODA designer to decide which data will be used in variants 2 to 15, see Figure 3c. These data may be related to the ODA itself and not just to the file content, just like in block 3 of group type 3A for legacy RDS on subcarrier 0.

Why do we use different chunk sizes? If we consider a relatively large file, it will be preferable to cut it into pre-defined chunks of either 16 groups or 32 or 64 or 128 or 256 groups and calculate the CRC-16 then for each of those chunks. We have defined those eight CRC modes shown above for this particular reason.

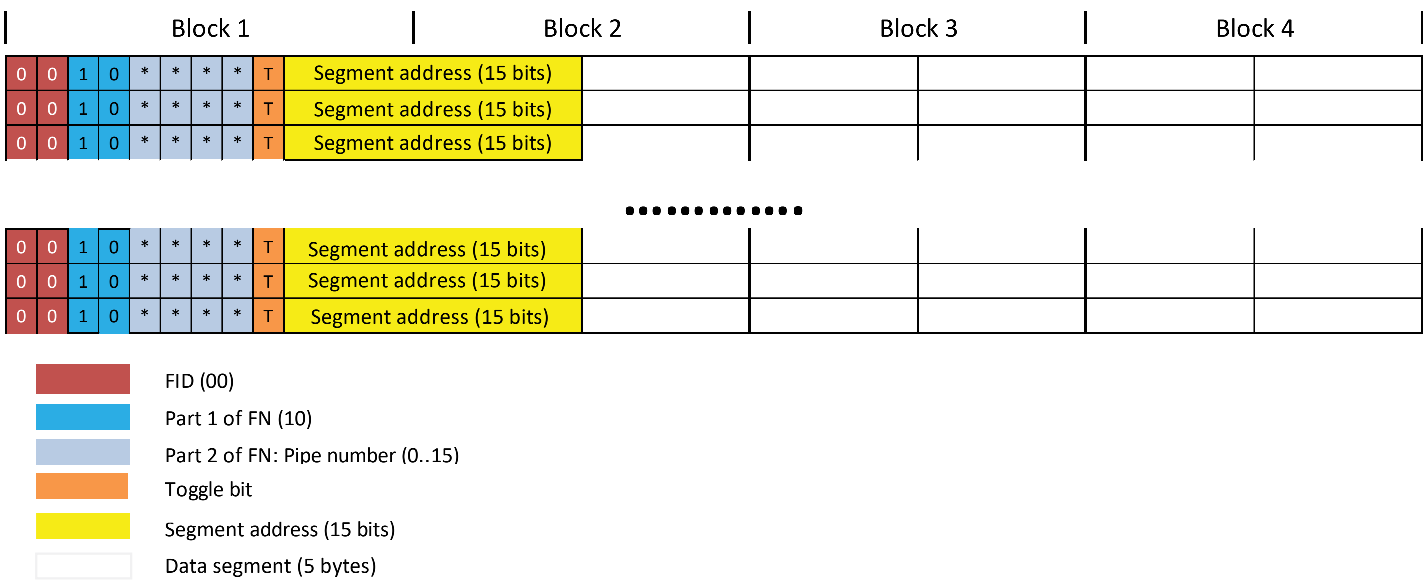
The CRC-16 calculation is explained in Annex D of IEC 62106-2 ed.2.

Figure 9-20 shows an example for mode 0 and the chunk address x=439.

Figure 9 - 20 - Example for CRC mode 0 and the chunk address x=439.

RFT data group format

The RFT data group format is shown in Fig. 9-21.



Note: The segment address is equivalent to a group sequence.

Figure 9 - 21 - RFT data group format used to transfer a file within a pipe.

Channel used to carry ODA data associated with a file, or not

FID = 01 / FN = yyyyyy (channels 0 … 63)

This Function Header allows group type C ODA data to be sent using channel yyyyyy (0 …63) indicated by the 6 bits of FN, 64 channels in total using one of data-streams 1, 2 and 3 or all.

Channels 0 to 15 are reserved for ODAs using files and they can be assigned only with the method 1 assignment method.

The ODA application data content is 7 bytes. However, to be able to transfer a large sequence of data bytes, it is common practice to design the protocol using variants. These may be and are often coded using the most significant 4 or more bits, as would be required by the ODA design process and the choice to be made is free.

The channel number associates the remaining 6.5 bytes (or less) of data with a particular AID of a group type C ODA, signalled by the method 1 assignment group using variants 2 to 15. This is a similar association as the one used, with group 3A, between the group number and a particular AID of a legacy group type A or B ODA in data-stream 0.

If the respective ODA requires a file or files to be transferred, channels 0 to 15 are to be used as described above for the RFT. Then the ODA data channel number is the same as the pipe number of the file being transferred and it is always in the range 0 to 15.

Channels 16 to 63 are for ODAs using no files. They can use for the channel assignment method 1, 2, 3 or 4.

For group type C ODAs the channel number is assigned to an AID as shown above in Table 1.

It is the transmission operator, or the broadcaster concerned who decides which channel is used for an ODA.

Summary of the above principles

Only method 1 assignment group will be used for ODAs with files.

- In case of an ODA without files: The ODA blocks 3 and 4 are fully available for ODA data (32 bits).
- In case of an ODA without files: The ODA channel range is limited to 16..63.
- In case of an ODA with files: block 3 of the method 1 assignment group starts with a 4-bit variant; the remainder is available for ODA data (28 bits) (and only variants 2 to 15, as variants 0 and 1 are already defined and must be used in sync with the respective file being transfered with the RFT file data transmitted in sequence.
- In case of ODA with files: The channel/pipe range is limited to 0..15.

The channel and pipe assignment groups are:

MSB in Block 1			
FID	FN	Function	LSB in Block 1
10	000000	ODA assignment for an application with files	0000yyyy (only 0 to 15)
10	000000	ODA assignment for an application without files	00yyyyyy (only 16 to 63)

Note: LSB is the least significant byte

The data groups are:

MSB in Block 1			
FID	FN	Function	LSB in Block 1
00	000000	Legacy data being tunneled	00000000

00	10yyyy	Pipe in range 0 to 15: RFT file with or without additional ODA data	data
01	00yyyy	Same channel no. as pipe: Additional ODA data for file	data
01	yyyyyy	Channel 16 to 63: ODA data for apps without a file	data

Possibilities to trigger the information to be shown on the display

A short signal, i.e. a burst of the group carrying this information, repeated few times and spaced with other groups transmitted in between, would be needed to trigger the information carried in the file and/or the associated data to be shown on the display. An example is the display of music cover art, which has to be transmitted before the respective music item will be played in the radio programme. This is because the music cover art file transfer will take two minutes or more.

Several possibilities exist, assuming that only a few bits will be needed to signal the link to the current image to be made:

1. One can use on the basic carrier a short sequence, a burst, of 3A groups with the application group code 0000 which has the special meaning that no application group type is associated on the basic subcarrier. The 16-bit application data in block 3 can carry the necessary information for the respective link for the cover art file concerned to be made. The AID to be used shall be the same as that of the application which transfers the music cover art with C-groups on the upper subcarriers. However, the UECP, as defined so far, does not permit to create such a burst.
2. One can use a burst an A or B type ODA group on the basic subcarrier. The A-type group permits to code 37 bits for this purpose and the B-type group 21 bits.
3. Or, on the upper subcarriers a burst with the variant code in the range 2 to 15 from the method 1 assignment group may be used. Such a variant can use up to 28 bits for defining the link to be made.
4. Or, on the upper subcarriers a burst of a RFT associated ODA group, to be defined for this purpose, may be used.

Example: Coding of a fictive ODA called “Image with Text”

AID=???? (this is a fictive value, as this ODA-AID we would need for this example is not assigned).

The respective image is transferred with the RFT group. The UTF-8 coded text, we consider here, is attached to the respective image. The image is transmitted first, followed by the text that belongs to it.

The text is structured using eight text fields or levels, called "Text type" 0 …7, as follows:

0. Level 0 / Title 1: Up to 64 bytes
1. Level 1 / Title 2: Up to 128 bytes
2. Level 2 / Header: Up to 256 bytes
3. Level 3 / Long text: Up to 5120 bytes (Text segment counter 0 …1024 / 10 bits)
4. Level 4 / URL 1: Up to 256 bytes
5. Level 5 /URL 2: Up to 256 bytes
6. Level 6 / URL 3: Up to 256 bytes
7. rfu - reserved for future use

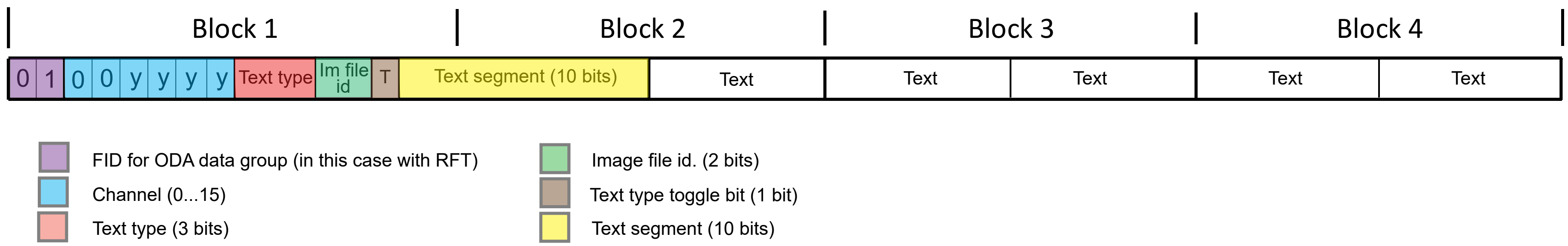


Figure 9 - 22 shows the coding of the text elements sent with the image; for the text transmission the associated ODA group is used that uses the same channel as the pipe used for the image transmission by means of the RFT.

In the example shown in Figure 9-22 we use 3 bits for the image file identification. This is to ensure that when the respective text fields are updated, they remain associated to the correct image file. In this example, the 3 bits permit to use a sequence of up to eight images to be placed on the carousel.

Which of the eight images with its respective text shall be shown on the receiver's display is to be determined by a trigger signal of which the details are not described here. To achieve this, a burst of an assignment group variant in the range 2 to 15 can be defined and used at the instant required.

We also use in Figure 9-22 a toggle bit T. As each text field can be updated when needed, the toggle bit changes when the content of the respective text field has changed. In that case, before the new text version is entered into the respective text buffer, and replaces the old text which is flushed.

To ensure correct reception of the image files and respective text fields, they shall be repeated at least twice and even better three times. When the receiver is switched off, all content in the respective buffers shall be flushed. This is to avoid that when the receiver is switched on again, outdated information is shown on the receiver's display.

Figure 9-23 shows a typical screen for this kind of application.

Figure 9 - 23 - Example, from an ongoing Radio France project, testing an image with associated text information.

ODA app for RDS2 - Slideshow transmission coded in C-group type

The app in IEC 62106-2 Ed 2 (2023), Annex F, applies the coding priciples explained above.
For details of the coding refer to this IEC standard.

With this Slideshow app the following objectives can be achieved using a carousel of up to 16 slides.

- Broadcasting of slides which are programme related, or not;
- A slide can contain an image and text components (all are optional);
- The text consists of structured text components to inform the receiver what kind of text it is;
- Some text components consist of text elements grouped together (as Preview and as URLs);
- Two next slides can be broadcast in advance to inform receivers what is coming next;
- The display by the receiver of the current slide can be synchronized with the audio using a directory trigger group (e.g. for music cover art);
- The directory trigger group signals three slides (current, next, 2nd next);
- The image and all text components can be updated independent of each other.

Several use cases can be covered:

a) Non-programme related where the broadcaster does not know what comes next (e.g. sport).
b) Programme related when the broadcaster knows what comes next (e.g. music play list).
c) Non-programme related Slideshow where a carousel cycles several slides (advertisements or sequence of news items).

Application identification code of this ODA

The AID code of this ODA is 0xFF80.

Image requirements

File type

Either jpg or png shall be used as File type. No file type identifier is needed as all file relevant info, including the file type, is already embedded in the file header of each of those formats.

Aspect ratios, resolution and file size

The required image resolution is expressed in pixels for the width and height. Two aspect ratios are possible: 240 x 240 px or 320 x 240 px.

Images not existing in this resolution will need to be re-scaled for transmission by the transmission operator or broadcaster.

COORDINATOR
degetel
PARTNERS
ARMINES LINKIO
octopus energy
WORLDCAST SYSTEMS

The FlexiMax Project

The FlexiMax Project is part of an ADEME initiative to increase flexibility in Europe's energy and industrial systems. This project contributes to the move towards carbon neutrality by 2050 in the context of a 100 % renewable energy scenario.

Objectives of the Project

> Managing the massive increase in electricity demand due to the transition to a zero-carbon economy, including the transition to electric vehicles.
> Improving the flexibility and resilience of the power grid.
> Automating and optimizing demand response to reduce the need for grid reinforcement and electrochemical storage.

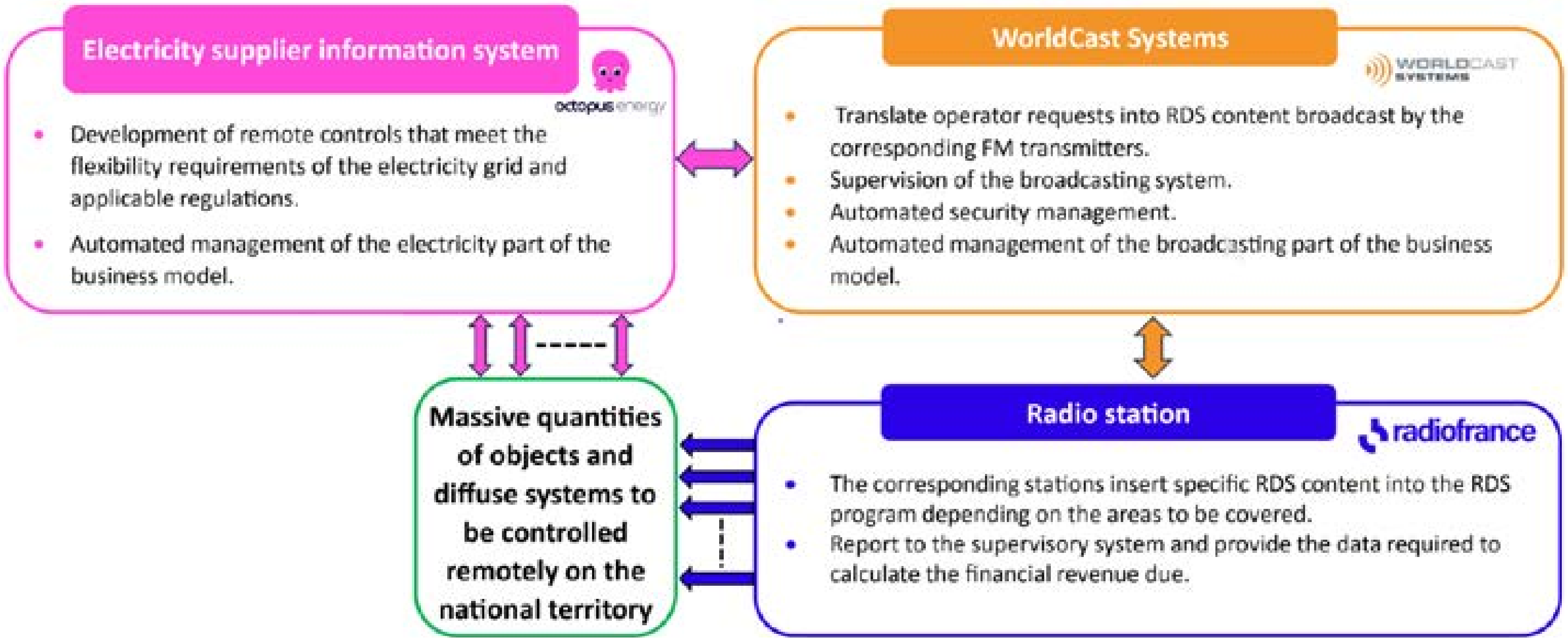
How to approach it

> By complementing traditional balancing of generation and consumption with real-time dynamic compensation.
> Based on low-latency control of the consumption of relevant electricity consumers.
> Responding to unforeseen fluctuations in generation or any disturbance in the grid.

How can it work ?

Innovative use of a proven and ever-present "DataChannel".

> Using FM-RDS broadcasting to control massive amounts of distributed electrical loads, 24 hours a day - 365 days a year.
> It is reliable, secure and economical as no new infrastructure needs to be built.
> Everywhere, nationwide, even in rural areas of the country without white spots, thanks to the service range of FM broadcasting.



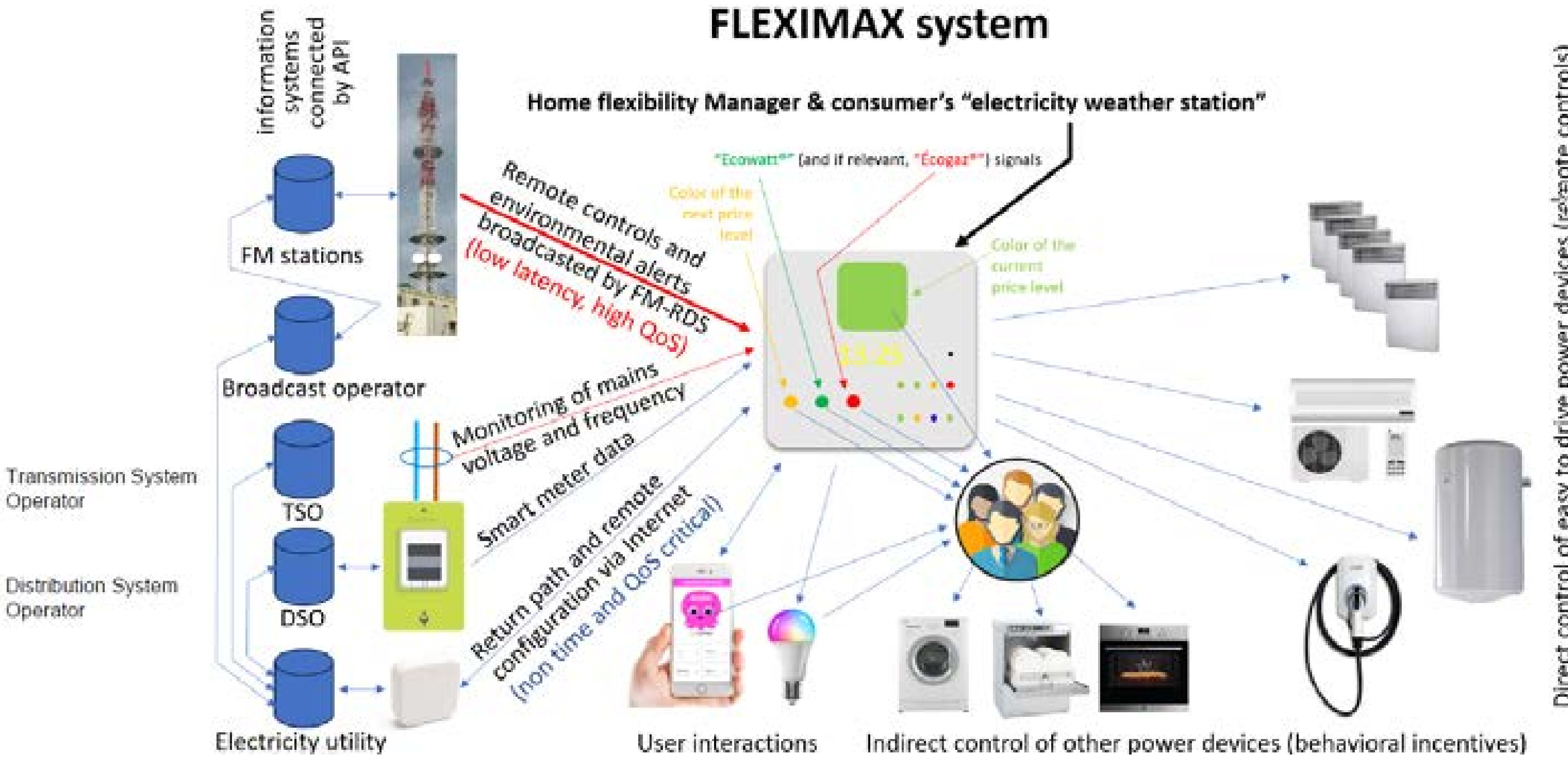
Expected results and innovation

> Removing the barriers that have prevented the use of the extraordinary potential of RDS digital broadcasting channels associated with FM broadcasting to manage power networks for more than 20 years.

> The first step will be based on RDS and if possible on the new international standard for RDS2 - a world first in this domain.

> Future innovative products and services for the broadcasting and energy industries, and for the general public.

> Reduce the need for reinforcement of the electrical network infrastructure and the need for electrochemical storage.



The Project relies on new solutions based on mature and internationally standardized technologies to meet the needs of the French and European electrical system. The national broadcasting ecosystem, given its status as an "operator of vital importance", is able to offer data broadcasting services with very high availability, 24 hours each day of the year and throughout the country. The extreme reliability of the broadcasting networks is congruent with the needs of the management of the electricity distribution networks, which are of systemic importance.

Reference: RDS Forum document R24/028_1.

Acknowledgement of a milestone in IC chip development for FM radio with RDS - The Silicon Labs radio receiver chip series Si47xx

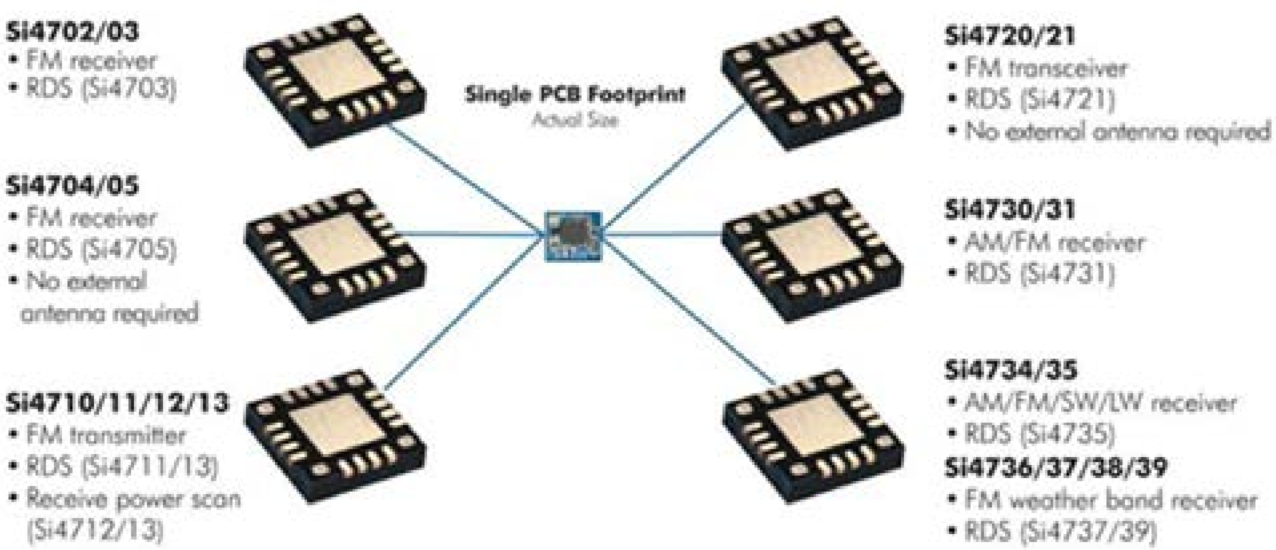
by Dietmar Kopitz

These ICs exist now for almost 20 years already. They were developed around 2007 by Silicon Labs in Austin Texas, founded in 1997. They were manufactured in the millions.

These are or were unique IC products on the market. To our knowledge nothing equivalent has so far been developed anywhere. The product range was very broad and the Si47xx ICs permit low-cost manufacturing of FM radios with RDS, FM/RDS equipped mobile phones, USB sticks with FM/RDS, etc. and all with a high-quality audio output, analogue and also digital, depending on the particular chip model. These IC chips have had a very low price, especially if bought in large quantities.

What was unique ?

- The chip size is very small, only 3 x 3 mm, but only for surface mounting and thus only for industrial manufacturing.
- Almost no external components are required for using the chip.
- The chips are controlled via an I2C bus by a microprocessor for tuning and volume control.
- The rf sensitivity for FM radio and RDS reception is good as experience gained with products thus created has shown.



In 2021 Skyworks Solutions, Inc acquired the Infrastructure & Automotive Business of Silicon Labs including all consumer and automotive broadcast radio products.
Skyworks is an American semiconductor company headquartered in California. Up to the end of 2024 it was a member of the RDS Forum.

Skyworks Si479xx Automotive Radio Tuners with FM-RDS and Diversity Algorithm

Introduction

The automotive industry continually seeks advancements in radio tuner technology to enhance the driver experience. Skyworks' Si479xx series of automotive radio tuners exemplify this pursuit by integrating FM-RDS and a proprietary phase diversity algorithm for antenna combining.

Phase Diversity Algorithm

Skyworks has developed a phase diversity algorithm for antenna combining, which significantly improves signal coverage in weak signal environments. This algorithm mitigates the effects of multipath interference and signal degradation due to RF fading. By combining signals from multiple antennas, the algorithm enhances the reliability and quality of FM reception, ensuring a seamless listening experience for drivers.

Background Scan for Alternate Frequency Checking

The Si479xx tuners utilize background scan to build a station list of alternative frequencies. This feature is vital for AF checking, as it allows the radio to switch to equivalent audio content on a higher quality alternate frequency when the current signal degrades. The background scan ensures that the station list is continuously updated, providing drivers with the best possible listening experience.

Conclusion

Skyworks' Si479xx series of automotive radio tuners, with FM-RDS and its phase diversity algorithm, represent a significant advancement in automotive radio technology. By accelerating FM-RDS PI code decoding and block correlation, and utilizing background scan for alternate frequency checking, these tuners ensure consistent audio content and enhance the driver experience. FM-RDS not only provides rich text content but also supports maintaining consistent audio content across various tune frequencies, even in impaired signal conditions.

RDS defended as an open technology

During the first 20 years of the existence of the RDS specification (since 1984) the RDS Forum had a hard time to defend the RDS system against unjustified IPR claims from companies like Telefunken, Thomson and Grundig. What follows is a testimony from those RDS Forum members that had been actively involved in defending what was initially agreed within the EBU, namely that RDS shall be an open technology which was jointly developed by public broadcasters in close collaboration with the European consumer electronics industry.

Introduction

The Radio Data System RDS was originally conceived by the EBU as an open technology. The IPR developments reported here may serve to better understand to what has happened afterwards. These are only a few elements of a puzzle on which we in the RDS Forum have collected this information over a period of about 35 years. Putting these puzzle elements together now serves to obtain a more complete image about what had happened in this particular domain.

History of the Telefunken Patents (1986)

The vast majority of the Telefunken patents may be considered to be worthless. These related to fundamental claims about the transmission of data using FM radio, but the patent concerning AF method B frequency lists had validity.

This 'patent' is in fact two patents. One relating to the transmission of AF method B frequency lists and the other to the reception of these lists. Telefunken owned both patents. The patents were originally filed by IRT (Institut für Rundfunktechnik). The inventor devised a primitive method for the transmission of AF lists with more than 25 elements and filed the patents for this invention. He then went to an EBU meeting in Barcelona and explained his invention to the other members of R1/RDS. Members of the Group were doubtful whether this invention would work and demonstrated many flaws in the technique.

Subsequently, modifications were proposed at the meeting and developed by a Subgroup which made the technique valid. The inventor then returned to Munich and modified the filed patents accordingly.

IRT was the research organisation of the German public broadcasters group ARD and ZDF and all patents being filed needed to be endorsed by a joint group of these broadcasters. When this joint meeting took place, it was agreed that IRT should not pursue these patents since the German broadcasters knew that RDS was being developed by EBU members as a patent free system. Under German law at that time (1986), if an employer does not wish to pursue such a claim, then the rights revert to the employee, who was the inventor. The IRT's patent lawyer who worked for the IRT informed the inventor that the patents were available for him to pursue (at his cost) or, alternatively to sell them, and that he knew an organisation interested in buying the patent rights.

The IRT patent lawyer told the inventor that the company interested in buying the patents was based in Zurich and traded under the name of IRT (Industrial Research Technology). The inventor agreed to accept a sum of 25'000 DM for the transfer of these rights. The similarity in naming the two companies IRT in Munich and IRT in Zurich was confusing the inventor might have felt that there was some connection. This is not so, at least not openly so.

RDS experts have attempted to locate the company IRT in Zürich and establish who are its shareholders - this they have been unable to do. The registered address of the company has been visited, but turned out to be a mailing address only, with a caretaker being paid to pass all correspondence to (surprise, surprise) an address in Munich. Clearly one must assume that the two IRT companies have had some connection unofficially. IRT (Zürich) contacted a German industrial patent holding company and asked it to circulate the availability of these patents to RDS manufacturers inviting them to buy the rights. Philips were the only company to pursue this. They paid 500'000 CHF for the rights to use the patents.

IRT (Zürich) further agreed that Telefunken could market the patent rights on their behalf. Telefunken offered this license agreement to many manufacturers, but not to Philips, since Philips already had a cross-licensing agreement in force with Telefunken and thereby essentially had not needed to pay the 500'000 CHF anyway. Philips tried to instigate the recovery of this money unnecessarily paid, but this was found to be impossible.

Telefunken have collected together many patents that have even the remotest connection to RDS and packaged them together as an impressive set, approaching many companies from all over the world offering licensing agreements. Telefunken had no RDS expertise, and their company representatives have never attended any of the meetings of the EBU's RDS group or participated in any RDS development work. The crown to their package was the acquisition of the rights to license AF method B frequency lists and their registration of the RDS logos.

Several companies have paid royalties to Telefunken (especially those from the Far East), because they were confused and because they were frightened of losing valuable trading arrangements. Telefunken Consumer Electronics later became part of the French electronics giant, Thomson, which has very large buying power for

OEM products in the Far East. Japanese companies value these partnerships very highly, and the relatively small sums asked for were therefore paid, so as not to· jeopardize more-lucrative deals. The BBC and EBU do not fundamentally believe, as far as car radio manufacturers are concerned, that any of the Telefunken patents had any technical validity. Although the EBU could explain this to the manufacturers, the RDS project coordinator was being restrained by his management from doing so. The EBU hierarchy did not want to unnecessarily change its valuable relationship with the IRT in Munich, as one could have easily imagined. There was undoubtedly some connection at a high level between the IRT in Munich and the IRT in Zurich.

1984 – 1989: Background to the RDS logo

The Radio Data System was developed by the BBC, Institut für Rundfunktechnik (IRT), and Swedish Telecom Radio STR (now Teracom), working together under the auspices of the European Broadcasting Union (EBU), between the mid 1970's, and March 1984, when the RDS Specification was published as EBU Technical Document 3244.
In 1985, the BBC undertook to introduce the service on all FM services, with the first phase (England) to be completed by mid-1987.
In 1986, the promotions section of Engineering Information Department (EID) commissioned Gary Blakeley, a graphic designer from the company Atkin and Blakeley to produce a 'service-mark' to publicise the service.
In late summer 1986, the logo had been designed. The service area of a transmitter is traditionally represented by a central point (the transmitter) from which emanates a signal, represented as a series of concentric circles. As one of the basic features of the Radio Data System is to cause a receiver to retune inaudibly from one transmitter to the next, the logo represented this concept by merging concentric circles from two transmitters to form a 'figure-of-eight' device.
The logo was first displayed publicly at the 1986 Motor Fair NEC Birmingham, when the BBC's commitment to introducing RDS was announced to the Press.
The BBC offered free use of its logo to its European broadcasting partners and encouraged the receiver industry to adopt the mark on their RDS products to aid recognition by the public. The logo was publicised in the October 1986 edition of the RDS Newsletter produced by the EBU, which was distributed to Broadcasters, equipment manufacturers, the press, etc.
December 1986, the designer assigns rights in the logo to the BBC. Several promotional items (ties, sweatshirts, jackets, scarves etc.) were produced by the BBC and others (notably Swedish Radio) all utilising the RDS logo. Details of the logo were distributed by the BBC and EBU to manufacturers to encourage widespread use.
The first widespread international use of the logo was at the August 1987 International Audio/Video show (Funkausstellung IFA) held in Berlin, at which the German Public Service Broadcasters (ARD) announced the start of their RDS service. Several manufacturers demonstrated their prototype receivers using the logo.
The BBC RDS Development Manager became con-

cerned that unscrupulous manufacturers could use the mark on non-RDS radios and hence mislead purchasers. He asked the BBC Copyright Department to seek to register the logo as a Trademark to provide some mechanism to prevent misuse of the logo.
In Autumn 1987, the BBC's Copyright agents FB Dehn (FBD) conducted a search of the appropriate registers and encountered a conflicting mark with a Class 9 registration, similar enough in their opinion to prevent a trade mark registration. Because of the similarity with this mark belonging to Time Manager International (TMI), who manufacture Personal Organisers. It was further advised that the BBC and EBU should not promote use of the logo as it could be construed that the BBC was encouraging others to infringe TMI's copyright. The BBC commissioned David Shortt from 'The Design Enterprise' to produce a new logo, retaining as much as possible of the original logo concept, but making it sufficiently dissimilar to TMI's mark such that it could be used without conflicting with this registration. Steps were also taken in the design of this new mark to ensure that it could be used more easily, the original logo was difficult to use as the series of fine concentric rings lost definition at small sizes.
David Shortt produced the new logo, assigning copyright to the BBC in March 1988. A search by FBD confirmed that the new logo, the letters 'RDS' or the words 'Radio Data System' did not conflict with any UK registered marks. The new logo, and the reason for the change was presented to the April 1988 meeting of the EBU Programme Experts Meeting in Turin.
The EBU agreed to adopt this new logo-mark, publishing the change in the August 1988 EBU Newsletter which advised that use of the original logo be stopped immediately. The BBC produced bromides, style guides, colour references etc. for the revised logo which were distributed on request to all.

BBC's legal services were informed that Telefunken had applied to register the original logo in Germany.
The EBU lawyers in consultation with BBC's legal service filed an objection to the application on the basis that the logo is BBC copyright, RDS is •generic' and that RDS was developed under the auspices of the EBU, not Telefunken.
In February 1989, the EBU wrote a letter to German Patent Office to protest against a trademark on RDS granted to Telefunken. Attention is drawn to that Telefunken has no right to register a trademark on RDS which is a development of the EBU and its members. Telefunken has clearly plagiarized the original logo designed by the BBC.
The EBU lawyers advise the legal services of the BBC that the BBC evidence would be convincing in action against Telefunken for copyright infringement, but that in German law the EBU would have no grounds to object to the German trademark registration.
The BBC and Philips jointly develop an additional feature of RDS called Enhanced Other Networks (EON) which improves RDS performance. Patents for EON held jointly by BBC and Philips were registered to protect this as an open technology. EON is an additional feature within RDS which 'turbo-charges' the response of a receiver using it.
In Spring 1989, receivers begin appearing using the new logo.
In July 1989, Telefunken are registered with a trademark for the old logo in Germany. EBU and BBC were not unduly worried as the old logo was now worthless.

All broadcasters and manufacturers were using already the new logo. In Summer 1989, the new logo started to become widely used at exhibitions etc. throughout Europe, especially at BBC county shows and the August 1989 Funkausstellung IFA in Berlin.
In Summer 1989, the BBC introduces its RDS Travel Service, which uses EON.
In September 1989, the BBC's legal services informed that Telefunken have applied to register the new logo in Germany. This and the fact that the EBU decides not to oppose the application is not communicated to the RDS team, who would certainly have opposed the application.
During the remainder of 1989, and throughout 1990, the BBC helps receiver industry to realise EON in their RDS radios. First RDS radios with EON capability were expected for Summer 1991.
January 1990, original RDS specification (3244) and its four supplements (which include EON), now becomes established as a part of European law, and is published as CENELEC standard 50067.
Included in the CENELEC publication is the advice that receivers should use the logo as recognition that they are produced in accordance with the specification.
In August 1991, the BBC's RDS Development Manager foresaw the need for an easy way to distinguish and promote sets with the EON facility from basic sets as differences would not readily be apparent when purchasing a receiver in a shop.
David Shortt was commissioned to produce a further ROS logo, for use only on receivers utilising the EON feature to provide extra receiver performance.
'RDS-EON' logo was produced by David Shortt, and copyright assigned to BBC in September 1990. In October 1990, the RDS Development Manager asked the BBC's legal services to advise about registering the 'RDS-EON' logo as a BBC trademark. The intention of the registration was for the BBC to authorise its use only on products meeting a defined minimum standard of RDS-EON performance, so that the 'RDS-EON' logo become a 'quality assurance' symbol.
In August 1991, written details of the 'RDS-EON' logo published in EBU's RDS Newsletter, stating that BBC had a trademark registration for the RDS-EON logo, and inviting manufacturers to apply for details of minimum standards required for compliance.
At the end of August 1991, the BBC's legal services inform, the RDS Development Manager that registration is not possible as the RDS-EON logo conflicts with the normal RDS logo which has been registered by Telefunken in 1989.
Blaupunkt ring the BBC to complain that Telefunken have registered RDS as a trademark in 53 countries and are demanding royalty payments for each set produced.
Blaupunkt seeks support of the BBC in opposing claims from Telefunken.
The BBC's Director of Resources for Radio calls a meeting of all interested BBC parties with a view to try to end Telefunken's interference in, and claims to rights in, RDS.
The BBC's Legal Counsel was to be consulted as to the best course of action to be taken.

References:

The RDS Forum compiled a detailed documentation about the history of the RDS logos in doc. R04/001_3.

Brief history of the Grundig EON trademark issue

1995-08-05: Grundig's EON trademark registration no. 641 930, WIPO.
1991-11-26: Grundig's EON trademark registration no. 2006559, DPMA.
2000-07-22: Letter from Dietmar Kopitz (RDS Forum) to Mr. Schneidenschnur (Grundig) asking to urgently seek an arrangement with the RDS Forum. Otherwise the cancellation of Grundig's EON trademark registration will be requested.
2000-08-03: As the letter is not being answered by Grundig, the RDS Forum asks, through a Munich patent lawyers' office for the cancellation of the trademark.
2000-08-10: Grundig informs the RDS Forum (see doc. R00/025) that it withdraws the offer to license their EON trademark to members of the RDS Forum.
2000-08-10: Grundig writes to all members of the RDS Forum (see doc. R00/031) to draw attention to the fact that the cancellation of the EON trademark will leave the designation unprotected.
2000-10-17: Grundig files its opposition against the request for its EON trademark cancellation.
2000-11-17: RDS Forum holds a second special meeting on EON. The meeting notes are first published only to the meeting participants. To the RDS Forum they are published as R00/037.
It was agreed to write to Grundig that they pass over the EON trademark to the RDS Forum for a symbolic fee of 1 DM. Only if they agreed, would the cancellation request be dropped.
2001-01-05: Letter from the RDS Forum lawyer to Grundig suggesting seeking an agreement with the RDS Forum.
2001-01-24: Letter from Dietmar Kopitz to Dr. Bruch (CEO of Grundig) appealing to Grundig that they should give up on the conflict with the RDS Forum. This letter was not being answered.
2001-02-01: Grundig answers the RDS Forum's lawyer suggesting that the best solution for the RDS Forum members will be to take a license against the payment of a lump-sum.
Grundig leaves the RDS Forum 2001 after membership since its foundation.
2001-03-20: "Special offer" from Grundig to RDS Forum that each industry member shall take a one-for-ever license against the lump-sum payment of € 52 000 each plus VAT. The offer is open until 30 June 2001 (see R01/003).
2001-03-22: Grundig seeks to arrange a delay for the delivery of their justification to object to the RDS Forum's cancellation request. The trademark office agrees with the final delay to be the 29 May 2001. Grundig informs the trademark office that it is negotiating with the RDS Forum which requires time to co-ordinate its position.
2001-04-06: Letter from the RDS Forum lawyer to the German trademark office insisting that a decision is urgently awaited by the RDS Forum. The recent offer of Grundig is quoted to prove that the only aim of this trademark is to draw money from the other manufacturers. The EON designation should be kept free for all manufacturers given the fact that they collectively made already more than a hundred million receivers.
2001-05-05: Grundig informs the RDS Forum that it withdraws from the RDS Forum the offer from 2001-03-20. Reason: The letter sent to the trademark office, dated 2001-04-06.

2001-08-23: Grundig is justifying its opposition over the cancellation request concerning absolute bars to protection.
2001-10-19: Final observations from RDS Forum to DPMA

Legal achievements

On 11 April 2006, the German Federal Patent Court in Munich, Germany, confirmed the earlier decision taken by the German Patent and Trademark Office in 2003 that the EON trademark, held by Grundig Multimedia BV, is invalid and thus cancelled for radio receiver products and associated goods (Class 9), but may be kept for other goods. This decision was based on evidence that EON was already a feature of the international RDS specification (issued by the EBU and CENELEC), and published prior to the initial Grundig trademark filing in 1991.

Before the year 2000 the RDS Forum had attempted to settle the matter directly with Grundig, but as they remained inflexible, it was then decided by the RDS Forum to request cancellation of the German EON trademark registration.

As the cancellation request was filed within the maximum permissible delay of five years for an objection, concerning the international registration of the same EON trademark made by Grundig at WIPO in 1995, the German Federal Patent Court decision from April 2006 also invalidates, in practice, the international WIPO registration.

Background information

The RDS system had existed for over 20 years. It had revolutionized the comfort of using FM radios, and thus it is found in almost all radios on the European and USA markets.

One significant step taken in the nineties was the improvement of the RDS switching functionalities achieved through the Enhanced Other Networks (EON) feature. The idea originated in the BBC and was then further developed through the EBU. By 1990, RDS-EON became an integral part of the European RDS standard, and in 1991 the first RDS car radios with the EON feature were launched on the European market by Panasonic, Grundig and Philips.

These were in a way the first car radios of a second RDS generation. To make it possible to distinguish these from radios without EON (first generation), the BBC commissioned the development of an RDS-EON logo, which was offered then to the industry via the EBU and its RDS Newsletter to be used, for free, and to be able to designate for consumer recognition RDS-EON radios.

Following this in 1991 Grundig registered an EON trademark in Germany, and 1995 an international trademark at the WIPO in Geneva. At that time, it was thought that Grundig was doing this only to protect itself. Grundig had been a long term RDS Forum member and therefore nobody in the RDS industry mistrusted this action. However, by 1999 a controversy with the RDS Forum started to develop. Grundig attempted to force market competitors (many of whom were RDS Forum Members) to accept a license agreement, permitting them to use the three letters EON on their RDS radios, on a fee-payment basis.

Nobody was prepared to pay a license fee for marking products with RDS-EON. The RDS-EON logo had been an integral part of the RDS standard since 1992 and thus this encouraged free use for appropriate products for the whole industry. The RDS Forum, acting on behalf of its members, attempted a settlement with Grundig, but this was unobtainable, and it was decided in 2000 to request the cancellation of the German trademark registration.

The RDS-EON logo of the RDS standard © 1991, BBC & EBU. This logo is optional and may be used to designate that an RDS receiver product has the optional EON feature implemented

References:
1: Grundig's German EON trademark registration (R06/025_1)
2: Grundig's International WIPO EON trademark registration (R06/026_1)
3: The decision from the German Patent and Trademark Office of 2003 (R06/027_1)
4: The decision of the German Federal Patent Court of 2006 (R06/028_2)

Nov. 2004: RDS Forum representatives meet with Thomson Licensing SA in Paris

The purpose of the meeting was for the RDS Forum to demonstrate to Thomson/Telefunken that they were wrong to exploit their so-called ownership of the RDS Logo trademark, and to prove that they were not entitled to charge members of the RDS Forum for the use of the RDS logo which in the view of the RDS Forum is not being used as a trademark.
Following the Forum's presentation, a response and comments were invited from Thomson.
They started by saying that although they were the current owners of the RDS trademark and several patents in respect of RDS (including AF Method B), they were also acting as agents for a mysterious little company called "Bräu" which we were led to believe is a front for several other people with fingers in the RDS pie.
It became clear that Telefunken/Thomson had registered the trademark in 1988 for the first RDS logo (no longer used by manufacturers), then followed by another registration of the horizontal eight symbol of the new and presently used RDS logo (registered then by initially Telefunken, since 1989) and lastly the letters 'RDS', surrounded by a rectangular frame, registered since 1998. From 1988, they said, they had been offering to allow licensees with free use of the logo, assuming that the licensees had paid for the use of their patents that included AF Method B. Now the life of these patents was ending, after 20 years, they were offering a new package of rights to the use of the RDS trademark alone.
To the best of their knowledge the RDS Forum had ever heard of any licensing demands from Thomson in respect of the ownership of these rights until last year, 2003 (see also doc. R04/019 for an example of the kind of license contract being proposed). Therefore, the former RDS Forum Chairman Johnny Beerling asked them why they had not made any demands from the time when they first acquired the trademark in 1988. They replied that this was not true; they had been continually issuing licenses for their patents since they first owned the trademark. Johnny Beerling challenged this and said if it was true, then they could only have been making demands to relatively small, non-European companies, since otherwise we would have heard about it via the RDS Forum members. It was our view that this sounded like an attack on the East Asian manufacturers to protect the European industry.

They denied this.

The RDS Forum representatives, said that from a European point of view their action could also be regarded as an act of unfair competition since their claims interfere clearly with the implementation of the open European RDS standard that includes a clause that RDS receivers complying with this standard shall be identified by RDS logo symbols. These symbols are part of the standard and their copyright is granted for free, as an integral part of the RDS standard, and to be used for identification purposes of the RDS technology specified in the IEC standard 62106. Therefore, the RDS Forum may later also choose to ask the European Commission for protection against those unjustifiable claims from the Thomson company which with their trademark claims indirectly inhibit the free use of the standard within the European market. Additionally, we observed that those Thomson trademarks are not exactly the RDS logos as laid down in the standard, and the horizontal eight figure they registered in 1989 has clearly been plagiarized from the second RDS logo that the BBC had developed and published together with the EBU in 1988.

There might therefore be one loophole that might get members “off the hook” in that the Thomson registration is of the horizontal figure of “8” logo and the letters “RDS” are in a different typeface from that used in our definitive logo as set out in the RDS standard. It would be worth seeking the opinion of a copyright lawyer as to whether using our official logo would be free of the Thomson claim that relates to a set of graphically different symbols.

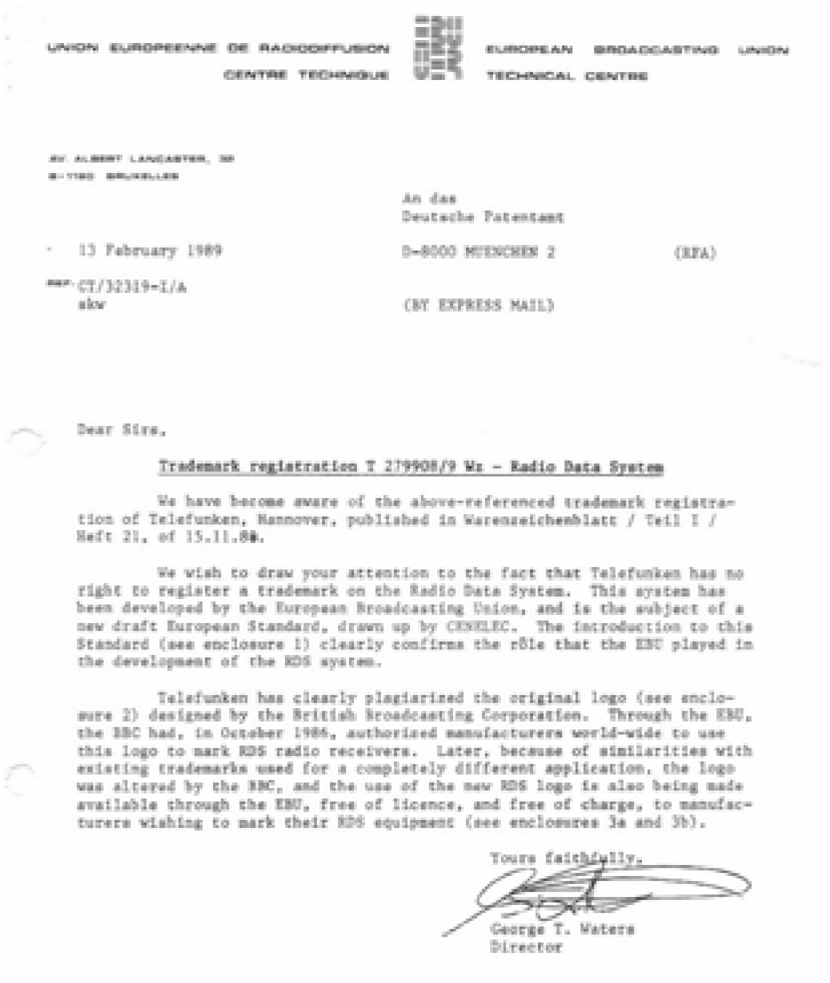
Thomson representatives said that they understood the morality of what we were saying. However, if we felt so strongly that Telefunken/Thomson had no right to these trademarks, why had we not complained at the time of the original registration? It was pointed out that the EBU had in fact tried to oppose the registration in 1989 (letter of EBU sent to German Patent Office on 13 February 1989), but under German law as it was at that time, the EBU was not a commercial company and so it was not allowed by the trademark registration procedure to register an objection. Nowadays, with European harmonisation, these regulations have been changed, and what was denied to the EBU in 1989 is of course now possible.

Thomson representatives also pointed out that after registration there was a five-year window from the first date of registration in which further objections could have been lodged and we had not done so, therefore there was little they could now do. It was clear to us that Thomson has been very clever, not issuing any claims in respect of the logo in that five years which might have alerted the RDS Forum to what was going on, until it was too late to do anything except appeal to their good nature!

Johnny Beerling, the RDS Forum Chairman at that time, said he felt very aggrieved that Telefunken/ Thomson had stolen a design for which the BBC had commissioned the RDS logo and paid and which they were now exploiting it without doing anything to deserve it.

It was wrong that they should take the product of our efforts and charge others for using it; this was nothing short of legalised theft!

In answer Thomson said they were only acting to protect their license interests and that they were in doing so serving the same objective as the RDS Forum, namely protecting and maintaining the RDS standard. This by virtue



UNION EUROPEENNE DE RADIODIFFUSION
CENTRE TECHNIQUE

EUROPEAN BROADCASTING UNION
TECHNICAL CENTRE

AV. ALBERT LANCASTER, 32
B-1180 BRUXELLES

An das
Deutsche Patentamt

13 February 1989

D-8000 MUENCHEN 2 (RFA)

REF. CT/32319-1/A
skw

(BY EXPRESS MAIL)

Dear Sirs,

Trademark registration T 279908/9 Wz - Radio Data System

We have become aware of the above-referenced trademark registration of Telefunken, Hannover, published in Warenzeichenblatt / Teil I / Heft 21, of 15.11.88.

We wish to draw your attention to the fact that Telefunken has no right to register a trademark on the Radio Data System. This system has been developed by the European Broadcasting Union, and is the subject of a new draft European Standard, drawn up by CENELEC. The introduction to this Standard (see enclosure 1) clearly confirms the rôle that the EBU played in the development of the RDS system.

Telefunken has clearly plagiarized the original logo (see enclosure 2) designed by the British Broadcasting Corporation. Through the EBU, the BBC had, in October 1986, authorized manufacturers world-wide to use this logo to mark RDS radio receivers. Later, because of similarities with existing trademarks used for a completely different application, the logo was altered by the BBC, and the use of the new RDS logo is also being made available through the EBU, free of licence, and free of charge, to manufacturers wishing to mark their RDS equipment (see enclosures 3a and 3b).

Yours faithfully,

George T. Waters
Director

of the fact that the terms of their license specified that any radio carrying the logo had to comply with the RDS standard.
Johnny Beerling suggested that a possible course of action by the Forum might be to design and launch a new logo for RDS which we would ensure was properly protected. Thomson said this might prove more costly than simply paying their demands. In that case, said Johnny Beerling, they should consider paying some percentage of their profits to the RDS Forum!
Thomson agreed to take forward our objections to their German partner "Bräu" and consider what action they might propose. In any case, they pointed out they had invested a lot of money in this international registration process and were concerned to recover these expenses now quickly, before they could consider any further actions.
The RDS Forum came away not very optimistic about their future response, and it would be surprised if there was a significant change of attitude that we could expect for the future. It was clear that we had bad advice from the BBC and EBU lawyers back in 1987/89 in respect of this subject. They told us that the RDS logos were a "service mark" to identify of whether RDS was used or not, and therefore did not need trademark protection, as these symbols were not used as a trademark and concerned broadcasters and manufacturers equally. Now with hindsight we understand, we should have found some way to register our rights and stop these robbers from taking what is rightfully ours.

Some additional background information about the company "Bräu": This asset administration company was created in 1998 by the IRT's patent lawyer and other of his family members with a start capital of 100'000 DM. "Bräu" is the maiden name of the IRT patent lawyer's wife, who acted as the administrator. By 2015, the company had already accumulated a capital of 85 million EUR. The company served mainly to park license payments for redistribution. In a 2017 court case at Munich, the IRT patent lawyer was accused to have betrayed the IRT by 200 million EUR over not forwarding MPEG (MP3) license money obtained from their respective patents for which he was charged by the IRT to act as an agent. In a court case at Mannheim, 2018 the dispute with him was settled by means of an "arrangement", concluded at the court for patent legal affairs. This implied that he had to return 60 million EUR to the IRT and in addition to donate 1 million to a public social welfare activity. This being accepted by him, the accusations from the shareholders of the IRT against him were dropped in 2019.

For the attention of industrial companies pursued on a license to be taken for using the RDS logo specified in the RDS standard:

- Be aware that on the RDS logo, if used outside the USA, there exist unjustified license claims, although the logo is part of the RDS standard IEC 62106.
- The logo was one created by the BBC and they gave it to the EBU, who published it first in the RDS Newsletter and then submitted it for standardisation within the RDS standard.
- In 2005, there was a special meeting of the RDS Forum at the BBC, involving legal experts to consult the RDS Forum what to do in defence.
- The resulting expert report gives all the information necessary to refute those totally unjustified claims.
- Non-members of the RDS Forum can purchase a printed copy via the RDS Forum's web site https://www.rdsforum.org

FM radio with RDS well suited for disaster warnings

by Frits de Jong, Dietmar Kopitz and Attila Ladanyi

Extreme environmental conditions as those recently encountered in California, Florida and Spain and the consequent disasters suffered by the population have created demands for improved emergency warning. This chapter contains the most relevant information and collective know-how within the RDS Forum on emergency and live-saving alert information.

Introduction

FM Broadcast is the most robust and reliable of all communications as has been proven over many incidents over the years and with RDS/RDS2 many possibilities exist to broadcast disaster warning information.

With the Open Data Application (ODA) feature of RDS/RDS2 remote switching via FM radio transmitters, as required by the organisation in charge of alerting the population, can be achieved. For example, a specifically designed RDS-ODA can switch-on sirens, many or even only an individual one, to encourage people to switch on their radio and listen to the news and respective alert messages. On FM with RDS one shall also take advantage of the alert announcement option PTY 31. This offers the authorities, in collaboration with broadcasters, to send out alert announcements that are treated by FM receivers like traffic announcements (TP/TA), see section 2 for more details. Experience has shown that FM radio is more robust than Internet. The high transmitter towers are seldom damaged in strong storms or wild fires. Even if electricity fails, these transmitters use in most cases a backup power supply and many FM radio receivers work on batteries. This communication infrastructure based on FM radio is one of the most reliable one today for transmitting alert messages covering thousands if not millions of people, and the RDS Forum highly recommends using it to prevent damage.

For using FM radio and RDS for disaster warnings the entire infrastructure required is already there on both sides: transmitter and FM radio receivers, and most of all, it requires relatively little additional effort to operate as needed by the authorities . In case of a "real" catastrophe mobile transmitters can be setup in a matter of minutes replacing a damaged "big tower". Portable radios, car radios and also certain smart phones with FM radio reception are all capable of alerting people using "standard" RDS with PTY 31 for spoken announcements, and for text announcements RT/RT+ and PS without even the necessity to change current firmware or software in existing FM receivers designed upon using the world-wide RDS standard, IEC 62106 (all parts).

Adding special ODA's with RDS2 can even provide much more text information, also for example on Variable Message (VMS) signs, and all that at relatively little cost. Even if these were controlled now via IP, for resilience reasons switching over for updating via FM radio using an ODA for RDS2 would be an interesting option to consider.

RDS Forum experts have been involved in many use cases when working on the various national projects in France, the Netherlands, Sweden and the USA, see the references listed below.

Current evolution

Many countries increasingly pay attention to emergency warning and make investments by improving their infrastructures. Particularly during the last couple of years, we are confronted by extreme weather conditions. Draught, Flood, Tsunami, Hurricanes warnings etc. However, the key issue is to get the proper information as quickly as possible to a maximum number of people in the affected area. Sending out an alert message in a timely manner can be a live-saving condition. Emergency warning is seen as a primary responsibility for broadcasters. FM radio with RDS being worldwide available is perfectly suited for this. The ITU-R has also collected a lot of information on the issues discussed below.

Broadcasters

Broadcasters have an important responsibility and play a crucial role in the dissemination of emergency messages and instructions. Assign the programme with the widest possible audience, also for those who are hearing or visually impaired. Proper receiver signalling using the PTY 31 flag on the respective radio programme is also achieved by cross-referencing with the RDS-EON (Enhanced Other Network) feature to the radio programme carrying the alert messages, spoken and with RadioText updates in addition.

Receiver manufacturers

For alarm receivers it should be mandatory to be equipped with a second tuner scanning the FM band at short intervals to detect radio programmes with PTY 31 on and to be waked up from a standby sleep-mode for alert messages, or for all other kinds of FM radios at least a search function for PTY 31 should be available.

Authorities

Broadcasters making alert announcements are usually not at the source of the information to be distributed to the public. This kind of information is produced by specialized agencies. The following types of information are typically required:

- alert area;
- severity of alert;
- description of the current event;
- recommended actions;
- timeframe for development.

The European Commission with its coordinating role related to important human live safety issues within the EU should regulate this domain and issue a directive in this respect. This could be similar to the protective alert measures already taken for long road tunnels.

Requirements

The facts are that every country has a different method of warning the population. Almost all of them are trying to transfer this alarm function to cell phones. But this will not be a guarantee that the message will come across. Firstly, many people switch their handsets to silent or turn them off altogether when they go to bed or don't have them with them during their free time. Secondly, it is the first way that fails. This has been noticed repeatedly, whether it be the California fires or the German Ahrtal floods. Earthquakes also paralyse the cell phone networks. In addition the mobile phone cells are getting smaller and smaller with increasing frequencies, from GSM to LTE to 5G, the data rates are increasing, the cells are shrinking. Disaster alert is not just for mobile communications. It is about alerting and informing residents at all times. On the road, especially in vehicles, this is no longer an issue. The bigger task is to cover residential and public buildings. This is where the larger gaps are. For domestic fires, there are already legally prescribed solutions that can be seen in every hotel room. These fire detectors run on battery for a year or more and are quite reliable. This is where one could start with RDS because reception is still quite good in buildings, while higher frequencies are often shielded. Without permanent audio output, the energy requirement for a receiver that only has to filter the PTY31, see below, is very low. PTY31 can be used as a switching signal to activate further functions such as audio, video, siren, networks.

Priority is the immediate launch of the primary message and the associated instructions (e.g. close all windows or make an immediate U-turn). Like for RDS-TMC, a standardised alert message catalogue with location referencing established on international level would be needed. Something of that kind is existing already with the Common Alerting Protocol (CAP), also identified for use by TISA and the EBU. Attention is drawn to the following: In 2007, the International Telecommunication Union, Standardization Sector (ITU-T) adopted the CAP protocol as Recommendation X.1303. The recommendation annex contains an authoritative ASN.1 module translation of the CAP XML schema that may be useful for some implementations. Rec. X.1303 is within the remit of ITU T Study Group 17 (Security), Rapporteur Group on Cybersecurity (Q.4/17) for purposes of further evolution of the standard. ETSI just issued a new Technical Specification for EWS with DAB. If for RDS/RDS2 a similar specification could be created by the RDS Forum, this would help the industry to implement the same approach for FM radio.

Use of Postal Codes

However a much simpler alternative should be widely considered. That is the use of postal codes, instead. Almost all persons know their postal code. Administrations and rescue forces are also organized according to postal codes. Navigational devices use them as well. This corresponds to the civilian structure of the area to be alarmed. So, the easiest way to use an alarm receiver device would be to set it to receive the postal code for the location where it is installed. This does not require any specialist knowledge: A simple and very user-friendly solution to switching on only those emergency warning receivers in the area concerned and nowhere else.

Switch-on directly the relevant radio programme carrying the alert audio messages of the radio programme having raised on FM radio with RDS the PTY31 flag. Products with enhanced text capabilities shall give the warning messages and instructions in the local language and English as a preferred second language.

Emergency warning messages with related instructions must be constantly available, also when local infrastructure with power-supply is out of operation.
Messages must cover the whole of the affected area and the direct adjacent areas as well.

VMS board on a German motorway | Extreme freezing weather in the USA, December 2022 | Flood in Germany, Summer 2021 | Valencia disaster Autumn 2024

Implementation in RDS

The RDS specification has several options to send and signal alert messages in a timely and reliable way to a large number of people in an affected area. PTY 31 is the most useful tool for this and PTY 30 can be used to test that functionality.
PTY 31 has been specified from the beginning for alarm and emergency messages. With the EON feature, PTY 31 on a given radio programme can be signalled from other radio programmes within the same radio programme network, to ensure instant switching to the relevant radio programme carrying the alert messages. When PTY 31 is set to ON by the broadcaster, a cross-reference data burst is sent and signalled from the other programmes pointing to the programme which is assigned to deliver the emergency messages. With one single trigger, the broadcaster can thus reach a massive amount of people in a reliable way to be directed to the relevant programme for further information and instructions.
The information is generally to be spoken. The alert warning is constantly repeated and preferably supported by a visual display text information. With RDS several different possibilities of using RadioText (RT/RT+) exist. An obvious choice is

- RT+ with RT content type 27 (INFO.ALARM), see the image below. RT/RT+ can also cross-reference to more detailed information on the Internet with RT content type 29 (INFO.URL)

Extreme cold weather alert using for display RT/RT+ with type 27 (INFO.ALARM)

Up-dates can be communicated by general RadioText RT as a continuing message carousel.

Extract from the RDS Guidelines on PTY 31

PTY code 31 ALARM indicates a transmission of great importance, carrying information concerning a national or local emergency. Therefore all receivers shall detect this code, sound an alarm or display >Alarm _!_< and turn up the volume. A simple way to implement this is to treat the Alarm like a TP/TA, but then without the user option to turn this function off and then, during ANY OTHER SOURCE being listened to, the receiver will switch (for the time the Alarm signal is on air) to the audio of the tuned or cross-referenced radio programme and use the same volume level as the one pre-set for TP/TA traffic announcements.

The broadcaster, to test the broadcast chain's ability to handle dynamic PTY 31 switching, may use PTY code 30. It has the function of testing the Alarm code (PTY 31), without causing unnecessary public concern. Consumer receivers should neither use this code for searching, nor to cause dynamic switching. Receivers shall display >_ _TEST _ _< if detecting a PTY 30 in use on a programme service.

Specific Emergency Warning System design options

When specific requirements will have to be met, the Open Data Application feature of RDS offers a wide range of possibilities for the design of an Emergency Warning System (EWS) application as required. However, in such a case special receivers designed to support the respective ODA are needed. The RDS Forum was already informed about the implementation of such specific solutions in Europe (France, the Netherlands and Sweden), the USA (Georgia) and Asia (Indonesia). In all these cases current or former members of the RDS Forum were involved in the implementation of these projects.

References

- **From the RDS Forum**

In the RDS Forum we have documented the following use cases for EWS implementations:

R03/019_2 Presentation from Marshall Bandy - Data FM inc proposition on EWS
R06/018_1 GSS - FM/RDS Global Warning Case Study
R13/018_3 France: IRIS alert system review / What is it all about? (Kopitz)
R13/019_3 France: IRIS alert system specification transcription for review
R14/004_1 Integrated Public Alert and Warning System using RBDS (Study from FEMA, USA)
R14/037_1 EAS - Emergency Alert System / Joop Beunders (Catena)
R14/039_1 IRIS - French alert system trial
R15/018_1 More IRIS - alert tests in the region of Nice, Simonacci (Radio France)
R18/029_2 EWS update by Jeroen Langendam
R23/006_1 NRSC EAS Guideline G303
R25/003_1 Accessible Common Alerting Protocol RDS – Demonstration Golf Coast States (USA) – Final report 2014

It was suggested that the RDS Forum should propose to the European Parliament to consider making radio reception (FM and DAB) mandatory in mobile phones for reasons of improved disaster message communication, as being already considered in Brazil, India and the USA. This request is not unreasonable as in the past and even nowadays there are mobile phones with FM radio (notably from Nokia) and with both FM and DAB radio (notably from LG - the unique model K520 of 2016). As in South Korea DMB which is a technical derivation from DAB is used, also Samsung has built phones with DMB, 150 million already. However, the same phones sold elsewhere have this option deactivated, see also the reference from India below.

- **From the ITU**

ITU-R Rec BS.2107 (12/2022) Use of International Radio for Disaster Relief frequencies for emergency broadcasts in the High Frequency bands is currently being revised by ITU-R WP6A,
Report BT.2299 (03/2022) Broadcasting for public warning, disaster mitigation and relief (specifically Annex G dealing with RDS) needs updating by ITU-R WP6A
Rec BS.643-4 on RDS (12/2022) which is up-to-date.

- **From the EU**

Directive 2004/54/EC on minimum safety requirements in the Trans-European-Road Network

References

- **From ETSI**

ETSI TS 104 089 (2024-09) - DAB / Emergency Warning System – Definition and rules of behaviour

- **From OASIS**

https://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html

- **From India**

Indian Central government has issued an advisory saying that phones which are equipped with frequency modulation (FM) receivers and tuners should not disable the feature by default.
In phones where this feature is not included by default, efforts should be made to provide the service, according to the advisory issued by the Ministry of Electronics and Information Technology.
The disabling of the feature also impacted the central government's ability to disseminate real-time information, the ministry said in its advisory to mobile phone manufacturing companies' associations, the Indian Cellular and Electronics Association as well as the Manufacturers' Association for Information Technology.

- **From Switzerland**

Switzerland had implemented on FM radio nationwide the on/off switching for over 6000 sirens, single or in groups.

Photos:TDF transmitter sites at Puy de Dome and Bastia

Normative references

IEC 62106-1 (2018), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 1: Modulation characteristics and baseband coding

IEC 62106-2 ed. 2 (2021), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 2: Message format: Coding and definition of RDS features

IEC 62106-3 (2018), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 3: Usage and registration of Open Data Applications ODAs

IEC 62106-4 (2018), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 4: Registered code tables

IEC 62106-5 (2018), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 5: Marking of RDS receiver devices

IEC 62106-6 ed 2 (2023), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 6: Compilation of technical specifications for Open Data Applications in the public domain

IEC 62106-9 (2021), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 9: RBDS – RDS variant used in North America

IEC 62106-10 (2021), Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 10: Universal Encoder Communication Protocol UECP

NOTE: The Part numbers 7 and 8 for the RDS standard IEC 62106 will not be used.

IEC 62634 ed.2 (2015) – Radio Data System (RDS) Receiver products and characteristics – Methods of measurement

ITU-R Recommendation BS.643-4 (12/2022) – Radio data system for automatic tuning and other applications in FM radio receivers for use with the pilot-tone system

Guidelines

RDS Implementation Guidelines, Edition February 2024 – RDS Forum document R24/002_1 available for free from the RDS Forum web site

RDS usage guideline, Edition April 2018, ref. NRSC-G300-C, available for free from the NRSC web site

Bibliographical references

KOPITZ, Dietmar and MARKS, Bev, RDS – The Radio Data System
Published by Artech House Publishers, Boston and London, 1999,ISBN 0-89006-744-9.

WRIGHT, Scott, The Broadcaster's Guide to RDS, Published by Focal Press, Boston, Oxford, Johannesburg, Melbourne, New Delhi and Singapore, 1997, ISBN 0-240-80278-0

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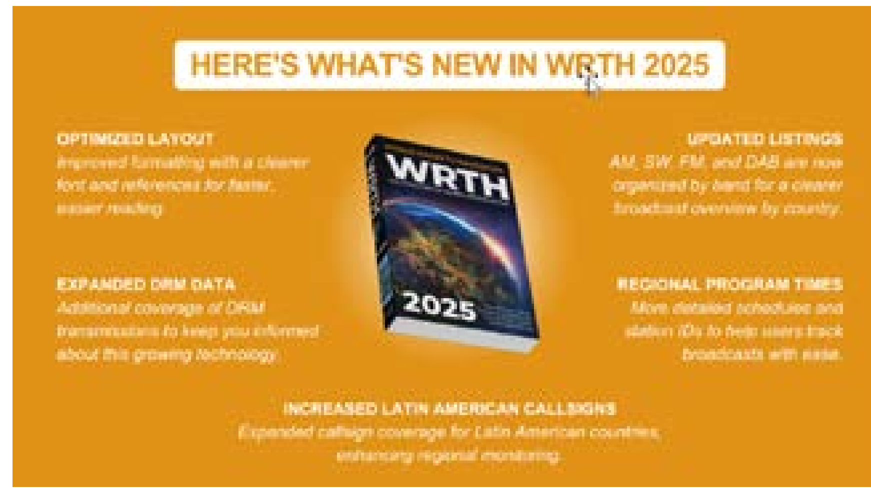

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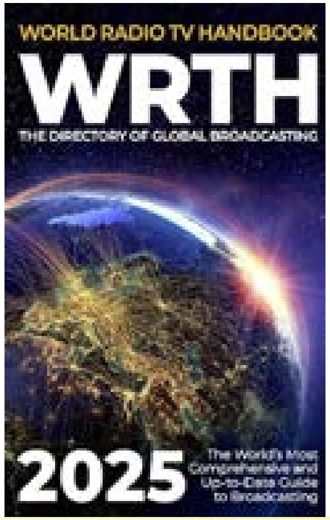

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RDS Forum - the association of RDS users

There are more RDS Forum ePublications available:

The RDS Forum Implementation eGuidelines provide assistance to broadcasters and receiver manufacturers to implement the RDS features correctly. The following RDS Implementation Guidelines are available now for free to non-members of the RDS Forum:

- About the Programme Service name - PS (static & dynamic)
- About the Programme Identification - PI & Extended Country Codes ECC
- About Programme Type coding PTY & PTYN
- About Radiotext – RT/RT+
- About Radiotext – eRT/eRT+
- About EON & Linkage
- About the Alternative Frequencies (AFs)
- About the Clock Time & Date feature
- About the Open Data Applications ODA
- About RDS receiver concepts
- About RDS receiver profiles
- About an RDS & DAB feature comparison
- About Regionalisation
- About Traffic Programme & Announcement coding TP/TA
- About Service Following for FM/RDS & DAB
- About broadcasting and reception in road tunnels

All these articles are part of the RDS Implementation Guidelines eBook, published by the RDS Forum in 2024. To download the respective eBook (ref. R24/002_1) please consult the RDS Forum's web site:

https:/RDS-forum.org/

For RBDS in North America the respective Guideline eBook is available from the NRSC web site:

https://www.nrscstandards.org/standards-and-guidelines/documents/guidelines/g300-c.pdf

Since over 30 years, in addition to maintaining and updating the RDS technology, the RDS Forum is pre-occupied by the digital radio switch-over developments. For Europe, the Forum also studies the conditions that will help new muli-standard car radios to work with minimal user intervention within a multistandard radio listening environment.

This eBook was written by a team of RDS Forum members who are closely involved in the RDS development since more than 30 years. Thus this book comprises an enormous amount of collective knowledge and information. It generally informs the reader about the possibilities seen now, within the RDS Forum, to use this well proven and much updated FM radio technology at its very best, well taking into account the transition to digital radio in Europe and the USA. This book gives an overview on the history of the RDS technology, describes generally the RDS system and all RDS features, explains the UECP and why it is needed. It also explains how to monitor and generate RDS signals on air, RDS in the world of automotive applications, the fundamental principles of RDS-TMC, the possibility to extend RDS and makes a prediction of the future use of FM radio and RDS2.

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