



# **RDS Technical Specification**

**Methods of measurements  
for  
RDS receiver products**

**CHARACTERISTICS RELEVANT TO RDS RECEIVERS  
AND THEIR MINIMUM REQUIREMENTS**

The  
RDS Forum draft  
for  
a replacement of the outdated IEC 60315-9

**Approved by the RDS Forum 2008**

### Purpose of this new RDS Technical Specification

This document presents a new proposal from the RDS Forum to replace the current IEC 60315-9 - Methods of measurement on radio receivers for various classes of emission – Part 9: Measurements of the characteristics relevant to Radio Data System (RDS) reception.

The IEC 60315-9 was issued first in 1996 and never updated since then. The RDS Forum proposes to replace this totally outdated text by this new proposal and then simply to delete the old specification. The fact that the old specification is also bundled with other radio receiver measurement standards is considered by the RDS Forum to be very inappropriate in the particular case of RDS. Therefore this new specification should preferably be issued with a totally different IEC reference number. This is also justified by the fact that nowadays RDS integrated FM receiver chips are being manufactured in a very large number (over 200 million pieces only in 2007). In the current IEC 60315-9 publication the target values quoted for RDS performance to be achieved were based upon tuner technology of the eighties and in addition one of the dominant RDS constraints, i.e. ARI, has now completely disappeared. Updating the IEC 60315-9 was considered by the RDS Forum to be meaningless and that was the main reason to propose to drop then the IEC 60315-9 totally.

The new methods of RDS measurement specification is recommended by the RDS Forum to be used instead. Hopefully it will also contribute to achieve well performing RDS products.

This new RDS Forum specification bridges also the information gap created by the very long IEC standard development procedure now in place within the IEC. The RDS Forum is a participant of this work, but it cannot influence the speed in which this work progresses. Attention is drawn to the fact that the IEC standard development process in place can result in editorial changes to be made to this present text. Technical changes are however quite unlikely, as this specification was developed in the RDS Forum with the full involvement of the industry using the RDS technology. RDS Forum industry members are committed to support their national standardisation bodies collaborating with the IEC, and they will participate on the IEC national level to endorse the present RDS measurement specification,

**Acknowledgement:** The concept of this document was inspired by a similar standard publication already existing for DAB / DMB receivers, the EN 50248.

### Document history

1996	IEC	First RDS measurement specification IEC 60315-9
2007	RDS Forum	RDS Forum members question the relevance of the current IEC 60315-9
2007	IEC TC 100	RDS Forum informs the IEC of the need to update or to replace the current IEC 60315-9
2008	RDS Forum	Experts from the RDS Forum draft this replacement specification
2008	IEC TC 100	Is asked by the RDS Forum to issue this proposal under a new IEC reference number and as a total replacement of the current IEC 60315-9, for which any updating turned out to be impossible

### What is new in this RDS measurement specification?

The objective to be achieved was to have everything needed to test RDS receiver minimum performance requirements handy in one document, such as

- using state-of-the-art measuring methods based on today's RDS products,
- give realistic performance targets agreed by RDS Forum Members,
- be complementary to the RDS standard IEC 62106, as being updated now,
- be in-line with the RDS Forum Guidelines for correct RDS implementation,
- and specifically cover the challenging RDS receiving conditions “Weak signal”, “Adjacent channel” and “Strong signal” to verify the required RDS sensitivity and selectivity for three different RDS product categories.

### About the RDS Forum

The RDS Forum is a non-profit international professional industry association that has as an objective to promote and maintain the RDS technology, which was developed by the European Broadcasting Union (EBU) in the early eighties as an open system to enhance FM broadcasting, primarily to enable automated tuning in FM radio receivers equipped with that then new technology. Nowadays, almost 25 years later after that technology was created, almost all FM radios 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, only one to three Euro. The trend of this price is still falling and the quantity of such chips sold on the world market is still much increasing, now over 200 million units per year already. Many applications of RDS are nowadays already within mobile phones and portable network devices. The more traditional car radios have sometimes a separate RDS decoder IC, but RDS decoding is very often an integral part of dedicated multi-purpose DSPs, necessary for the product even without RDS. In these products the RDS function price is then almost zero, as it is done in software only.

It was actually RDS that made FM broadcasting very successful and extremely widespread. The RDS technology will most probably live as long as FM broadcasting, which will most likely end as the last analogue broadcasting technology, of which a likely switch-off is impossible to predict at this time, given the fact that it is so widely used now.

The RDS Forum was founded in 1993 and serves its members also as a contact network for experience exchange regarding the use and correct implementation of the technology. Maintenance means not only keeping the RDS system going as originally conceived by the EBU, but also upgrading it, *maintaining full compatibility with the very large number of exist RDS receivers*, to enable new functionalities that have only recently become available for implementation in new RDS receiver generations.

RDS Forum members are many world-wide known companies that include

Zwcom in Germany, Audemat-Aztec in France, Autosound Electronic in Hong Kong, Best Creative in China, Blaupunkt Werke in Germany, Catena Radio Design in the Netherlands, Cambridge Silicon Radio in the UK, Clear Channel Broadcasting in the USA, the Swiss Private Radio Association, Clarion Europe, Continental Automotive in France, the Denon Brand Company in Japan, Data FM in the USA, Delphi Grundig in Germany, Digita Oy in Finland, Globalsat Technology Corp. in Taiwan, GNM in the UK, Harman Becker Automotive Systems in Germany, Hyundai Autonet Co. in Korea, Institut für Rundfunktechnik in Germany, ItoM in the Netherlands, JVC Technology Centre Europe, Kenwood Electronics Europe, KRS Electronics Co. in Korea, LG Electronics in Korea, MC&T Electronics in Korea, Media Broadcast in Germany, Mitsubishi Electric Automotive Europe, Nokia, OFCOM in the UK, Pioneer, Proflin in the Netherlands, Qbit in Germany, Ruoss AG in Switzerland, Silicon Labs in the UK, Sony, Swiss Broadcasting Corp. (SRG/SSR), Swisscom Broadcast AG, TomTom International, Visteon Engineering Services in the UK and WiWi Industries in Hong Kong.

The internet address for the RDS Forum web site is URL <http://www.rds.org.uk/>

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## 1 Scope

Since the IEC 60315-9 has been issued in the nineties, many changes in RDS technology took place. The ARI system has been switched off in Austria, Germany and Switzerland making the RDS-ARI compatibility constraints superfluous. New generation of RDS products with a variety of market applications have created new requirements and new performance targets.

As a consequence, the documentation of a commonly agreed measuring method is considered to be a valuable and necessary complement to the RDS standard IEC 62106.

The RDS measuring methods presented here are meant to be for all involved in manufacturing RDS products, and in particular tuner modules with embedded RDS functionality.

Methods and algorithms to achieve automatic station-following by means of AF lists are however very customer- and manufacturer-specific, and therefore this topic is left out here deliberately in this document.

Most importantly the document describes *minimum RDS receiver performance requirements*, which concern three RDS receiver product categories. It should however be noted that there are also RDS receiver products on the market that significantly out-perform the minimum RDS receiver performance requirements quoted.

## 2 Definitions and abbreviations

### RDS receiver product categories:

- RDS product category 1: Portable devices
- RDS product category 2: Car radios
- RDS product category 3: Home receivers

**RDS reception:** The signal at which the RDS signal is received with 50% non-corrected error-free blocks; in practice, the level at which the TP bit is immediately detected.

**Large signal behaviour:** The capability of the RDS receiver to fulfil its function at or in the neighbourhood of strong FM signals.

**RDS selectivity:** The capability of the RDS receiver to cope with adjacent signals at both sides of the tuning frequency:  $\pm 100$  kHz,  $\pm 200$  kHz.

AF	Alternative Frequency
AM	Amplitude Modulation
ANT	Antenna
ARI	Autofahrer-Rundfunk-Information (see IEC 62106, annex H)
DAB	Digital Audio Broadcasting
dB $\mu$ V	signal level in $\mu$ V; 0 dB $\mu$ V = 1 $\mu$ V, 6 dB $\mu$ V = 2 $\mu$ V, 20 dB $\mu$ V = 10 $\mu$ V
DMB	Digital Multimedia Broadcasting
EON	Enhanced Other Networks information
FM	Frequency Modulation
GUI	Graphic User Interface
IPR	Intellectual Property Rights
MW	Medium Wave
PI	Program Identification
PND	Personal navigation device
PS	Program Service name
PTY	Program Type
RDS	Radio Data System
RBDS	USA Radio Data System
S+100	Unwanted signal, +100 kHz offset from the wanted signal
S-100	Unwanted signal, -100 kHz offset from the wanted signal
TA/TP	Traffic Announcement/Traffic Programme
TMC	Traffic Message Channel

### 3 References

#### 3.1 Normative references

IEC 62106	Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 to 108,0 MHz
IEC 60315-9	Methods of measurement on radio receivers for various classes of emission – Part 9: Measurements of the characteristics relevant to Radio Data System (RDS) reception
ISO TS 14819-1 to 3	Traffic and Traveller Information (TTI) – TTI Messages via Traffic Message Coding – Parts 1 to 3
US NRSC-4-A	National Radio Systems Committee – NRSC-4-A: United States RBDS standard

#### 3.2 Informative

RDS - The Radio Data System by Dietmar Kopitz and Bev Marks, published by Artech House Publishers, Boston and London, 1999, ISBN 0-89006-744-9

## 4 Measuring method

### 4.1 Standard measuring signal

Unless otherwise stated, the following measuring signal shall be applied

Tuning Frequency	97 MHz
Signal input level $V_i$	60 dB $\mu$ V
Deviation $\Delta f$	22.5 kHz
Modulation frequency $F_{mod}$	1 kHz
Pilot 19 kHz deviation	6.75 kHz
Modulation method	L=R
Deviation RDS carrier $\Delta f_{RDS}$	2 kHz
De-emphasis	50 $\mu$ s (USA: 75 $\mu$ s)

Where an unwanted signal will be added, for RDS car radio selectivity measurements, this will be done with the coupling circuit shown in figure 1

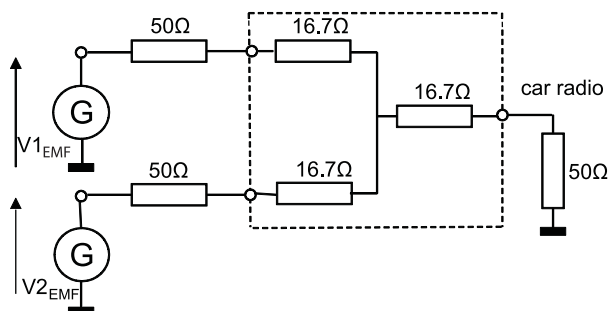


Figure 1 – Coupling circuit to be used to add the unwanted signal  $V2_{EMF}$  for two signal measurements

### 4.2 RDS data conditions

The RDS data shall consist of an appropriate PI code, a PS name, one or more AFs and chosen values for, e.g. TP (=1), DI (=0000), TA (=0), PTY (=00001) and M/S (=1), with a maximum repetition rate for group type 0A of four groups per second. Use group type A only.

### 4.2.1 Matching circuit

For the three types of receiver categories (modules for portable devices, car radio and home receiver), the matching circuit is given in figure 2:

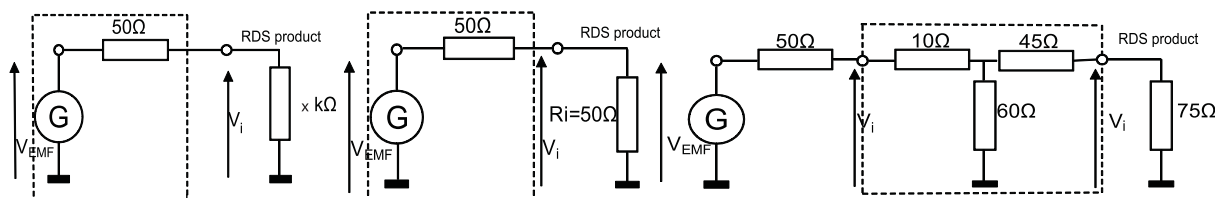


Figure 2 – Matching circuits for the three receiver categories:

RDS product category 1  
Portable device  
(high input impedance)

category 2  
Car radio

category 3  
Home receiver

The RF generators have a characteristic impedance of  $50\ \Omega$ . For a car radio with an input impedance of  $50\ \Omega$ , no additional matching circuit is needed. The antenna input signal  $V_i$  is then  $V_{EMF} - 6\text{dB}$ . In case of a device like a PND, which generally has a high input impedance,  $V_i$  is then almost equal to the generator voltage  $V_{EMF}$ . When the input impedance cannot be ignored in relation to the  $50\ \Omega$  generator impedance, one has to calculate the correction separately.

Example: For a device with  $2\ \text{k}\Omega$  input impedance this will give  $V_i = V_{EMF} \cdot 2000/(2000+50)$  and in  $\text{dB}\mu\text{V}$  this yields  $V_i\ \text{dB}\mu\text{V} = V_{EMF}\ \text{dB}\mu\text{V} - 0.2\ \text{dB}\mu\text{V}$ .

## 5 RDS sensitivity

The lowest FM input signal is determined for which RDS reception is obtained.

### 5.1 Method of measurement

The receiver and the signal source are operated under standard measuring conditions, according to 4.1.

1. When a GUI is available, which is capable of measuring good and bad blocks, then a reading of 50 % good blocks is an accurate result for the sensitivity measurement. The ratio should be calculated over at least 2000 receivable blocks.
2. A good alternative in the case, where a GUI and statistical read-out is not available to measure the level of correctly received RDS blocks, is the TP flag.

Turn the signal level up until 50% error free RDS blocks are received. Alternatively, turn the signal level up until the TP flag lights up. Repeat this three times and take the average value of these three observations.

**Note:** If the TP flag cannot be displayed, then the complete PS can be used instead. However, care should be taken that a new programme service name is entered into the RDS encoder each time a new measurement is done. The new programme service name shall differ from the previous one in all eight characters.

#### 5.1.1 Presentation of the results

The result is presented in  $\text{dB}\mu\text{V}$

<b>Minimum receiver sensitivity requirement:</b>	RDS product category 1	21 $\text{dB}\mu\text{V}$
	RDS product category 2	18 $\text{dB}\mu\text{V}$
	RDS product category 3	18 $\text{dB}\mu\text{V}$

## 6 RDS Data acquisition

Particularly for tuner modules or circuits with RDS fully integrated for mobile use, it is important to know the time to synchronize after a re-tune. Strongly related to this is the time to receive the PI code for the first time.

### 6.1.1 Time to synchronise

When tuned to an FM-RDS station, it is important to have RDS synchronisation immediately.

Taking into account the synchronising time of the system and the recognition of at least two consecutive RDS blocks, the time to synchronise RDS shall be max 120 ms, 80 % over 100 measurements.

### 6.1.2 Time to detect a first PI

In addition to the time to synchronise, it is often required to specify the time to detect the PI code for the first time. There is a fixed relationship between both, the PI code is present in block A of all groups and in block C' of the B groups. The maximum time shall not exceed 180 ms. A value of 160 ms shall not be exceeded in 80 % over 100 measurements.

### 6.1.3 Method of measurement

The tuner module or receiver and the signal source are operated under standard measuring conditions, according to 4.1.

The RDS monitor program on the PC screen must provide the information of time needed to synchronise. Tune from a frequency higher and a frequency lower than the wanted frequency of 97 MHz. (Tuning should be from both sides of the wanted frequency, because the behaviour can be different). Read out the value for the time needed to synchronise and the time needed to read the PI code.

Repeat this at least 100 times. 80 % of the results shall then be below the minimum requirements.

#### Minimum requirements:

Time to synchronise	120 ms
Time to PI detection	160 ms

## 7 Large signal capabilities

The two issues to be dealt with are:

1. The product shall be resistant to high signal levels of the wanted frequency.
2. RDS decoding shall work correctly in the presence of strong FM signals other than the wanted one.

### 7.1 Resistance to high wanted signal levels

#### 7.1.1 Method of measurement

The tuner module or receiver and the signal source are operated under standard measuring conditions, according to 4.1; turn the input signal level up until 120 dB $\mu$ V.

**Large wanted signal requirement:** No defects shall occur.

## 7.2 RDS performance at large unwanted signal

### 7.2.1 Method of measurement

The tuner module or receiver and the signal source are operated under standard measuring conditions according to 4.1. In addition one of the signals according to table 1 is added at a time.

**Table 1 – Presentation of the measurement result**

Wanted frequency	Unwanted frequency	Result
97 MHz RDS sensitivity level +6dB	91 MHz	____ dB $\mu$ V
	103 MHz	____ dB $\mu$ V

The wanted and unwanted signals are applied simultaneously by means of a combining network in accordance with 4.1. Adjust the RF level of the wanted frequency to the RDS sensitivity level (50% correct RDS blocks) without the unwanted signal. Add 6 dB to this level. Adjust the unwanted strong signal until the RDS sensitivity level of 50 % correct blocks is reached again.

#### Minimum large unwanted signal requirements:

RDS product category 1 and 3	RDS reception at 50% correct blocks	60 dB $\mu$ V
RDS product category 2	RDS reception at 50% correct blocks	88 dB $\mu$ V

## 8 RDS selectivity

RDS selectivity: The capability of the RDS receiver to cope with adjacent signals at both sides of the tuning frequency:  $\pm 100$  kHz,  $\pm 200$  kHz.

### 8.1 Method of measurement

The wanted and unwanted signals are applied simultaneously by means of a combining network in accordance with figure 1. Adjust the RF level of the wanted frequency without the unwanted signal to the RDS sensitivity level (50% correct RDS blocks).

Add 6dB to this level.

Add the unwanted frequency: Tuned wanted frequency with a distance of  $\pm 100$  kHz,  $\pm 200$  kHz

Deviation $\Delta f$	22.5 kHz
Modulation frequency $F_{\text{mod}}$	1 kHz
Modulation method	L=R
De-emphasis	50 $\mu$ s (USA: 75 $\mu$ s)

Check the RDS reception. Adjust the unwanted signal until the RDS sensitivity level of 50 % error-free blocks is reached again.

The level of the unwanted signal related to the wanted signal in dB is presented as S+100, S-100, S+200, S-200 RDS selectivity.

#### Minimum RDS selectivity requirement:

RDS product category 1:	S $\pm 100$ 2 dB $\mu$ V,	S $\pm 200$ 32 dB $\mu$ V
RDS product category 2:	S $\pm 100$ 4 dB $\mu$ V,	S $\pm 200$ 50 dB $\mu$ V
RDS product category 3:	S $\pm 100$ 2 dB $\mu$ V,	S $\pm 200$ 32 dB $\mu$ V

## 9 Minimum operational RDS compliance requirements

The issues in this chapter are highly significant for a well performing RDS product, mostly car radios. However, clear performance values and levels cannot be given, because of manufacturer and/or customer specific implementations. Therefore a set of general considerations and guidelines is given here with the view to help to evaluate the dynamic RDS performance in the products concerned.

### 9.1 RDS dynamic behaviour

An ideal RDS radio switches in time inaudibly over to an alternative frequency (AF) with the *best audio* quality. Variations in sound should *not* occur.

Car radio manufacturers have developed algorithms to achieve this in the best possible way. Therefore objective criteria or switching levels will not be specified, as they are often subject to IPR. In this document a few key criteria are nevertheless given, which will need to be taken into account, where applicable, in order to ensure a proper dynamic behaviour of the RDS product:

1. Signal level of an AF in relation to the tuned frequency
2. Multipath distortion: Distortion of the audio, caused by reflections, like in mountainous areas
3. Noise: Unwanted signals in higher parts of the audio spectrum, generally coming from adjacent FM channels
4. RDS reception: The number of correctly received RDS blocks; valid for the tuned frequency only. This is also relevant for TMC reception.

A radio will receive either single (Method A) or multiple (Method B) AF list(s). The order, in which these AF's are stored and used, is manufacturer specific. Important is however that the radio checks these AFs at certain intervals, to identify their quality, taking those first three criteria mentioned above into account. All modern tuners nowadays offer the possibility of doing these AF checks in an almost "inaudible" way. When the overall signal quality of an AF from the list becomes better than the currently tuned frequency, then the radio shall switch to this better AF

Correct processing of the PI code: Before releasing the audio of the new frequency however, first a PI check must be made in order to verify that the new frequency carries indeed the same wanted radio programme.

Manufacturers of car radios have developed and optimized over the years algorithms to adapt the dynamic RDS performance to most challenging receiving conditions. We have to consider here mountainous areas, tunnel roads and areas with a poor coverage. Quite often the AF lists are exceeding 25 or sometimes even 30 AFs.

RDS car radios that are capable to cope with these complex receiving conditions, can well make the difference in comparison to more average or poor and not so well performing radios. The car industry has been deeply involved in evaluating this process.

Simulations on the bench may give only a first impression and show, if the most basic functions will work properly. However, the real dynamic RDS performance at these challenging conditions can only be validated at critical locations and on the roads, where such critical receiving conditions then really occur.

A simple bench test can start with only two or three generators with programmable AF lists, to make sure that the radio will at least "recognise" each generator, when tuned to just one of them. By varying the signal level or introducing multipath or noise distortion to the tuned frequency (=generator), the radio shall look for the best alternative frequency (=one of the other generators) and then switch accordingly.

#### 9.1.1 Traffic announcements TA/TP

Customer Requirement:

The radio shall detect a Traffic announcement (TA) on the tuned programme (TP) or one of the cross-linked programmes via EON. The radio shall switch to the TA message from any source currently in use.

During a TA, the display indication and the volume level are either product specific or customer adjustable.

### 9.1.1.1 End of message.

After the TA message, the radio shall return to the previous status.

When during the traffic message RDS synchronization is lost, the radio must return to the previous situation within a fixed period. A practical value is 2 minutes.

### 9.1.1.2 TP search

When a TP or TP/EON search is started, it will be done according to the following criteria:

The radio stops at the first station, which corresponds to TP=1 being present in all groups or TP/EON being signalled in the type 0A group.

According to the following status of the TP and TA flags in the 0A group, i.e. TP=1 and TA=0, or TP=0 and TA=1 or TP=1 and TA=1, a traffic announcement is currently on air, or not.

**Note:** An automatic TP search (initiated by the radio and not by the user) is not allowed during listening. It is only allowed, when the current audio source is not the tuner.

### 9.1.1.3 TA Announcement skip

A current TA message can be interrupted at customer request. The next TA message will however be passed on, when the TA receiving mode remains on.

## 9.1.2 Regionalisation

Regional services use PI codes that are identical in the first, third and fourth-nibbles, but have different second-nibbles in the range 4 - F (Region 1 - 12). Broadcasters may split during certain periods of the day their supra-regional network into a maximum of 12 regional networks. In Austria, Germany and Switzerland this regionalisation feature is very widely used. The PI code structure will be x3yz, and when regionalized, the second PI segment may change then from 3 into 4 to F. Often the PS name also changes dynamically, to communicate the regional status to the listener, i.e. BAYERN1 becomes BR1 MUN, when regional.

Another public broadcaster in Germany uses the concept of regionalisation completely static, i.e. the area codes in the second PI segment are kept as one value from the code range 4 to F and the PS name also remains unchanged and refers to the region. In this configuration there can be a supra-regional common radio programme for certain hours of the day, without using the supra-regional code 3 at all in the second PI segment.

AF method B lists give all AFs in frequency pairs, with the parent frequency in ascending or descending order, indicating then also the regional variants for that radio tuned programme. The tuning frequency is given in the header of the list. Table 2 illustrates this issue.

**Table 2 – AF example**

F <sub>1</sub>	F <sub>2</sub>	
# 11	89.3	Total number (11) of frequencies for tuning frequency (89.3)
89.3	99.5	F <sub>2</sub> > F <sub>1</sub> hence 99.5 is an AF of tuned 89.3, and is the same programme
89.3	101.7	F <sub>2</sub> > F <sub>1</sub> hence 101.7 is an AF of tuned 89.3, and is the same programme
88.8	89.3	F <sub>2</sub> > F <sub>1</sub> hence 88.8 is an AF of tuned 89.3, and is the same programme
102.6	89.3	F <sub>2</sub> < F <sub>1</sub> hence 102.6 is an AF of the regional programme variant for tuned 89.3
89.3	89.0	F <sub>2</sub> < F <sub>1</sub> hence 89.0 is an AF of the regional programme variant for tuned 89.3

### 9.1.2.1 Requirement

Although various product and customer specific implementations may exist, RDS radios must manage and store PI codes and dynamically change their structure into regional programme variants in a proper way.

The AF list must be structured in such a way that a distinction is given between the AFs belonging really to the same supra-regional PI and the ones belonging to the associated programmes, whose PI differs then only in the second PI segment.