RDS – The Radio Data System: a milestone in the history of broadcasting traffic information[1]

Dietmar Kopitz

Inhaltsübersicht

1. It started all with ARI

ARI was developed in the early seventies by the IRT in Munich and Bosch/Blaupunkt in Hildesheim. The desired achievements, in terms of broadcasting traffic information on FM radio, are the following: Firstly,

1 Acknowledgement: I was helped in the elaboration of this article by two RDS Forum members:

- Mr. Joshua Caskey, Silicon Labs, Austin, Texas, USA
- Mr. Mark Saunders, HERE Technologies, London, UK

I appreciate the observations and proposals both have made, and I have used them with pleasure.

identify the radio programme that carries the respective announcements. Secondly, identify the region to which the messages are addressed. Thirdly, to signal to the radio when a Traffic Announcement was being broadcast.

ARI, regardless of a listener travelling in silence or listening to a cassette, the cassette would be paused and volume increased when the radio detected the start of the Traffic Announcement. This development was quickly adopted by the automobile receiver industry and used widely by the public broadcasters in Austria, Germany, Luxemburg and Switzerland.

2. *How RDS came into life*

In 1974, at the EBU's Technical Committee meeting in Paris, the German public broadcasters proposed to use ARI Europe-wide for the identification of traffic info broadcasts. Many representatives did not support this concept as in some ways ARI could be considered 'anti-radio' as the technology gave drivers Traffic Information without the need to listen to the radio programmes anymore. Instead, it was suggested that the EBU develops a data system to enhance the overall listening and use of FM radio and incorporate the functionality of ARI. This proposal was approved and thus the development of the RDS system was started in the EBU, with a commitment to consult the FM car radio industry in Europe during the development phase. During the development, which took ten years, the EBU consulted its broadcast members over the features that they desired RDS to incorporate. In 1984, the RDS technical specification was completed and published to the FM receiver industry. Simultaneously, the EBU started discussions with the European receiver industry association to coordinate the rollout of RDS, both by broadcasters equipping their transmitters, and the development of car radio receivers, with the receiver industry showing a keen interest to develop a new range of car radios with enhanced functionalities. The goal was to launch RDS at the 1987 IFA in Berlin. This was achieved with several European broadcasters by then having equipped their transmitters with the necessary RDS encoders, developed by leading European broadcast equipment manufacturers. One additional condition from the industry to be observed by the EBU was that RDS should be capable of carrying coded traffic messages, suitable to address the evolving navigation system receivers under development., which the EBU agreed to support.

3. 1987 – RDS started to become reality

At the IFA 1987 in Berlin, RDS was already on air from the ARD broadcasters and the BBC, and the industry showed the first RDS receivers. The first implementation by Volvo was quickly followed by Blaupunkt, Philips, Grundig and Becker. The functionality that ARI provided, had been replicated in RDS and it was agreed that ARI could be phased out. To support the already existing receivers with ARI, RDS and ARI had to be broadcasted in parallel for a long transition period.

RDS had been conceived, developed, and launched within ten years between 1975 and 1984. In retrospect, we see the following developments in this 10-year long period:

(1) The desire to universally identify each FM programme in a non-ambiguous way, so that listeners could instantly identify the programme they wanted. This was achieved by the PS – Programme Service – which shows the programme name in plain text. The PI – Programme Identification – feature is used by the receiver to identify the same programme, or, if the driver has travelled some distance, a similar regional variant programme.
(2) The desire to replicate the Traffic Information features of ARI. In RDS, this uses TP – Traffic Programme – to indicate stations that provide regular traffic information, and TA – Traffic Announcement – that indicates when an announcement is in progress to pause cassette listening and control volume.
(3) The desire to ensure the receiver is always using the optimum frequency for the listener's tuned radio programme. This is achieved with the AF – Alternative Frequency – feature that provides a list of the frequencies on which the required programme is being broadcast so that inaudibly the receiver can check each one, always selecting and re-tuning to the strongest signal, as the driver travels across the region or country.
(4) The desire to let the listener search the FM band for programme type. This created the PTY feature.

In retrospect, RDS produced a technology designed for the mobile listener, which drastically improved the listening experience on FM, for the various reasons established by audience research; namely, automatic retuning from one transmission coverage area to the next, rapid identification of the programme service, and, importantly, via TP & TA, a means of alerting drivers to traffic congestion, accidents, and problems caused by weather and road works, among many others. These features were not only valuable then but are still valuable today.

4. 1990 – RDS was enhanced with RDS-EON and standardized by CENELEC

1990 was the year when the EBU's RDS specification became a European industry standard of CENELEC. Also, a significant new RDS feature, RDS-EON had been developed within the EBU RDS experts' group.

What could be achieved with RDS-EON?

Although RDS has advantages for all FM broadcasters, there are particular advantages for broadcasters, primarily the Public Service broadcasters, such as the ARD members and the BBC etc. that operate several network radio stations. EON – Enhanced Other Networks – provides the opportunity for the RDS data on one network to transmit data about what is happening to the other networks. This is especially of use for the broadcasting of traffic information. Often, the programme content on a station, for example a classical music network, does not allow for and indeed would be a distraction if regular traffic announcements had to interrupt the content. EON allows a broadcaster to 'nominate' just one of their programme services in a region to broadcast the traffic information, with the nominated station being signalled in the EON data on the other networks. If the listener has chosen to allow traffic news interruptions (by selecting on the receiver the TP/TA option), the receiver will re-tune to the nominated station for the duration of the bulletin and then return to the initial radio programme, when the 'nominated' station makes an announcement. An added advantage in some cases is where the 'nominated' station is a local station, listeners listening to the nationwide programme services receive only the locally relevant traffic information. The basic function of EON is to build up a database of information about other transmissions (over a 120 second period) and to place it into the receiver memory. In the case of the traffic service, EON is used to provide dynamic information to an RDS receiver, so that it can act very quickly to retune to a specific frequency; from the database it "knows" on which radio programme a traffic announcement is taking place.

5. RDS-TMC – a development of the EU

TMC – Traffic Message Channel – development started in 1987. The initiators were Blaupunkt and Philips with a concept to provide language independent traffic information. This concept was quickly adopted by the EU and became a topic of several European projects, leading to a Europe-wide implementation. This effort started approximately in 1991 and was endorsed by several EU actions proposing to use this technology in all member states. TMC is not a spoken traffic information service, but rather a series of codes, in essence relating to what is to be described. For example, 'traffic congestion, average speed of 30 km/hr, or 'beware object on road.'

TMC provides over 1'600 pre-defined messages and a code, defining uniquely every junction or stretch of roadway across the world. Due to the information being data defined, each driver can choose how the information is to be presented – in whatever language and metric or non-metric system.

Although TMC information may be presented on a screen or spoken via voice synthesiser, today's use is primarily to dynamically update mobile navigation systems so they may find the optimum route to avoid congestion and road closures. TMC, which is itself standardized by ISO, uses an RDS data channel on FM radio. A complete traffic message comprising the 'event' and 'location codes' described above, requires only a single RDS group to transmit. RDS is transmitted at the rate of 11.4 groups per second and the 'basic' features use about half of these groups. EON and RadioText (information about the radio programme item, the music title and artist etc.) use about another quarter of the groups, leaving a maximum of 25% of RDS groups for TMC use. However, this still delivers up to around 250 traffic messages every five minutes, which is far more than could ever be conveyed in a conventional spoken traffic announcement.

6. 1997 – TPEG was first proposed by the EBU

TPEG is a concept that originated in the BBC, and it immediately attracted a wide support in the EBU to be used for traffic information using DAB. DAB provided enhanced data transmission capabilities compared to RDS. As far as the RDS features were concerned, DAB had duplicated most of them. Due to the low data rates of RDS, it was necessary to transmit TMC using pre-defined codes, including the ones for locations. RDS used

'Location Tables' as a database of all roads in a geographical area. Because new roads are continuously being built, the 'Location Tables' needed to be regularly updated, not only in the service providers' servers, but also in every vehicle to keep road information up to date. The EBU argued that, as DAB had a much higher data rate, locations need not be pre-coded as was necessary on RDS. Thus, the Traffic Programme Experts Group was formed to develop a system for the location information for each message to be created on-the-fly using geo-coding integrated into the digital road maps. This data was already widely available within the navigation systems used at that time. The group hence created the protocol that took their name – TPEG.

The ongoing TPEG development resulted in more detailed coding of the information, and not only road traffic information. Many more applications were foreseen. It became quickly clear that RDS could not be used, because of its limited bandwidth for data transmissions. TPEG was ideal for DAB but could also be used on the mobile internet for traffic information services created to update navigation systems in cars and smart phones. Many new service providers came into this traffic information service offer, such as TomTom, HERE Technologies and Google.

One important objective pursued by the EBU was that the TPEG protocol should enable broadcasters to develop their TTI services in non-delivery specific databases. Accordingly, these broadcasters should implement just one editorial activity and offer these TTI services via one or more delivery technologies. This provides simplification in the knowledge that no on-air conflicts of information will result. The use of a single TPEG protocol by all EBU members was predicted to facilitate reduced production costs, which would be important for those broadcasters, who continue to be TMC service providers as part of their Public Service portfolio.

Of interest is that the majority of TPEG services used for traffic information continues to use the TMC Location Tables due to many complexities with on-the-fly location creation.

7. 2014 – The need for RDS2

RDS had served broadcasters and listeners well for over twenty-five years and was widely implemented across five continents but was limited in data throughput. In 2014 the RDS Forum recognised that RDS need not be limited by using a single subcarrier to transmit data. Over the following three years 'RDS2' was designed and developed, adding three additional subcarriers, quadrupling the total data throughput. These additional subcarriers use the same group structure as the 'primary' subcarrier, but do not need to carry the basic features of RDS. This allows the additional subcarriers to be redefined to support exclusively the Open Data Application concept, where any application can be developed and transmitted without reference to any other or the need for standardization of the respective application.

Although the Open Data Application has been part of RDS, and indeed TMC itself is an ODA, the capacity on each of the three additional subcarriers provides additional opportunities for many new applications.

With DAB and other digital standards providing increased bandwidth, does RDS, providing three additional subcarriers, offer additional benefits? Absolutely, and this issue was checked with the RDS Forum experts working for the semiconductor industry. For many years, they have been using a technique called DSP to produce chips that decode both, the audio (stereo) and the RDS data transmitted on FM radio. Hereby, it does not matter if the data is carried on one or more subcarriers. With this technique used for fifteen years, chip production has become very inexpensive and if produced in quantities a typical chip used for FM radio with RDS would cost no more than 1 €.

RDS2 would increase the price a little, but not significantly, we were told, provided the additional subcarriers are intelligently chosen to achieve this kind of a decoding performance. The RDS Forum did just that and achieved an improvement that had not been realized since RDS had been invented almost forty years ago.

What does this development of RDS2 mean for RDS-TMC? In RDS2, TMC can exclusively use just one of the additional three subcarriers, increasing the throughput of TMC messages by a factor between five and ten without changing anything in the existing TMC ISO-standard.

But is TPEG still better than DAB? Some will argue that it is, but the answer could often be 'no'. DAB is most often transmitted on a national or large area multiplex, so the content of the traffic information a device receives is mostly irrelevant, and recipients then have to decode each TPEG message, determine the location and whether it is of any relevance to the driver's location or journey. Due to the multiplex covering a large area or country, the data is often not relevant to the local area near the transmit site. FM transmitters by contrast typically serve an area with a radius up to 60 km, so the traffic information on RDS-TMC is already localised for the driver.

TPEG, in addition, is no longer what the EBU wanted to develop. After 2005, TPEG was simplified and the automotive community felt that the RTM app was too flexible and expansive, so they demanded something simpler (and more basic). What was created was Traffic Event Compact (TEC), which was a condensed version with a much-reduced functionality. TEC concentrated on non-congestion events. To handle congestion, Traffic Flow and Prediction (TFP) was created which allows the current and predicted traffic speeds over a road network to be communicated.

Generally, all services now use TPEG-TEC and TPEG-TFP in tandem.

Does RDS2 allow for TPEG use directly? No, TPEG requires too much bandwidth. TMC instead is still ideal, which is why there is no need to change the TMC standard. Many existing navigation systems could be adapted, by simply replacing their existing special RDS-TMC receiver adaptor by one supporting RDS2. Some software adaptation to decode the new group format on the upper RDS carriers would be needed in addition, which could be part of the new adaptor.

The problem with RDS2 at present is that the chip just described is not on the market yet, as it would only be inexpensive if mass-produced, which would require a "killer" application, not yet widely identified. Thus, RDS2 is mostly misunderstood and pre-judged because RDS would be a pretty "old" technology, but it is at least "digital" on "old" analogue FM radio. To be frank, DAB is almost as old as RDS, but is within the DAB community not perceived the as "old". The DAB community is continuously fighting for success and despite all those major efforts made, is still not widely supported across Europe. This is due to major broadcasters seeing streaming radio services at home and eventually also mobile over 5G as the replacement for DAB over the next decade.

8. Future trends

The Vice-Chairman of the RDS Forum, Mark Saunders, who has worked for HERE Technologies for many years and has implemented many traffic information systems using RDS-TMC and DAB-TPEG all over the world, gave his opinion about how this might develop in the future.

Here are his views:

> "HERE operate RDS-TMC services in five continents, and we had intended to have a DAB-TPEG service in Australia (principally because our broadcast partners hoped that this would encourage the use of DAB and they would get at least some revenue to fund their DAB service as a whole), but the lack of interest from the automotive industry there for DAB meant we never started it.
>
> We do have a DAB-TPEG service in Germany, but this has the problem mentioned in Dietmar's talk above of localization. For RDS-TMC, we

created 24 regions, and use 200+ transmitters to broadcast the service with each carrying only the data matching its location, so each vehicle only receives relevant information – up to 250 messages per region or a total of 6,000 messages across Germany every five minutes. Conversely as our DAB-TPEG service uses a national multiplex, all these messages are on each of the DAB transmitters used for the service, so a driver's receiver in Munich is getting information about a road closure or slow traffic in Berlin and indeed all other parts of the country as well as Munich problems. Receivers have the job of filtering out those relevant to the driver's location – each message has to be 'unpacked' and decoded, the location determined and compared to the vehicle's position – and then a decision made as whether the message has any relevance at all. On average over 95% of the messages received in an area have no relevance at all to the driver's location. The unpacking, decoding and location determination requires enormous processing power in the receiver and the evidence is that the automotive industry is not going to support DAB-TPEG much longer and are increasingly looking to other bearers for TPEG, rather than broadcast.

In fact, DAB-TPEG has never been as successful as RDS-TMC, and I don't know of a single country where there was a significant number of vehicles using DAB-TPEG when compared to those using RDS-TMC. Even in the UK, the most successful for DAB uptake and with DAB well established, neither of the two DAB-TPEG traffic service providers had a successful or profitable DAB TPEG service and I believe, both services shut down a long time ago.

The sad news is that as the automotive industry are moving away from broadcast and are transitioning to non-broadcast, although I firmly believe, RDS2-TMC would be a real winner, I can't see it happening as the automotive industry won't support it.

So how is the future looking?

We (HERE Technologies) are increasingly using two-way communications with vehicles. This is because the vehicles themselves are beginning to provide the data about speeds and road conditions that will add to the global pool of knowledge that we already have from the billions of 'hits' we get from devices giving us in real time traffic flow information on every road across much of the world. In addition to speed information, vehicles can provide us other information too. For example, if a vehicle's outside air temperature sensor tells us that it is close to freezing, and also that windscreen wipers are in use, then this is a good indication that ice could form on the road; similarly, if we get this information from a number of vehicles in the same area. If they have their fog lights illuminated, we can send warnings about foggy conditions ahead to vehicles approaching the area. Increasingly forward-facing sensors are being built into cars for adaptive cruise-control and anti-lane divergence and these can be used to detect queues of traffic, and also to spot traffic cones and other signs of road construction etc., A number of vehicles changing position from one lane to another is also a sign that a lane is closed or obstructed, all

> adding to the accuracy and timeliness of the information we have and can communicate to other road vehicles.
> So, although broadcast traffic information, primarily by RDS-TMC will still be around for a few more years, the next decade will likely see a full transition to two-way traffic information, although I am confident that across the world the majority of radio listening will still be on FM (with RDS!) for many more decades."

I wish to close this report with the following observation: Even though what I have reported here are mostly European developments, used here in Europe, other regions of the world that have not yet adapted to digital radio standards like DAB or HD Radio, would benefit from the increased RDS2 bandwidth for enhanced data services. This technology is relatively inexpensive to implement, and at a much lower cost than comparable digital broadcasting standards, that require much higher investments to implement. For example, an existing FM transmitter only requires the addition of a RDS2 encoder and systems to supply the data while digital broadcasts often require new transmission equipment. In addition, RDS2 allows for example existing cars to continue the use of FM radio and their RDS-TMC supported navigational devices and to achieve enhancements at a much lower cost. To study and consider such an alternative will be worthwhile in many cases.

9. Abbreviated terms used

AF	RDS feature: Alternative frequency
ARI	Autofahrer Rundfunk Information
BBC	British Broadcasting Corporation
DAB/ DAB+	Digital Audio Broadcasting
DSP	Digital Signal Processing
EBU	European Broadcasting Union
EON	RDS feature: Enhanced Other Network info
EU	European Union
FM	Frequency Modulation radio broadcasting (UKW in German)
IEC	International Electrotechnical Commission
IFA	Internationale Funkaustellung Berlin
IRT	Institut für Rundfunktechnik München (dissolved in 2020)
ISO	International Organisation for Standardization

MS	Former RDS feature (no longer used): Music/Speech identification
PI	RDS feature: Programme Identification
PS	RDS feature: Programme Service name
PTY	RDS feature: Programme Type code
RDS	Radio Data System
RDS2	RDS with three additional optional subcarriers
RTM	Road Transport Messages (TPEG1)
TA	RDS feature: Traffic announcement
TEC	Traffic Event Compact (TPEG2)
TFP	Traffic Flow Prediction (TPEG2)
TMC	Traffic Message Channel using RDS
TP	RDS feature: Traffic information programme
TPEG	Transport Protocol Experts Group
TTI	Traffic and Travel Information

10. Bibliography

EBU – TPEG: What it is all about? – Publication of the TPEG Project (2000–2003).

European Broadcasting Union (ebu.ch)

IEC 62106 (all parts) RDS standard as from 2018.

Kopitz, Dietmar / de Jong, Frits: RDS2. What it is all about, May 2021, URL: https://www.rds.org.uk/2010/pdf/R21_010_2.pdf.

Kopitz, Dietmar / Marks, Bev: RDS. The Radio Data System, Boston / London, 1999.