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TECHNICAL REVIEW

COST-BENEFIT ANALYSIS OF FM, DAB, DAB+ AND BROADBAND FOR RADIO BROADCASTERS AND LISTENERS

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EBU

FOREWORD

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ABSTRACT

With Norway switching off analogue FM radio services in favour of DAB+ digital broadcast technology and Finland opting for no digital radio broadcast technology at all, we can see a wide divergence of approach. In the light of this, can we objectively compare the costs associated with the distribution and consumption of radio services? This article describes a study that takes digital radio (using DAB or DAB+ - referred to as DAB in this article), analogue FM radio and internet radio streamed via unicast, and analyses their respective distribution and consumption costs.

The distribution analysis is based on available information regarding capital expenditure on equipment, maintenance costs, power and other operational expenditure. A significant element of this article relates to the estimation of the costs for the different types of station, using information available from the largest European markets. The consumer analysis is based on the cost of network and service access, where relevant.

Although the broadcast radio model we enjoy today is not economically viable when translated through an internet distribution model, the findings show that digital radio is favourable compared to analogue radio – even for the smaller audiences associated with local and regional radio stations.

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1. INTRODUCTION

In today's world, information and communications technology (ICT) infrastructures play a vital role in bridging the digital divide.

Selecting one infrastructure over another has both economic and social consequences for content providers and their audiences.

Radio broadcasters have relied on analogue, frequency modulated (FM) transmission for many years, but today new opportunities arise; digital terrestrial transmission in DAB/DAB+ (referred to as DAB in this paper) and on-demand delivery via the internet.

Which of these three distribution technologies – FM, DAB or internet – provides the best value for broadcasters in this day and age?

On the other side of the equation, radio audiences may have distinct preferences; is FM radio still sufficient or is a migration to digital radio preferred? What kind of digital radio is preferred, DAB or internet delivery?

The high number of variables in play makes it difficult to answer these questions. EBU Technical Report 026[1] describes the requirements a distribution platform must meet to be considered as a viable option for public service broadcasters; these requirements include universality, reach, availability, ease of use and so on.

The starting point of the discussion should nevertheless be the economic sustainability of the chosen distribution platform for all parties involved.

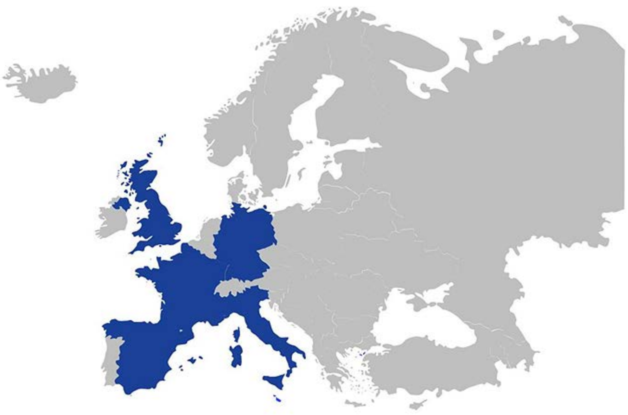
This leads to the need to assess the costs:

- For radio broadcasters, each of these infrastructures requires both operational expenditure (OpEx) and capital expenditure (CapEx).
- For audiences consuming audio content using these infrastructures, both fixed costs (such as a broadcast reception licence and ISP charges) and, especially for mobile reception, data use and other charges pertain, which together amount to the real expense of radio listening.

To assess the aforementioned costs, the five principal countries (France, Germany, Italy, Spain and the UK) of the EU28 were used to create a statistically relevant 'model country'. In fact, these countries together represent a reasonable benchmark for the transmission cost and listening cost for each of the distribution platforms considered.

[1] https://tech.ebu.ch/docs/techreports/tr026.pdf; available for free public download.

The big five European markets as baseline
- Population: 321 M (63% of the union)
- Area: 2 Mkm^2 (46% of the union)
- GDP: 13212 Billion$ (71% of the union)



2. DISTRIBUTION COST ANALYSIS

2.1. Requirements analysis

In order to assess the transmission cost for each distribution platform it is necessary to understand which elements comprise the OpEx and CapEx.

For terrestrial broadcasting (both analogue and digital) the principal elements that contribute to the OpEx are energy consumption, heat dissipation, site rental and site maintenance costs.

The CapEx is defined by the transmitter cost and the tower cost plus tower installation cost.

Consequently, the input figures required to assess the OpEx and CapEx for terrestrial broadcasting include the number of sites comprising the network and, for each site, the power of the transmitter and the type of site, large or small.

For internet distribution, the OpEx is basically defined by the amount of traffic delivered via content delivery networks (CDNs), which means that the input figures will be the cost per gigabyte, the listening time, the bitrate and the population reach. No CapEx is considered.

	OpEx	**CapEx**	**Input figures**
FM and DAB Radio	• Energy consumption • Heat dissipation • Site maintenance cost • Site rental cost	• Transmitter cost • Tower cost • Installation cost	• Number of transmitters • Transmitter power • Transmitter energy profile • Site categorization
Internet Radio	GB of data distributed via CDN	No CapEx	• Price per gigabyte • Listening time • Bitrate • Population reach

2.2. FM and DAB network analyses

The type and quality of the transmitters and the consequent nature and size of the radio sites is related to the network planning outcome for a specific country. This will be treated in detail in section 2.3 (FM predictive model). Nevertheless a common trait of all the networks analysed is the dynamic range of effective radiated power (ERP), spanning from 1 W to more than 150 kW.

It would be a challenge to precisely predict the cost of a typical standard FM network, given the elevated number of transmitters and the high variance of their radiated power. For the purpose of this study, it was decided to create a manageable approximation of the network based on the dynamic range of the effective radiated power. By converting the dynamic range to dBm, it is possible to establish sub-ranges of approximately the same size.

To have a good balance between complexity and precision, eight separate sub ranges were considered. Moreover, assuming that a reasonable value for the total gain provided by the transmitting antenna, power amplifiers and so on is at least 10 dB, the transmitters have been chosen accordingly to be able to cover one of the eight different sub-ranges.

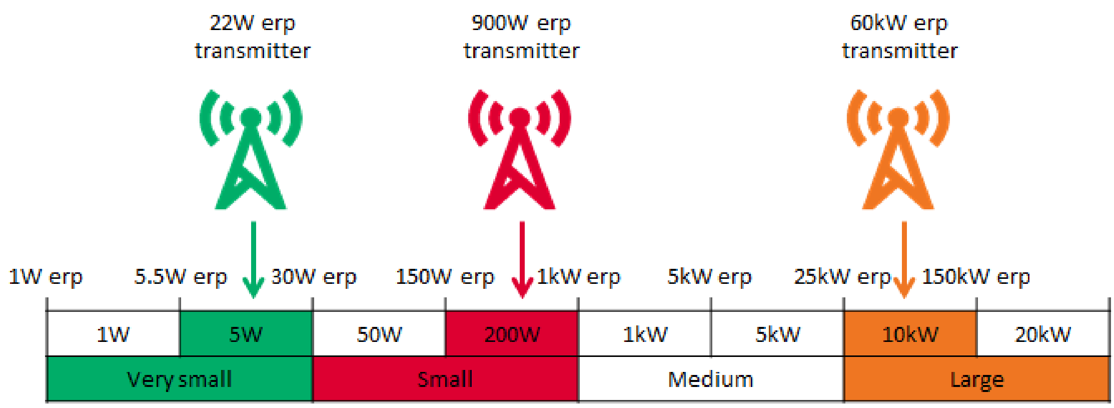
With this methodology, each transmitter power of a FM network is categorized with only eight possible values. These values, along with the cost of energy and the efficiency of the transmitter, will establish the baseline to calculate the energy consumption and heat dissipation of the network.

The next steps are to assign a transmitter type and a specific type of site. The type of site, in fact, has a different impact concerning maintenance and rental. It was decided to have four possible categories: very small, small, medium and large sites.

The following table shows the final outcome:

FM ERP range	Dynamic range in dBm	FM Transmitter power in W (dBm)	Site category
1 - 5.5 W	30 - 37.4 dBm	1 W (30 dBm)	Very small (1 - 30 W ERP)
5.5 - 30 W	37.4 - 44.8 dBm	5 W (37 dBm)	
30 - 150 W	44.8 - 52.2 dBm	50 W (47 dBm)	Small (30 W - 1 kW ERP)
150 W - 1 kW	52.2 - 59.6 dBm	200 W (53 dBm)	
1 - 5 kW	59.6 - 67 dBm	1 kW (60 dBm)	Medium (1 - 25 kW ERP)
5 - 25 kW	67 - 74.4 dBm	5 kW (67 dBm)	
25 - 150 kW	74.4 - 81.8 dBm	10 kW (70 dBm)	Large (>25 kW ERP)
>150 kW	>81.8 dBm	20 kW (73 dBm)	

Based on this table, each FM transmitter of an existing network will have a defined power profile and site profile.



To compare FM and DAB costs it is necessary to apply the same approach used for FM networks to DAB networks. In particular, the key here is to find a correlation between transmitter powers.

Based on the analysis of a significant number of existing sites running both FM and DAB transmitters, as a rule of thumb it is possible to state that the power dynamic range for DAB is restricted at both ends by a factor of 10 and that the coverage ratio is 1.6 in favour of FM.

After having restricted the whole dynamic range, it is now possible to apply the same concept of the case for FM to DAB, meaning that each transmitter can be assigned one of eight different power profiles and four site categories.

DAB ERP range	**Dynamic range in dBm**	**DAB Transmitter power in W (dBm)**	**Site category**
10 - 30 W	40 - 44.5 dBm	10 W (40 dBm)	Very small (10 - 80 W ERP)
30 - 80 W	44.5 - 49.1 dBm	30 W (44.8 dBm)	
80 - 250 W	49.1 - 53.6 dBm	100 W (50 dBm)	Small (80 - 650 W ERP)
250 - 650 W	53.6 - 58.1 dBm	250 W (54 dBm)	
650 W - 2 kW	58.1 - 62.7 dBm	500 W (57 dBm)	Medium (650 W - 5 kW ERP)
2 - 5 kW	62.7 - 67.2 dBm	2 kW (63 dBm)	
5 - 15 kW	67.2 - 71.8 dBm	5 kW (67 dBm)	Large (>5 kW ERP)
>15 kW	>71.8 dBm	15 kW (71.8 dBm)	

Having categorized sites and transmitters, the last step is to assign the input numbers to each transmitter category for energy consumption and site maintenance and rental.

Here are the input numbers assigned to evaluate the OpEx[2]:

Site category	FM Annual maintenance	DAB Annual maintenance	FM or DAB Annual rental
Very small	1k$	2k$	1.2k$
Small	1k$	2k$	6k$
Medium	2.5k$	5k$	12k$
Large	5k$	10k$	30k$

Transmitter efficiency	
FM	72%
DAB	40%
Cost per kW/h	0.15$

And here are the input numbers assigned to evaluate the CapEx[3] for DAB

Site category	DAB Tower cost	DAB Installation cost
Very small	2k$	5k$
Small	10k$	5k$
Medium	75k$	50k$
Large	120k$	100k$

FM Site reusability	
Percentage of towers that can be reused	20%

DAB Transmitter type and equipment	Price	DAB Transmitter type and equipment	Price
10 W	1k$	500 W	15k$
30 W	1k$	2 kW	60k$
100 W	2k$	5 kW	90k$
250 W	5k$	15 kW	150k$

2.3. FM predictive model

The study considered the FM networks of the principal radio broadcasters in France, Germany, Italy, Spain and the UK.

The complexity of each network is dependent on several factors such as topology, planning techniques, radiating power limits, number of radio stations, number of neighbouring countries, and so on.

Aligning all countries to have the same boundary conditions is impossible, therefore analysing the individual networks to obtain a standardized mathematical mean of those networks should provide a suitable model to partially address all different conditions.

[2] The values are the average of interviews and data found on the internet
[3] The values are the average of interviews and data found on the internet

FM networks based on data[4]

	France	Germany	Italy	Spain	UK
Population	66991000	82175700	60599936	46423064	65110000
Area	551695	357168	301338	505990	242495
Site category:					
Number of Very Small sites	24	0	140	0	42
Number of Small sites	494	123	532	22	106
Number of Medium sites	82	32	160	138	47
Number of Large sites	26	7	37	46	21
Transmitter category:					
Number of 1 W TX	5	0	8	0	5
Number of 5 W TX	19	0	132	0	37
Number of 50 W TX	188	52	408	6	83
Number of 200 W TX	306	71	124	16	23
Number of 1 kW TX	39	19	130	84	25
Number of 5 kW TX	43	13	30	54	22
Number of 10 kW TX	19	7	36	46	10
Number of 20 kW TX	7	0	1	0	11

Proceeding from the network data, it is now necessary to normalize the countries to represent the same geographical area, which will be set as the mathematical mean. The population and the number of transmitters for each country will be scaled accordingly.

[4] Networks data based on http://fmscan.org/

FM networks scaled to normalization factor

	France	Germany	Italy	Spain	UK	FM predictive model
Population	47M	90M	78M	35M	105M	71519744
Area	391737	391737	391737	39173 7	391737	391737

Site category:						
Very Small sites	17	0	182	0	68	53
Small sites	351	135	692	17	171	273
Medium sites	58	35	208	107	76	97
Large sites	18	8	48	36	34	29

Transmitter category:						
1 W TX	4	0	10	0	8	4
5 W TX	13	0	172	0	60	49
50 W TX	133	57	530	5	134	172
200 W TX	217	78	161	12	37	101
1 kW TX	28	21	169	65	40	65
5 kW TX	31	14	39	42	36	32
10 kW TX	13	8	47	36	16	24
20 kW TX	5	0	1	0	18	5

The mathematical mean of those five networks provides the predictive model, scalable according to the size of the country. It is important to highlight that the population of this newly created 'model country' is about 72 million.

2.4. DAB predictive model

Using the same structured categorization, it is now possible to craft the composition of a DAB network starting from the existing FM predictive model.

A FM transmitter is substituted with an equivalent DAB transmitter following the table, but considering the coverage ratio, it will also be necessary to have 1.6 more DAB transmitters for each type.

FM ERP range	FM Transmitter power
1 - 5.5 W	1 W
5.5 - 30 W	5 W
30 - 150 W	50 W
150 W - 1 kW	200 W
1 - 5 kW	1 kW
5 - 25 kW	5 kW
25 - 150 kW	10 kW
>150 kW	20 kW

DAB Transmitter power
10 W (1.6 more)
30 W (1.6 more)
100 W (1.6 more)
250 W (1.6 more)
500 W (1.6 more)
2 kW (1.6 more)
5 kW (1.6 more)
15 kW (1.6 more)

Applying this technique, the final predictive models are the following.

FM predictive model	
Population	71519744
Area	391737

Site category:	
Very Small sites	53
Small sites	273
Medium sites	97
Large sites	29

FM Transmitter category:	
1 W TX	4
5 W TX	49
50 W TX	172
200 W TX	101
1 kW TX	65
5 kW TX	32
10 kW TX	24
20 kW TX	5

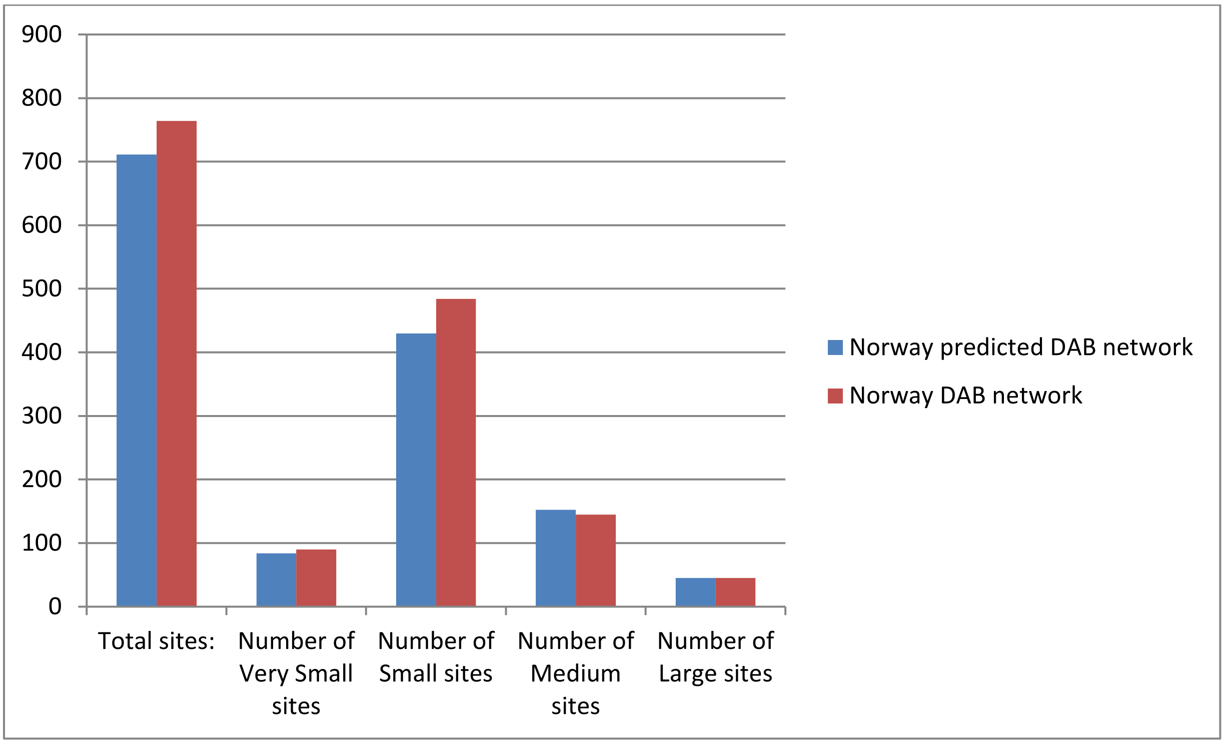
DAB predictive model	
Population	71519744
Area	391737

Site category:	
Very Small sites	85
Small sites	437
Medium sites	155
Large sites	46

DAB Transmitter category:	
10 W TX	7
30 W TX	78
100 W TX	275
250 W TX	162
500 W TX	103
2 kW TX	52
5 kW TX	38
15 kW TX	8

The model was then applied to a real case example to validate the overall accuracy.

Here follows the example of Norway[5] which resulted in an error of 7% on the total number of transmitters. Furthermore, the number of individual sites per category was accurately identified.



2.5. FM and DAB OpEx and CapEx

Once the FM and DAB networks for our country have been modelled, the evaluation of the operational expenditure simply requires the application of the input prices identified in section 2.2.

$$FM\ OpEx = \sum_{i=1}^{nr\ transmitters} (\text{Energy consumption} + \text{Heat dissipation}) + \sum_{i=1}^{nr\ sites} (\text{Renting} + \text{Maintenance})$$

$$DAB\ OpEx = \sum_{i=1}^{nr\ transmitters} (\text{Energy consumption} + \text{Heat dissipation}) + \sum_{i=1}^{nr\ sites} (\text{Renting} + \text{Maintenance})$$

$$DAB\ CapEx = \sum_{i=1}^{nr\ transmitters} (Transmitter\ cost) + \sum_{i=1}^{nr\ sites} (\text{Tower} + \text{Installation})$$

The results show that the total cost to run the national DAB network is larger than the FM equivalent. The reason for this is identifiable in the larger number of sites required, leading to higher expenses on maintenance and rental, but also to the poorer efficiency of DAB transmitters.

Nevertheless, even if the cost of running the entire network is higher, DAB is still a cheaper option than FM; this is because the cost of an FM network is absorbed entirely by a single radio station whereas the cost of the equivalent DAB network is shared

[5] Norwegian DAB network based on http://fmscan.org/

across the different radio stations populating the multiplex ('mux'); typically up to about 18 different stations.

'Model country' national FM network OpEx	**5.8M$**
National radio OpEx	5.8M$

'Model country' national DAB network OpEx	**11M$**
National radio OpEx in the worst-case scenario (only station in the mux)	11M$
National radio OpEx in the best-case scenario (18 stations sharing the mux)	600k$
National radio OpEx in the realistic case scenario (10 stations sharing the mux)	1.1M$

'Model country' national DAB network CapEx	**14.7M$**
National radio OpEx int the worst-case scenario (only station in the mux)	14.7M$
National radio OpEx in the best-case scenario (18 stations sharing the mux)	810k$
National radio OpEx in the realistic case scenario (10 stations sharing the mux)	1.5M$

2.6. Internet radio OpEx

The operational expense associated with internet radio distribution is a direct function of the traffic generated by the radio station. In turn, the amount of traffic depends on the stream bitrate, the population reach and the daily listening time per citizen.

A standard quality audio stream ranges from 64 kbit/s up to 320 kbit/s. However, for the purpose of this study, 96 kbit/s will be considered the reference bitrate.

The population reach for the 'model country' was evaluated during the creation of the predictive model for FM and DAB and it is the normalized mathematical mean of the five countries considered. Consequently the total population is about 72 million (71519744) people.

Regarding daily listening time, two scenarios were considered:

- Radio listened to exclusively online
- Radio listening online as a percentage of total listening

The reason for this choice is to understand the impact that an eventual full migration to internet delivery would have on the distribution budget.

According to EBU statistics, in the five countries considered the daily listening time per citizen to a public radio station could be as low as 10 minutes per day and as high as 28 minutes per day. It is assumed here that the daily listening time will be 17 minutes per day on average. Furthermore, according to RAJAR[6] and other industry bodies, across all possible platforms, internet radio listening time is about 10% of the total.

The price per gigabyte billed to broadcasters and, more generally, content providers is dependent on the monthly traffic generated. The higher the traffic generated, the lower the price per gigabyte.

According to online sources[7] the CDN cost can be categorized as follows:

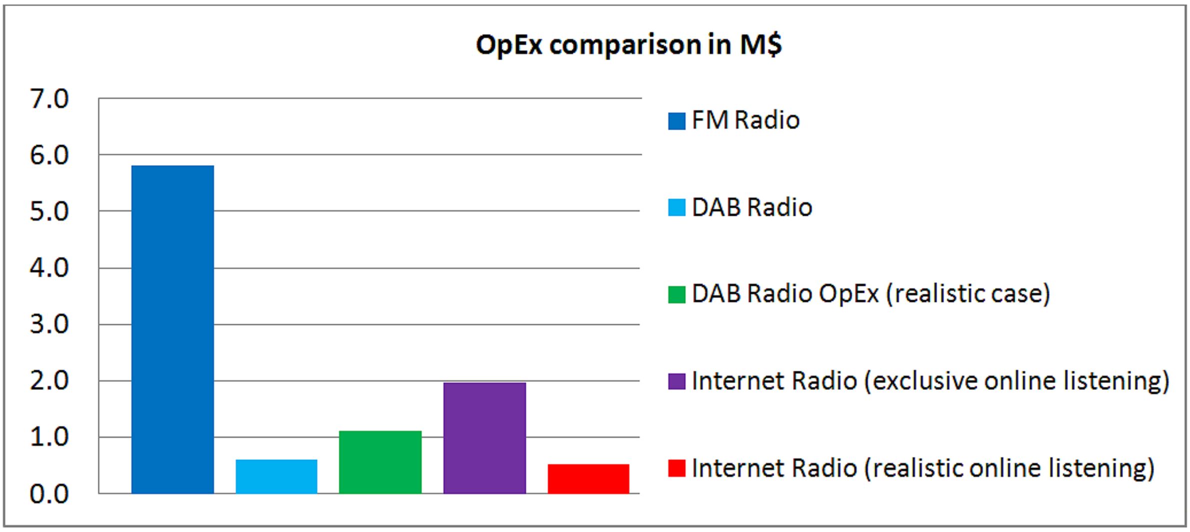
Monthly traffic 1 - 4 Pbyte	→	0.01$ to 0.025$ per Gbyte
Monthly traffic 4 - 8 Pbyte	→	0.007$ to 0.012$ per Gbyte
Monthly traffic more than 20 Pbyte	→	0.005$ to 0.008$ per Gbyte

Exclusive internet radio listening	**Realistic internet radio listening**
Population: 72 million Bitrate: 96 kbit/s Daily radio listening: 17 minutes Internet radio listening percentage: 100% Daily online radio listening: 17 minutes Total data traffic per year: 288 Pbyte Total data traffic per month: 24 Pbyte Per year expense: 1.96M$	Population: 72 million Bitrate: 96 kbit/s Daily radio listening: 17 minutes Internet radio listening percentage: 10% Daily online radio listening: 1.7 minutes Total data traffic per year: 28.8 Pbyte Total data traffic per month: 2.4 Pbyte Per year expense: 520k$

[6] http://www.rajar.co.uk/content.php?page=listen_market_trends
[7] www.cdnpricing.com

3. DISTRIBUTION TECHNOLOGIES COMPARISON

Having evaluated the cost of distribution for each of the technologies under study, it is possible to draw some conclusions.



The above chart shows the operational expenditure for each distribution technology per single radio station.

It is immediately visible that, with the current data, FM OpEx is the highest, followed by exclusive internet delivery and the realistic case for DAB.

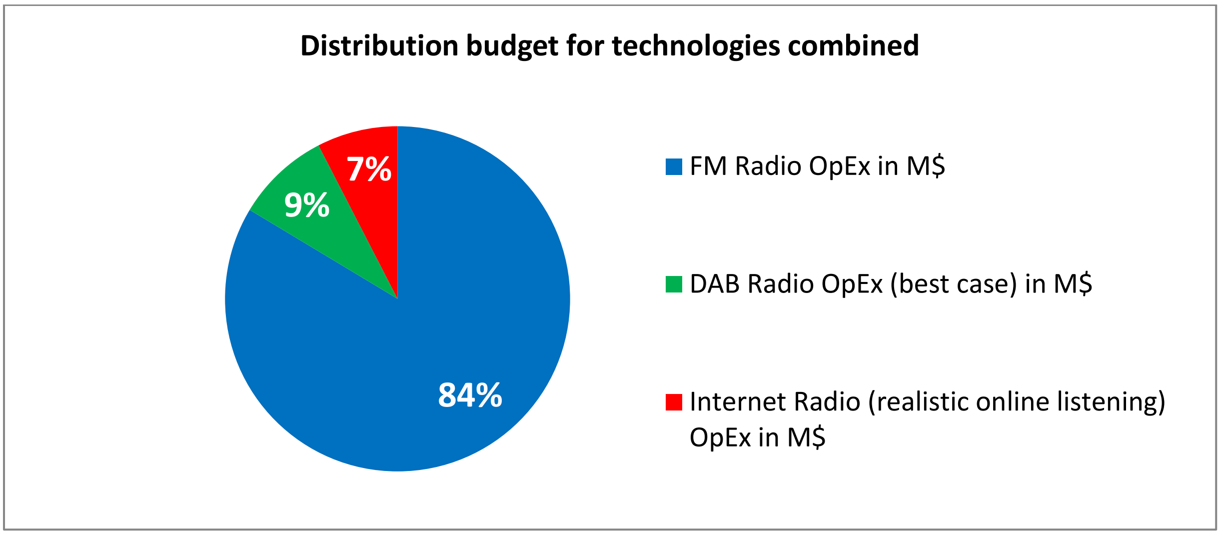
While the difference between FM and DAB is largely explained by the peculiarity of digital transmission via multiplexes, it is interesting to notice that the exclusive distribution via broadband looks cheaper than FM but still much more expensive than DAB.

It is, however, necessary to put the different technologies in perspective; traditional terrestrial broadcasting provides a 24/7 service whether the audience is actively listening or not, while internet distribution is very susceptible to changes in listening habits.

The figure provided here is based on the distribution cost associated with 17 minutes of online listening per day per citizen, but, the real expense could either increase or decrease dramatically according to the popularity of the radio station, making it practically impossible to forecast yearly expenses. While this would not overly affect large broadcasters with a national footprint, it could very well endanger smaller entities such as local broadcasters serving communities with longer listening times per citizen than the national stations.

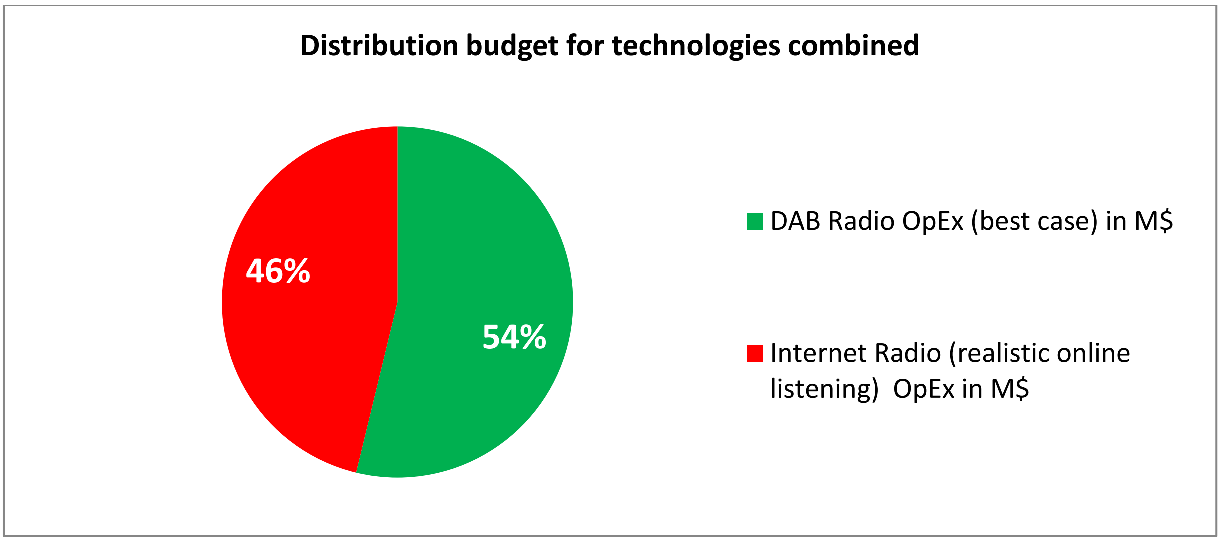
DAB is the cheapest technology among the three, and interestingly in the case of a full multiplex, DAB OpEx matches the cost of internet distribution in the realistic case.

When the three technologies are combined it is also possible to weigh the relative costs of each compared to the total listening time. The following figure considers the realistic case of a national radio stations simulcasting on FM and DAB, and at the same time distributing their content online, which accounts for 10% of their daily listening time[6].



In this example, internet delivery performs very well, since to generate 10% of the listening time it only consumes 7% of the total distribution budget.

In the event that FM were to be switched off the result would change dramatically.



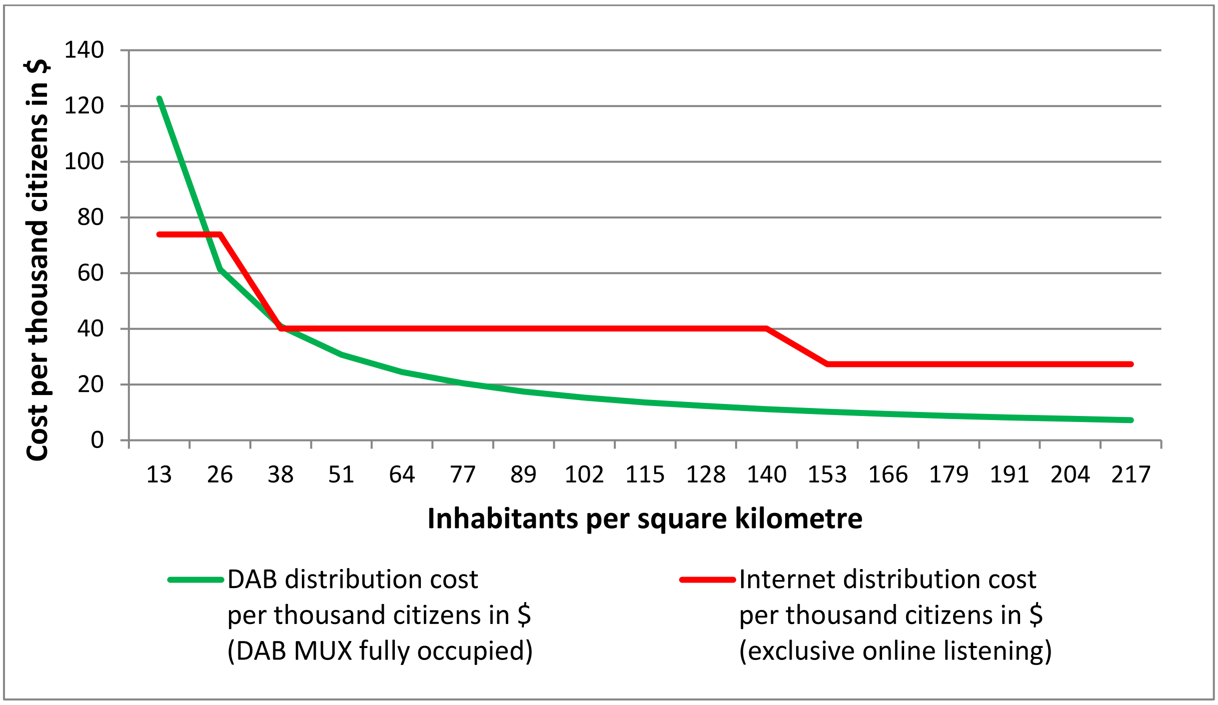
In this example internet delivery accounts for 10% of listening time but it requires 46% of the distribution budget.

It is also true that the main variables impacting the cost for distribution are different in the case of terrestrial networks and of internet distribution.

For terrestrial broadcasting, the larger the area to be covered, the higher the cost, while in the case of internet distribution, the larger the population to be served, the higher is the cost.

This study only considers the case of our 'model country' defined above, which is characterized by an area of 391737 km^2 for 72 million inhabitants, leading to a density of about 183/km^2.

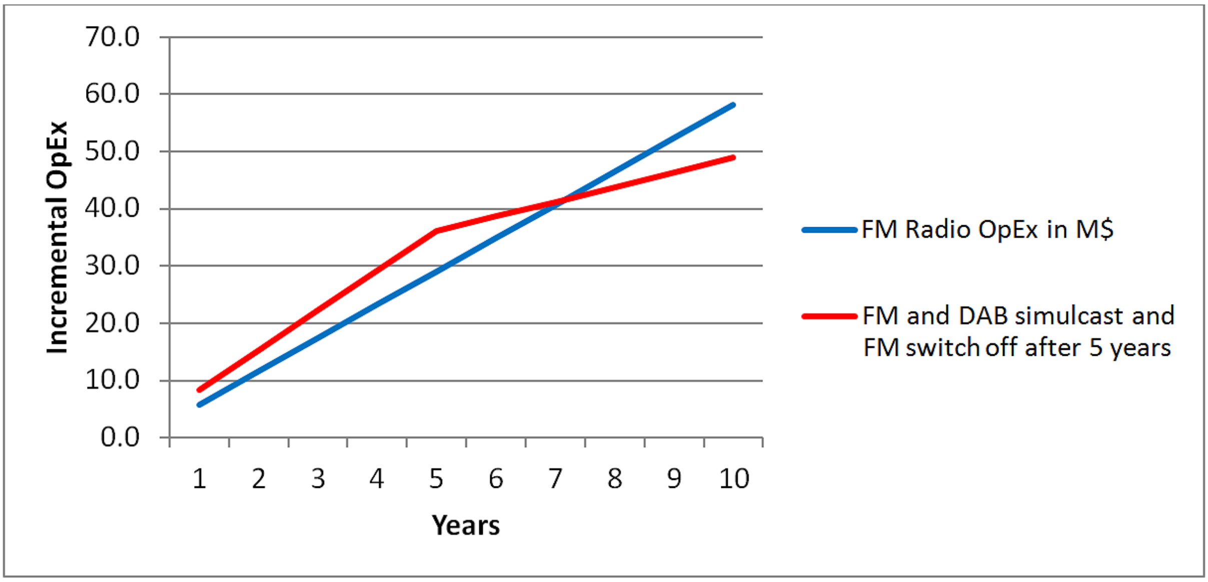
The following plot shows what happens if the population density of the 'model country' is modified (with internet distribution cost evaluated according to the population).



From this it appears that sparsely populated countries (with a density of 40/km^2 or less) might consider dropping terrestrial distribution completely in favour of internet distribution only. In fact, for these densities, broadband distribution would be cheaper than DAB. Nevertheless the question of internet service availability arises.

Countries characterized by these low densities see most of their population living in big cities, with large parts of their territory almost completely uninhabited. In these cases, it would be hard for broadband providers, either fixed or mobile, to justify the investment needed to cover those sparsely populated areas with the appropriate infrastructure.

Conversely, in the case of DAB the financial exposure to building the appropriate infrastructure is shared among stations, similarly to how the OpEx was evaluated. This is an advantage as the investment is limited and the break-even point can be reached quickly.



The above figure shows the case of FM and DAB simulcast, supposing that the financial exposure to building the DAB network is completely allocated in the first year. If FM was switched off after five years, the break-even point would be met in slightly more than two years.

4. LISTENING COST ANALYSIS

4.1. Radio listening scenarios

Radio can be consumed everywhere at any time, at home, in the office, in a car, on the move etc. Inevitably, not all distribution technologies can cover such a variety of use cases.

Reception Use Case	FM	DAB	Wi-Fi	MBB
Indoors (at home, in the office,…)	Available	Available	Available	Available
In car (via traditional radio, smartphone…)	Available	Available	Not Available	Available
On the move (portable radio, smartphone, …)	Partially Available	Partially Available	Not Available	Available

As shown in the table, terrestrial broadcasting (FM and DAB) is available indoors and in the car, but usage might be restricted on the move, since the only devices currently having access to terrestrial broadcasting are portable radio sets. Wi-Fi allows internet radio listening only indoors, while mobile broadband (MBB) permits internet radio listening in all three use cases considered.

Being able to access radio not only requires having the right device matching the right technology, but also means having the legal right to consume the content. This varies between countries, but frequently citizens are required to pay the public broadcasting licence fee to access radio legally, and in some cases – namely in the online world – they need to sign up for additional subscriptions.

	FM	DAB	Wi-Fi	MBB
Public broadcasting licence fee	FTA, no additional expense	FTA, no additional expense	Fixed broadband subscription	Mobile broadband subscription

FM and DAB require no additional subscriptions but fixed or mobile broadband implies an additional subscription cost. The conclusion is that to be able to assess the money spent to listen to radio in all use cases, the public broadcasting licence fee is not the only cost to be considered.

While FM and DAB incur no additional expense, these technologies are not fully capable of serving the "on the move" case, principally due to the lack of FM and DAB receivers in handheld devices. LTE MBB (Long Term Extension mobile broadband) is a technology that covers all reception use cases and this will now be analysed for the delivery of internet radio.

4.2. Requirements analysis

In line with distribution costs, listening costs are also composed of CapEx and OpEx.

For citizens, the CapEx is linked to the money spent in buying the right device to access radio according to their needs; a traditional radio set, a car radio set, a smartphone and so on. This CapEx cannot be evaluated here due to its high variability, but it is a one-off investment, which depends on the resources and preferences of the purchaser.

The OpEx, on the other hand, is simply the combination of the public broadcasting licence fee and the LTE subscription cost.

Related to this, it is possible to identify two distinct numbers:

- the cost to access radio (the minimum expense to be able to listen to radio)
- the actual expense (the real expense a listener is subject to in a year).

The inputs to evaluate these two aspects are shown in the table below.

Cost to access radio	
Broadcasters licence fee	LTE subscription with sufficient data allowance

Actual expense	
Broadcaster licence fee allocated to radio	LTE traffic allocated to radio

4.3. Public broadcaster licence fee

For the five countries considered in this study, the average public broadcasting licence fee amounts to 133 euros.

According to statistics, citizens typically consume 221 minutes of television and 149 minutes of radio daily. If these two numbers are summed it could be assumed that the licence fee gives access to 370 minutes of broadcast content daily.

In proportion, the 149 minutes of radio listening accounts for 40% of the consumed broadcast content, thus the pro rata amount of the licence fee allocated to radio will be 54 euros.

4.4. LTE subscription

In the countries considered, LTE subscriptions vary widely, depending on the selection of different mobile network operators and data plans. For the purposes of this study, we need to understand how many gigabytes per month are required to accommodate radio listening.

As was done in the case of calculating distribution costs, two separate cases will be analysed: listening exclusively through MBB, where the entire 149 minutes of daily radio are consumed on LTE, and the realistic case, where a small percentage of radio listening is consumed on LTE.

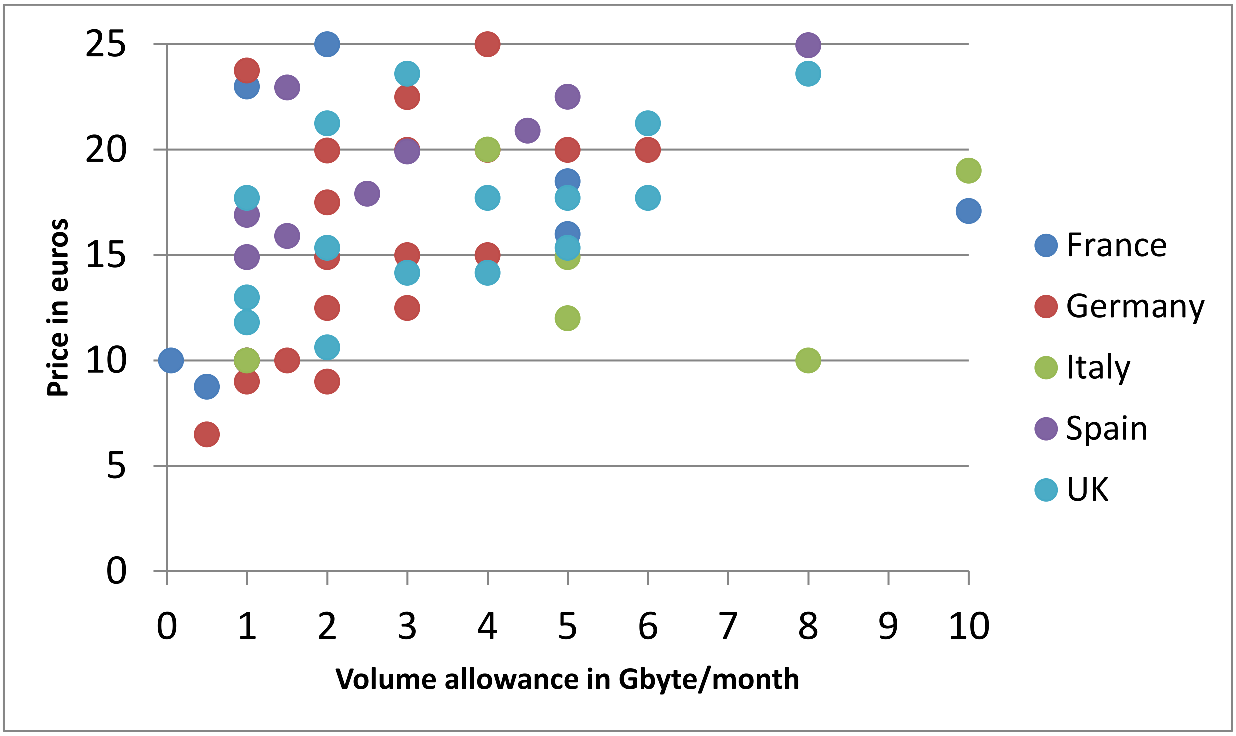
In section 2.6 we learned that the percentage of internet radio listening is 10% of the total daily listening[6]; this percentage concerns both fixed and mobile broadband. Deeper analysis of the statistics indicates that there is a 50-50 split between fixed and mobile internet radio consumption; each therefore accounts for 5% of total daily listening.

Exclusively MBB radio listening	Realistic MBB radio listening
Bitrate: 96 kbit/s Daily radio listening: 149 minutes Internet radio listening percentage: 100% Daily online radio listening: 149 minutes Total data traffic per month: 3.1 Gbyte	Bitrate: 96 kbit/s Daily radio listening: 149 minutes Internet radio listening percentage: 5% Daily online radio listening: 7.5 minutes Total data traffic per month: 0.16 Gbyte

Now that we know the minimum data allowance needed to accommodate internet radio listening, it is necessary to find the right subscription[8].

The following plot shows the available LTE subscription plans in France, Germany, Italy, Spain and UK, limited to a monthly expense of 30 euros.

[8] http://dfmonitor.eu/prices/country/



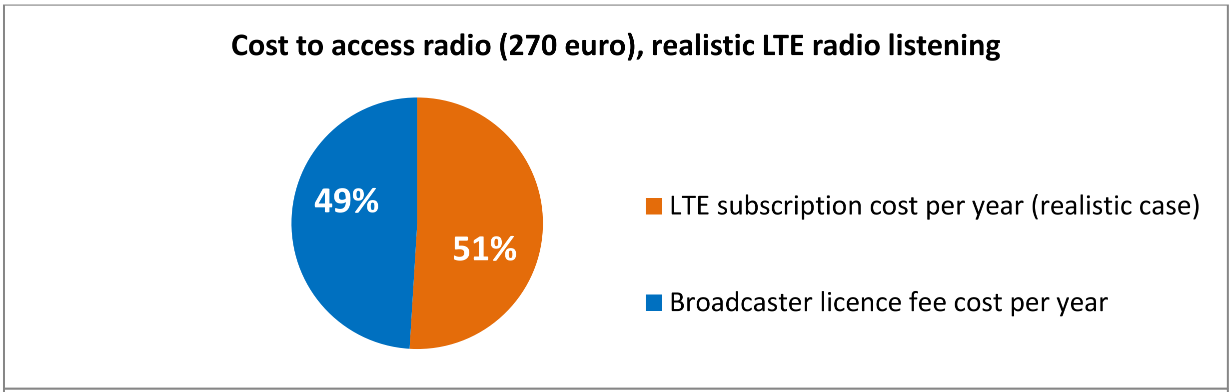
Having chosen the best deals separately for each country the following table summarizes the findings:

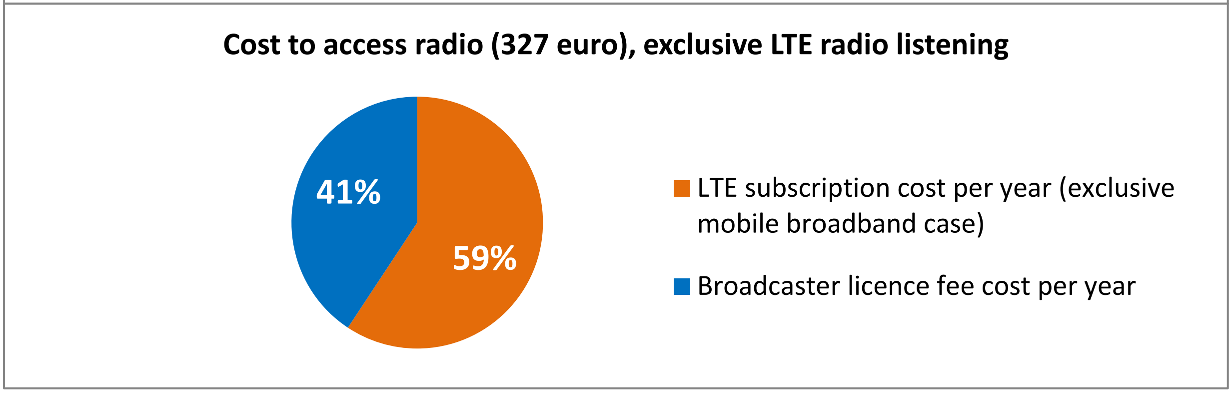
Best deal for exclusive MBB radio listening	Best deal for realistic MBB radio listening
Data allowance required: 3.1 Gbyte LTE subscription allowance: 4.8 Gbyte Average monthly price: 16.1 euros Average yearly price: 194 euros Data plan percentage spent for radio: 65% LTE yearly expense for radio listening: 126 euros	Data allowance required: 0.16 Gbyte LTE subscription allowance: 1.2 Gbyte Average monthly price: 11.5 euros Average yearly price: 138 euros Data plan percentage spent for radio: 13% LTE yearly expense for radio listening: 18 euros

4.5. Costs combined

The previous paragraphs analysed the individual elements that define the cost for access, and the real ongoing expense of radio consumption.

Starting with the cost to access radio, the following figures combine the broadcasting licence fee and the LTE subscription cost.

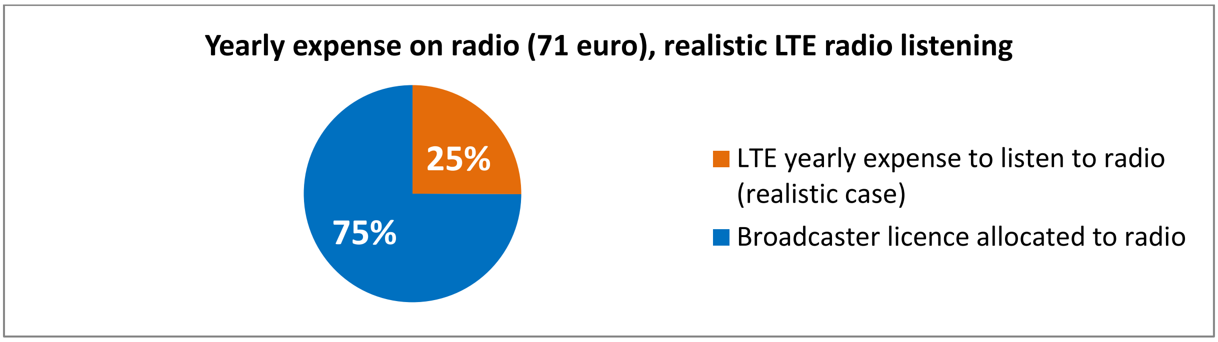




These two figures show that the additional cost to access radio, beyond the broadcasting licence fee, which covers both FM and DAB, is almost doubled in the case of realistic MBB radio listening and is almost tripled in the case of exclusive MBB radio listening.

These results pertain to a single individual. In the case of a family the situation would be even more exaggerated. While the licence fee grants access to all family members, the LTE subscription is personal. In other words, the larger the family, the higher is the impact of the LTE mobile broadband subscription for accessing radio.

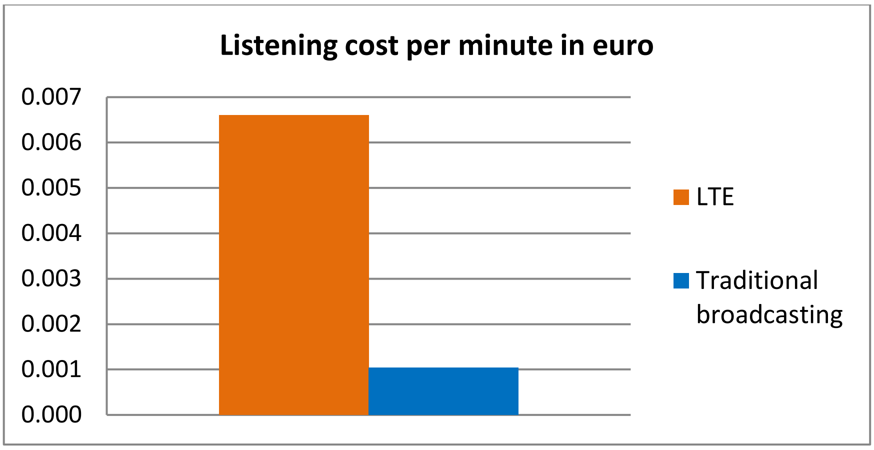
This poses a serious threat to accessibility of service, especially for low income families.



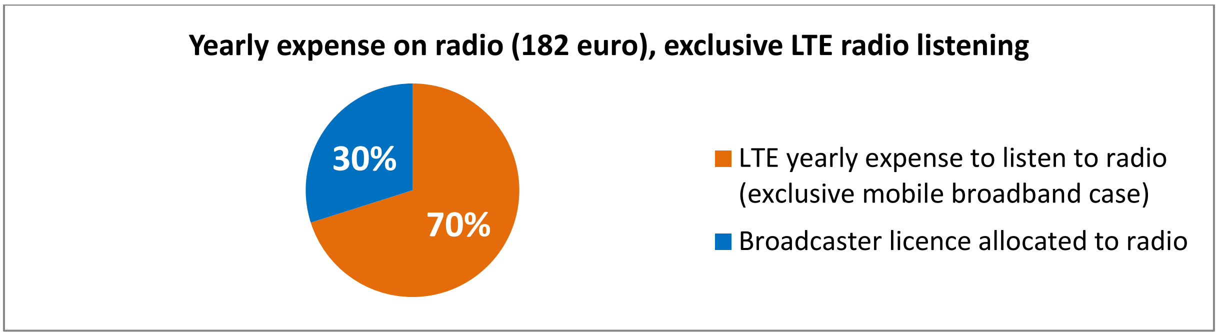
Moving to the real expense for radio listening, the scenario is a little different.

The first figure shows the expense in the case of realistic MBB listening, which accounts for 25% of the total money spent for radio consumption. At first glance, it might not seem too onerous, but considering that just 5% of realistic radio listening employs MBB and it accounts for 25% of the total expense, it puts things in the right perspective. MBB is very expensive in comparison with the time spent using it.

An analysis of the equivalent cost per minute (real expense of the technology divided by the time spent using it) reinforces the previous statement.



As shown above, for a listener consuming radio content on MBB, it costs seven times more than using traditional broadcasting.



The situation would be even more extreme if radio was exclusively delivered using mobile broadband.

5. CONCLUSIONS

This study modelled a country based on the statistics available from the five principal countries (France, Germany, Italy, Spain and the UK) of the EU28, and defined the operational expenditure for FM, DAB, and broadband using this ‘model country’.

FM emerged as the most expensive distribution platform. Digital transition to DAB would indisputably lower the budget required for distribution, permitting greater investment in content production and employment.

Broadband has a variable cost that depends on the listening time and the population reach it sustains. It proves to be an expensive technology for distribution and not really capable of competing with DAB for various reasons.

Nevertheless, MBB could be considered as an alternative solution to terrestrial broadcasting in extreme cases where population density is very low. In these cases, the broadband providers’ business models will determine whether it is feasible to cover the sparsely populated areas or not.

The current need for MBB addresses some use cases that terrestrial broadcasting cannot; mainly due to the absence of mobile devices capable of receiving FM and/or DAB signals.

By any standard, mobile broadband comes at a high price premium, in comparison with the broadcast model, that could in some cases threaten the ability of the population to access information. There is a clear need to make both analogue and digital radio broadcast reception available on handheld devices, thus reserving the mobile data packages on such devices for more appropriate uses.

For radio broadcasters, the way forward could be a transition to DAB, exploiting internet connectivity to provide additional low data services that enable interactivity with the audience.

Author biography

	Marcello Lombardo joined the European Broadcasting Union in 2014 as Project Manager. He works actively on Spectrum for Digital Terrestrial Television, Digital Radio and Ultra HD TV. He holds a master degree in Electronics/Robotics Engineering and his master thesis work was published in 2009 with the title "Policy Gradient Learning for a Humanoid Soccer Robot". In 2013 he also became a PMI certified Project Management Professional. Through the years he nurtured transversal experience in various technology fields such as telecommunications (Ericsson), railway automation (Bombardier), aerospace and missile flight (MBDA). At the moment he is keen on ensuring the relevance of Public Service Broadcasting mixing innovation and audience trends.

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