Why Other Countries Have More FM Stations Than England, Scotland, Wales and Northern Ireland

Introduction

England, Scotland, Wales and Northern Ireland have relatively few FM stations compared to most other countries. For example, London has 14 city wide stations on FM; Birmingham and Glasgow have 11 large scale stations licensed; Manchester, Cardiff and Edinburgh have 10; while Leeds, Newcastle and Bristol have 9. By contrast, Paris has about 30 city wide stations (and another 20 with more limited coverage), Amsterdam has 23 and Berlin has about 25. Looking at smaller cities, Eindhoven and Frankfurt both have 13 FM stations. This article explores the reasons why and discusses options for FM in England, Scotland, Wales and Northern Ireland.

Universal Coverage Versus City Stations

The more radio stations with universal coverage a country has, the less spectrum is available for extra stations in the main cities. England, Scotland, Wales and Northern Ireland have 6 universal coverage services on FM: Radios 1 to 4, BBC local and regional radio and the first tier of independent local radio. Classic FM has near universal coverage. By contrast, France has 4 universal and one near- universal coverage services, the Netherlands has 5 universal coverage services and Germany has 4 or 5, depending on the state. Consequently, other countries have more space for city stations.

In the British Isles, more city stations could thus be accommodated by reducing the number of national services (e.g., making Radio 3 digital only). Each national service could be replaced by two or three stations in each major city at the cost of reducing the number of services receivable in smaller towns. Another option would be to limit the coverage of a national service (e.g., Classic FM), allocating some of its filler transmitters to other services.

Geography

England is a densely populated country, with major towns and cities close together. The number of stations in Birmingham affects the number of stations you can have in Coventry and Wolverhampton. The same applies with Manchester and Liverpool, Bristol and Cardiff, Leeds and Bradford and so on. In more sparsely populated countries, such as France and Spain, the main population centres are much further apart, enabling them to have more radio stations without interfering with their neighbours. The Netherlands is also a densely populated country, but has been able to take advantage of its biggest cities being near the coast; inland, there is less station choice.

For national stations, the geography of the British Isles is an advantage. Frequencies for high power (~100 kW) transmitters can only be re-used every 500 km or so. In mainland Europe, around 3.5 MHz is needed for a universal coverage network, whereas in the British Isles, it has been possible to accommodate the national networks in 2.2 MHz each, albeit with slightly poorer coverage, particularly in parts of southern England, compared to some other countries. This is because Great Britain is a long thin island, so there are much fewer distant signals coming from East and West. In the 1970s, England provided more choice in its 9.5 MHz FM band than most other European countries did in 12.5 MHz. For local radio, lower transmitter powers are used, so frequencies may be re-used at smaller intervals, reducing the advantage of the British Isles' shape. Thus 6 MHz is allocated to provide two universal coverage local radio services.

Planning Standards

England, Scotland, Wales and Northern Ireland have planned the FM band relatively conservatively. Consequently, there is very little interference to stations within their intended coverage area.

The required field strength to provide a good stereo signal is 54 dBµV/m in rural areas, 66 dBµV/m in suburban areas and 74 dBµV/m in city areas. For good mono reception, the required field strengths are 6 dB lower. However, most popular music stations use lots of dynamic range compression, providing a listenable signal at lower field strengths. However, for good reception, the signal must also be significantly stronger than other signals on the same and adjacent frequencies. The following margins are needed:

Co-channel: 45 dB
100 kHz separation: 33 dB
200 kHz separation: 7 dB
300 kHz separation: -7 dB
400 kHz separation: -20 dB

A negative value indicates that the interfering signal can be stronger. To meet these margins, transmitters on the same and adjacent channels must be some distance apart or heavily screened by hills. Stations 200 kHz apart of similar field strength may be receivable in the same location with different aerial positions. However, official coverage areas cannot overlap. If there are hills separating the two coverage areas, 200 kHz spacing can be used for adjacent stations; otherwise there must be a small buffer region. With stations 300 kHz apart, the margin is -7 dB, so it will always be possible to pick up one station or the other, but not always both. This spacing is suited to transmitters broadcasting the same programme to overlapping areas, provided the stonger signal is not subject to multipath interference. It can sometimes be used for different stations serving neighbouring areas, depending on the geography of the overlap region.

A 400 kHz spacing is always suitable for transmitters with overlapping coverage areas, whether they carry the same programme or not, provided reception of each station near the other's transmitter is not required. If both stations are transmitted from the same mast or nearby masts, a 400 kHz spacing is OK. For example, a local station on 97.5 in Nottingham would interfere with Radio 1 from Sutton Coldfield on 97.9, but the same frequency could be used from the Sutton Coldfield mast without disrupting Radio 1. However, if a network radio filler was introduced for Nottingham, it would then be possible to use 97.5 for local radio from the same mast as the network filler as reception of the 97.9 signal would no longer need to be protected.

The final issue to consider in planning FM transmitters is intermodulation products. There are two types: intermediate frequency and cross station. FM radios use a superheterodyne circuit to reduce the mean carrier frequency of the selected FM station down to 10.7 MHz prior to demodulation. As a consequence, intermodulation products within the receiver can prevent reception on a frequency 10.7 MHz below a strong local station. In practice, this only happens very close to the transmitter. In addition, radio receivers transmit a weak signal on a frequency 10.7 MHz higher than they are tuned to - you can demonstrate this yourself using a pair of radios. Consequently, stations serving the same area are never spaced 10.7 MHz apart in England, Scotland, Wales and Northern Ireland. 10.6 and 10.8 MHz spacings are usually avoided as well as cheaper receivers sometimes have off- centre intermediate frequencies, though 10.8 MHz spacing has been used in Bradford and Kettering. Very close to the transmitter or with a poor receiver, intermodulation products of stations on frequencies x and y can be received on frequencies $2x - y$ and $2y - x$, blocking out weaker stations on those frequencies. The use of regular station spacing reduces the impact of intermodulation products and a station covering the same area from a different mast can usually operate 100 kHz apart from a cross station intermodulation product.

Some other countries implement more relaxed planning standards, giving more choice of station in some places at the expense of poor reception in other places. For example, the outskirts of Paris is infamous for poor radio reception. In the Netherlands, when the number of commercial stations was increased in 2003, reception of some of the public stations in a number of major cities was disrupted, so extra filler transmitters had to be quickly installed.

England, Scotland, Wales and Northern Ireland could accommodate more FM services by reducing the planning margins and/or abandoning the 10.6/7/8 MHz separation constraint. However, this would be at the expense of reduced coverage for many transmitters. A major replanning exercise is also difficult because each frequency change has a knock-on effect on many other transmitters. It is particularly difficult to move high power transmitters because of the need to coordinate with neighbouring countries.

Sub-bands

England, Scotland, Wales and Northern Ireland (and to a lesser extent the Irish Republic) is unique in dividing the FM band into distinct sub-bands, each dedicated to a different radio service:

87.6-88.0: Temporary and very low power stations
88.1-90.2: Radio 2
90.3-92.4: Radio 3
92.5-94.6: Radio 4 and BBC regional radio
94.7-96.1: BBC local radio and Radio 4
96.2-97.6: Independent local radio
97.7-99.8: Radio 1
99.9-101.9: Classic FM and Independent local radio
102.0-103.4: Independent local radio
103.5-104.9: BBC local and regional radio and Radio 4
105.0-107.9: Independent local radio

With a handful of exceptions, every transmitter operates within the appropriate sub-band for the station it carries. This makes it easy to follow the national stations from transmitter to transmitter in a car without RDS, but has the disadvantage that spare frequencies can be left empty because they're in the wrong part of the band. As a consequence of this, many towns and cities have run out of space for local radio, while spare capacity remains in the national sub-bands. By placing BBC and independent local radio transmitters throughout the FM band, much more efficient use could be made of the spectrum available. Space is available in the national sub-bands in some parts of the country, but not others. However, by moving existing local radio transmitters to the national sub-bands where possible, the local sub-bands could be re-planned, making space available everywhere. In many cases, moving a local radio transmitter to the national sub- bands will increase incoming interference, particularly during temperature inversions when high powered FM transmitters carry much further due to tropospheric ducting. Because of this, lower power transmitters are more suitable for relocation because their powers can be increased to compensate without outgoing interference becoming a problem. In recent years, the use of frequencies throughout the FM band has made use of some of the spare capacity.

Synchronisation

Normally, a spacing of 200 kHz is too close to avoid interference. However, if the two transmitters carry the same programme and are time synchronised to within 25 μs, then both carriers will always be on the same side of the centre frequency, preventing the receiver being captured by the unwanted signal (the stereo difference signal is always of equal or less magnitude than the sum signal). Consequently, if the difference in the signal path to the two transmitters does not vary by more than 15 km over the area where they might otherwise interfere, they can be synchronised and operate at 200 kHz spacing. In the Netherlands, synchronisation technology has been used to enable transmitters carrying the same programme to broadcast on closer frequencies. This partly enabled a major expansion of national commercial radio in 2003.

Within England, Scotland, Wales and Northern Ireland, there is scope to move a number of low powered fillers to new frequencies 200 kHz away from the corresponding main transmitters, freeing up space. However, this will increase the transmission cost as a separate feed will be needed instead of simply using the main transmitter's FM signal to feed the relay.

It is also possible for two transmitters carrying the same programme to share the same frequency. However achieving contiguous coverage is challenging and requires each relay transmitter to be highly directional, pointing away from the main transmitter. This technology has been implemented in parts of the United States to enable filler transmitters to operate in areas where no spare frequencies are available.

More Stations

The best ways of increasing the number of FM stations in England, Scotland, Wales and Northern Ireland without adversely affecting reception of existing stations are relaxing the division of the FM band into sub-bands and implementing more synchronised transmitters. The other options could be considered once FM coverage reductions are considered acceptable for stations that are also available on DAB.

The possibility of replanning the FM band was considered by the Radio Authority and the Radiocommunications agency (both superseded by Ofcom) in the early 2000s. However, it was considered too expensive and the decision was made to focus on DAB instead.

Paul Groves 2004 (reformatted and revised 2015, 2016)