Telecom Regulatory Authority of India

Recommendations

on

"Prescribing Minimum Channel Spacing, within a License Service Area, in FM Radio Sector in India"

New Delhi: 19th April, 2012

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Preface

Radio broadcasting has been a primary medium for entertainment, information and education amongst the masses. To complement the Government's effort to expand radio coverage in the country, private participation was allowed in the FM radio sector in the 9th five year plan. Since then, 245 FM radio channels have come up in 86 cities including all the state capitals and cities having population of three lakhs and above, in various parts of the country, in two phases. Phase III expansion of FM Radio Broadcasting Services is to pave way for introduction of new channels in 294 cities having population of one lakh and above.

The minimum channel spacing i.e the frequency separation between the adjacent channels' carrier frequencies is an important parameter which determines faithful reception of individual channels at the listener's FM radio receiver set. Presently the minimum channel spacing is generally 800 KHz in the country. The Ministry of Information and Broadcasting had requested TRAI to reconsider the issue of minimum channel spacing within a license service area in the FM radio sector. On examination of the issue through a consultation process, the Authority has come to the conclusion that it is now technically feasible to reduce the minimum channel spacing to 400 KHz. This would also lead to effective utilisation of the radio spectrum.

It is hoped that these recommendations will facilitate greater consumer choice and better utilisation of natural resources, while spurring innovation and healthy competition in the industry, as well as its orderly growth.

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Introduction

I. Radio broadcasting has been the primary medium for entertainment, information and education amongst the masses in India largely owing to its wide coverage, terminal portability, low setup costs and affordability. Presently, radio coverage is available with amplitude modulation (AM) in Short Wave (SW), Medium Wave (MW) and Frequency Modulation (FM) in analogue mode in the FM band (88 to 108 MHz). The All India Radio (AIR), the public broadcaster, has a network comprising of 237 stations & 380 transmitters (149 MW, 54 SW & 177 FM), which provide radio coverage to 99.14 % of the population and reaches 91.79 % area of the country. However, the FM coverage is only 37% of the territory of India. In the digital radio transmission AIR is running a test transmission based on DRM (Digital Radio Mondiale)[1] technology since 2009, and during the 12th Five year plan AIR plans to commission DRM stations in 76 MW and 10 SW frequencies.

II. The policy objective of the Government for Radio in the 9th Five year plan was to improve the variety of content and technical quality of Radio. On the technology front the focus shifted from amplitude modulated (AM) transmissions to frequency modulated (FM) transmission as the latter has a much better performance in the presence of noise. Keeping in line with the policy of liberalization and reforms followed by the Government since 1991, the Government during the 9th Five year plan allowed Indian companies to setup private FM Radio stations and in May 2000, the Government auctioned 108 frequencies in the FM spectrum across 40 cities as part of the First phase of FM Radio expansion through private participation in India.

III. The results of the first phase of private FM radio expansion were not very encouraging as only about 25% of the expected licenses could become operational. Government received bids for 101 frequencies in Phase-I, out of which bidders paid money for only 37 frequencies and bidders in respect of 64 frequencies defaulted. Out of these 37 permissions, only 22 channels became operational, of which one channel closed down subsequently.

IV. The subsequent second phase of private FM Radio expansion has been well received by all the stakeholders. The scheme to rope in private broadcasters for FM radio has significantly contributed to the growth of FM radio and provision of good quality of reception to FM radio listeners, both in terms of content & listening experience, of

[1] DRM: Digital Radio Mondiale (DRM) is the universal, open standard digital broadcasting system for all broadcasting frequencies up to 174MHz, including LW, MW, SW, band I and II (FM band).

reception to FM radio listeners. It has also encouraged local talent and generated employment opportunities in various cities. Employment opportunities in this sector are thus no longer confined to Metros and handful of Class 'A' cities, but are also becoming available in other smaller cities. The Private FM Radio services have made rapid strides in the recent past, particularly since the launching of Phase-II. The cities with a population of three lakh and above besides the state capitals were taken up in the first two phases. The policy has been well received and presently, a total of 245 channels are operational, including 21 channels of Phase-I, in 86 cities.

V. With a view to further expand the spread of FM services to other cities particularly in J&K, North Eastern States and island territories and to address certain other issues, the Government, on 25th July 2011, issued consolidated policy guidelines on phase III of expansion of FM radio broadcasting through private agencies. The Phase-III is intended to extend FM radio's reach to 294 cities with additional 839 FM radio stations thereby boosting the regional growth of FM radio stations. It is expected that post Phase III, the FM radio will cover around 85% of the territory of the country.

VI. The policy for the phase III provides for 9 to 11 channels in A+ cities and 6 channels in class A cities, except for Bangalore and Hyderabad where 8 channels are provided. In case of B and C category cities, 4 channels are provided and for category D cities (and cities with population less than one lakh) 3 channels are provided. Apart from the minimum channel separation (channel spacing between adjacent channels within a city) the other factor that has been considered for determining the number of channel in a city is the viability of FM radio channels in a particular city depending upon its revenue potential for that city category.

VII. Some of the FM operators and their Associations, in their representations to the Ministry of Information & Broadcasting, have asked for the consideration of reduction in the minimum channel spacing within a license area and release of more frequencies, specially, for A+ and A category cities. The operators have mentioned that since 2008, when TRAI made its recommendations to the Government to maintain 800 KHz as the minimum channel spacing, significant technological developments have taken place making possible the release of additional frequencies for FM radio operations and thereby have the potential of generating additional revenue for the Government by efficient utilization of the earmarked spectrum for FM Radio operations. It has also been stated that increased availability of frequencies

would lead to rational bidding and would also help in providing a greater variety of music and other programmes to listeners thereby leading to enhanced growth of the radio sector.

VIII. The Ministry of Information and Broadcasting, vide DO No. 102/2/2008-FM(Vol. IV) dated 8th Aug. 2011(Annexure I), made a reference to TRAI with a request to reconsider its earlier recommendations concerning the minimum channel spacing keeping in view the demand of the FM radio operators, the technological developments and viability of FM radio operations in a city category. In their reference, the Ministry of Information & Broadcasting have stated that except for the A+ category cities, it may be possible to release some additional frequencies even without reducing the minimum separation between the channel frequencies, but in A+ cities release of additional frequencies may not be possible unless the minimum separation between the channel frequencies in not reduced from the present level of 800 KHz.

IX. Accordingly, TRAI, on 8th Dec 2011, issued a consultation paper on "Issues related to prescribing minimum Channel spacing, within a license service area, in FM Radio sector in India". Subsequently, an open house discussion (OHD) was also held at Delhi on 19th January 2012.

X. After considering the stakeholders comments, analysis of the issues and taking into account the international practice, TRAI issues these recommendations for the consideration of the Government.

XI. The first chapter discusses the technical aspects pertaining to the minimum channel spacing within the radio channels operating in a particular license service area. The issues raised in the consultation paper, comments of the stakeholders thereupon & analysis of the same followed by the recommendations of TRAI have been compiled in the second chapter. The third chapter provides the summary of the recommendations.

Chapter-1

Background

1.1 The Ministry of Information and Broadcasting, in its reference dated 8th Aug. 2011(Annexure I), has requested TRAI to reconsider its earlier recommendations concerning the minimum channel spacing, keeping in view the demand of the FM radio operators, the technological developments and viability of FM radio operations in a city category.

1.2 The FM radio transmission service is analogue in nature. Each FM radio channel, operating at a specified frequency, requires a separate transmitter. However, if these transmitters are co-located then the output of these transmitters can be clubbed through a combiner and fed to a single transmitting antenna system. Irrespective of whether the individual transmitters are co-located or not, the channels so radiated from these transmitters can be received, within the coverage area, by the FM radio receiver sets of the listeners. A listener's FM receiver set separates out the individual channels by frequency tuning to the specified channel frequency.

1.3 The minimum channel spacing i.e. the frequency separation between the adjacent channels' carrier frequencies is an important parameter which determines faithful reception of individual channels at the listener's FM radio receiver set. In a given license service area, if the minimum channel spacing between the channels is reduced, the transmitting setups at the transmitter end may require certain modifications with cost implications besides the fact that the consumer receivers should have the requisite selectivity to faithfully receive the closely spaced channels. If the channel spacing is made too large, it limits the number of channels that can be operated in a given license service area. Thus, these two aspects are required to be balanced out for the optimum utilization of the radio spectrum on the one hand and ensure faithful reception of FM channels on the other hand. The minimum channel spacing, within a license service area, in FM Radio broadcasting depends on various technical factors like ERP (Effective Radiated Power), quality and level of port-to-port isolation of combiners, channel selectivity of FM receivers, location of Transmitters etc. Presently, the minimum channel spacing in the FM radio sector, within a license service area, in the

country is generally 800 KHz, whereas the channel spacing between adjacent service areas is kept as 400 KHz.

1.4 There is a limit beyond which channel spacing cannot be reduced. There are several factors that limit the minimum channel spacing for effective transmission/reception of FM radio channels. The important factors are described below:

At the transmitter end

1.5 If collocated and a combiner is used, the ability of the combiner to combine two (or more) channels without causing interference to any of the individual channels plays an important role at the transmitting end, for interference free transmission. The relevant combiner characteristics in this regard are frequency response[2], insertion loss[3], group delay[4], port-to-port isolation[5] etc.

At the receiver end

1.6 The ability of the consumer's receiver set to separate out an individual channel from received signal(s) consisting of several channels radiated from one or more transmitters is important for faithful reception. The selectivity[6] of the radio receiver determines the capability of the receiver to faithfully separate out different channels received from one or more transmitters.

Location of the Transmitters (i.e. whether co-located or located at a distance apart)

[2] Frequency response: A graph of frequency response with signal amplitude or gain plotted against frequency

[3] Insertion Loss: The change in load power due to the insertion of a particular device into a transmission system. A well-designed power splitter will offer high isolation, low insertion loss and good VSWR.

[4] Group delay is a measure of phase distortion. Group delay is the actual transit time of a signal through a device under test as a function of frequency. When specifying group delay, it is important to specify the aperture used for the measurement.

[5] Isolation: A unit of measure (in dB) that states the separation of signal levels on adjacent ports of a device. The greater the isolation value, lesser the interference from a signal on one port is present at the other port.

[6] Selectivity of a receiver is its ability to receive the wanted signal and reject unwanted signals in adjacent channels. Selectivity is a measure of the performance of a radio receiver to respond only to the radio signal it is tuned to (such as a radio station) and reject other signals nearby in frequency, such as another broadcast on an adjacent channel.

1.7 In case of co-located transmitters the propagation path for all the channels is same and they attenuate similarly making it possible to maintain nearly constant wanted to unwanted signal ratio in the service area thus avoiding creation of interference zone around individual towers which may so happen in case the transmitting sites are at different locations. Thus, co-location of transmitters allows lesser minimum channel spacing as compared to the case when the transmitters are placed at different locations.

1.8 In case all the transmitters in a license service area are not co-located, the attenuation patterns of the signals from different transmitters will vary from place to place within the coverage area. Therefore it may be possible that at several points in coverage area, interference is above acceptable limits. Keeping in view the above and other facts like early roll-out, efficient use of infrastructure and demographical requirements etc, the Authority, in its recommendation dated 11th August 2004 for the phase II expansion of private FM radio, had recommended mandatory co-location of transmitters. While recommending, it was also observed that-–"In metro and large cities (category A cities of phase I) demand of large number of channels can be met by reducing the carrier separation (say from 800 KHz to 400 KHz)." However, no specific channel spacing was recommended by the Authority. Thereafter again in its recommendation dated 24th February 2008 for the Phase III of FM radio broadcasting, TRAI had recommended to mandate all successful bidders to co-locate the transmitters and the same is also reflected in the FM Phase III Consolidated Policy Guidelines dated 24th July 2011.

RF protection Ratio

1.9 The RF Protection ratio is an important parameter to determine likelihood of interference in any particular area. The Radio-Frequency (RF) protection ratio is defined as the minimum value of wanted to unwanted signal ratio, usually expressed in dB at the receiver input, determined under specified conditions so that a specific reception quality of the wanted signal is received. If the carrier frequency spacing is high, the RF protection ratio requirement is less stringent. ITU, in its recommendations "Planning Standards for terrestrial FM sound broadcasting at VHF", (ITU-R BS 412-9), has prescribed RF protection ratios for different carrier frequency spacings, which are reproduced in Table 1.1 below:

Carrier frequency spacing (kHz)	Radio-frequency protection ratio (dB) using a maximum frequency deviation of ± 75 kHz			
	Monophonic		Stereophonic	
	Steady interference	Tropospheric interference	Steady interference	Tropospheric interference
0	36.0	28.0	45.0	37.0
25	31.0	27.0	51.0	43.0
50	24.0	22.0	51.0	43.0
75	16.0	16.0	45.0	37.0
100	12.0	12.0	33.0	25.0
125	9.5	9.5	24.5	18.0
150	8.0	8.0	18.0	14.0
175	7.0	7.0	11.0	10.0
200	6.0	6.0	7.0	7.0
225	4.5	4.5	4.5	4.5
250	2.0	2.0	2.0	2.0
275	–2.0	–2.0	–2.0	–2.0
300	–7.0	–7.0	–7.0	–7.0
325	–11.5	–11.5	–11.5	–11.5
350	–15.0	–15.0	–15.0	–15.0
375	–17.5	–17.5	–17.5	–17.5
400	–20.0	–20.0	–20.0	–20.0

Table 1.1: RF Protection Ratio as defined by ITU-R

1.10 The RF protection ratio values in the Table-1 are given for steady and tropospheric interferences[7] respectively. The prescribed protection ratio for steady interference provides for approximately 50 dB signal-to-noise ratio. The prescribed protection ratio for tropospheric interference corresponds closely to a slightly annoying impairment condition and it is considered acceptable only if the interference occurs for a small percentage of the time, not precisely defined but generally considered to be between 1% and 10%. It may also be seen from the table that the protection ratio required for monophonic signals are much lower than that required for stereophonic signals when the frequency separation between the wanted and interfering signal is small.

1.11 The RF protection ratio curves (Figure 1.1) were originally determined by subjective evaluation of interference effects. As subjective tests are rather time

[7] Whether interference is steady or tropospheric is defined by ITU, through the concept of the 'nuisance field' wherein nuisance field is defined as the field strength of the interfering transmitter exceeding the relevant protection ratio. If field strength of the nuisance field exceeds the normalized ERP (normalized to 1 KW) of the interfering transmitter by a margin of protection ratio for more than 50% of times, it is known as **steady interference**. If it exceeds only within 1 – 10% of times, it is generally termed as **tropospheric interference**. However at the VHF/FM conference, Geneva 1984, times exceeding 1% was chosen for considering it as tropospheric interference.

consuming, an objective measurement method was developed and found to yield results which are in fair agreement with those to the subjective tests.

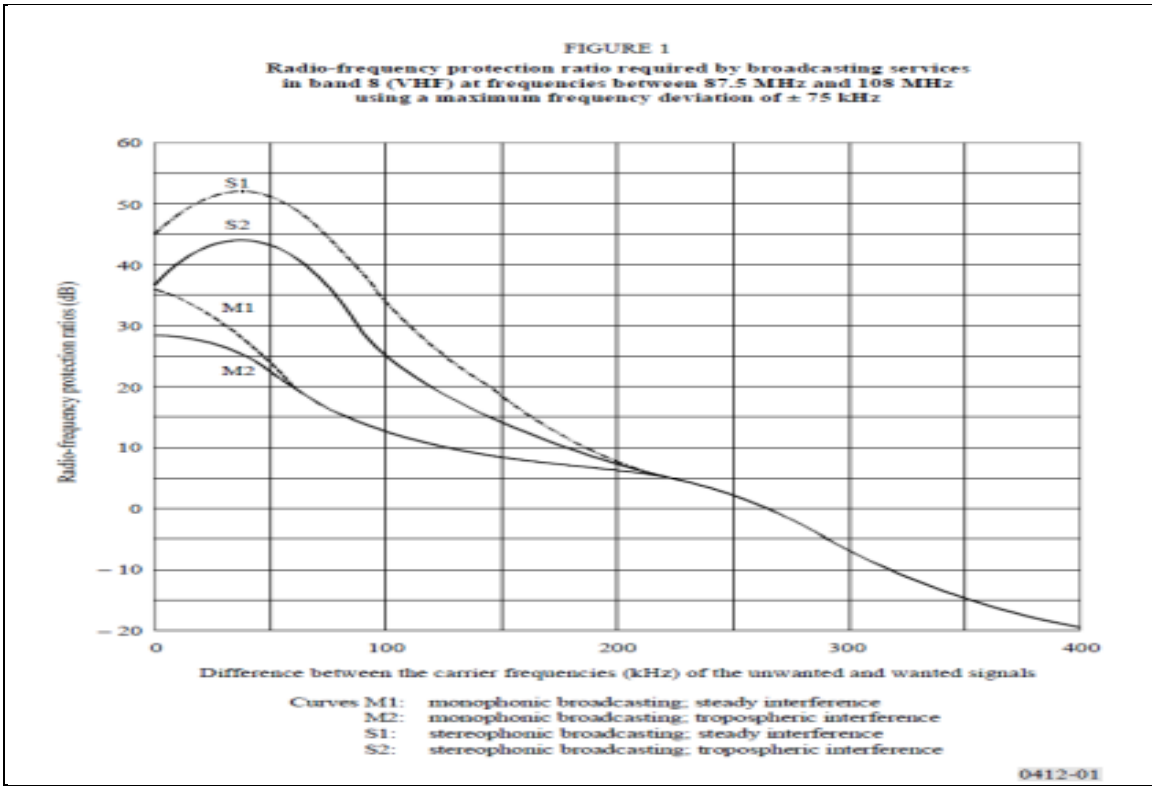

Figure- 1.1 : RF Protection Ratio Graphs

1.12 The reference of the Ministry of Information and Broadcasting encloses inputs from some of the existing FM operators, proposing a reduction in the minimum channel spacing from existing 800 KHz to 400 KHz in the category A+ and A cities so as to enable more number of channels in such cities and efficient utilization of the earmarked spectrum for FM Radio operations and would also lead to generation of additional revenues for the Government. It has been further stated that increased availability of frequencies would lead to rational bidding and would also help in providing a greater variety of music and other programmes to listeners thereby leading to enhanced growth of the FM radio sector.

Proposal of FM operators

1.13 Regarding the limitation of receiver selectivity, the operators have stated that with time, the technology has improved and commercial radio sets of improved quality are now available in the markets and also the penetration of digital receivers, having better selectivity properties, has improved among the masses, addressing largely the issue of receiver capability for reception of channels with reduced channel spacing. On the premise that the selectivity of the receivers would no longer pose a challenge for faithful reception of closely spaced channels, two solutions have been suggested by the operators (Ref Appendix 2 to Annexure I) to achieve the objective of more channels in an license service area:

i. In the first solution it has been proposed that the existing combiners should be replaced by combiners which are capable of combining closely spaced (400 KHz) channels. However, it has also been pointed out that apart from the fact that such combiners would cost substantially more, replacement of the existing antenna and feeder system would also be required to match up with the higher power handling capability requirement due to more number of transmitters being combined for which expenditure would have to be incurred. Moreover, as the new broadcasters would be the real beneficiaries this solution, it would be objected to by the existing operators as they would not be gaining directly by allowing in more broadcasters. It has been suggested that in case this solution is adopted, the new broadcasters should share the cost for the replacement of combiners, antenna and feeder system and in this regard the terms and conditions of the tender can be suitably prescribed so that the new broadcasters could factor the cost into their business plans and bid accordingly. Alternatively, the Government could decide to pick up the costs since it would also be a big beneficiary of the additional spectrum created.

ii. The second solution suggested by the operators requires a separate common transmission infrastructure (CTI) which includes transmitting tower, combiners, feeder cable, transmitting antenna etc. There would be two CTIs, one existing and another new one. The combiner designed for combining 800 KHz spaced channels could be used as the minimum channel separation within a CTI would remain 800 KHz. However, suitably choosing the new channel frequencies (having channel separation of 800 KHz) in between the existing channel frequencies radiated from the existing CTI (also having channel separation of 800 KHz), would result into a transmission setup with channels

being radiated effectively spaced at 400 KHz for the license area for which these two CTIs are meant. For example if the channels radiated from existing CTI are 100, 100.8, 101.6 and 102.4 MHz then from new CTI the channels could be placed at 100.4, 101.2, 102.0 and 102.8 MHz's. This solution entails identifying a new and suitable tower location and building a new tower there, which would be a fairly expensive proposition, however, if it is built into the tender terms for new bidders, they could factor the cost into their business plans and bid accordingly.

International Scenario

1.14 The study of some of the major international market with respect to the minimum channel spacing of FM radio channel in a service area reveals the following:

In UK, in general, services are planned to a general rule which states that services within the same coverage area from the same site should have 400 kHz separation. There are two transmission sites which are close together (less than 2km) which, have services installed which are separated by only 4 channels (i.e. 400KHz). These transmission sites are being treated as co-sited. In Singapore, all FM broadcasts are carried out on a nationwide basis. The channel spacing's typical range is 400 KHz to 800 KHz. In the late 1980s in USA, the FCC switched to a band-plan based on a distance separation table using currently operating stations. Depending upon the transmitter powers and antenna heights, eight different classes of FM stations, viz. A, B1, B, C3, C2, C1, C0 and C, have been made. Rule 73.211 of FCC Code of Federal Regulation mentions the minimum and maximum ERP for each class of FM station. The Table 1.2 below depicts the relationship between the class of FM station and the maximum ERP[8] (in Kilowatt)/ HAAT[9] (in meters). As of late 2004, a station can be "squeezed in" anywhere as long as the location and class conform to the rules in the FCC separation table.

[8] ERP : The ERP is the product of the transmitter output power, the transmission line (and combiner) efficiency and the power gain of the antenna relative to a half-wave dipole.

[9] EHHAT/HAAT : The effective height of the antenna above average terrain (EHAAT) is the average of the antenna heights above the average terrain (HAATs) for eight radials spaced every 45 degrees of azimuth starting with true north. The height of the antenna above average terrain (HAAT) is the height of the centre of radiation of the antenna above the average elevation of the terrain between 3 to 16 km from the antenna for each radial.

FM Station Class	Reference(Maximum) facilities for station class ERP (in KW) / HAAT (in meters)
CLASS A	6.0 KW/ 100 meters
CLASS B1	25.0 KW/ 100 meters
CLASS B	50.0 KW/ 150 meters
CLASS C3	25.0 KW/ 100 meters
CLASS C2	50.0 KW/ 150 meters
CLASS C1	100.0 KW/ 299 meters
CLASS C0	100.0 KW/ 450 meters
CLASS C	100.0 KW/ 600 meters

Table 1.2 – Maximum ERP/HAAT for each class of FM station (Rule 73.211 of FCC code of Federal Regulation)

The Table 1.3 below as prescribed by FCC under section 73.207 of the FCC code, depicts the relation between channel spacing and the minimum distance between any two FM transmitters.

Relation	Co-Channel (Same Frequency)	200 KHz (First-Adjacent Channel)	400 or 600 KHz (Second- or Third-Adjacent Channel)
A to A	115	72	31
A to B1	143	96	48
A to B	178	113	69
A to C3	142	89	42
A to C2	166	106	55
A to C1	200	133	75
A to C0	215	152	86
A to C	226	165	95
B1 to B1	175	114	50
B1 to B	211	145	71
B1 to C3	175	114	50
B1 to C2	200	134	56
B1 to C1	233	161	77
B1 to C0	248	180	87
B1 to C	259	193	105
B to B	241	169	74
B to C3	211	145	71
B to C2	241	169	74
B to C1	270	195	79
B to C0	272	214	89
B to C	274	217	105

C3 to C3	153	99	43
C3 to C2	177	117	56
C3 to C1	211	144	76
C3 to C0	226	163	87
C3 to C	237	176	96
C2 to C2	190	130	58
C2 to C1	224	158	79
C2 to C0	239	176	89
C2 to C	249	188	105
C1 to C1	245	177	82
C1 to C0	259	196	94
C1 to C	270	209	105
C0 to C0	270	207	96
C0 to C	281	220	105
C to C	290	241	105

Table 1.3 : Minimum Distance Separation Requirements in Kilometers (FCC Regulation , Section 73.207)

Similar is the case of Canada. Depending upon the ERP and associated EHAAT values, different FM classes[10] have been defined. Factored upon the channel separation, the table 1.4 below depicts the minimum distance between the FM transmitters of varying transmitting powers.

Class A1	**Co-channel**	78					
	200 kHz	45					
	400 kHz	22					
Class A	**Co-channel**	131	151				
	200 kHz	78	97				
	400 kHz	42	47				
Class B1	**Co-channel**	164	184	197			
	200 kHz	98	118	131			
	400 kHz	55	60	63			
Class B	**Co-channel**	189	209	222	236		
	200 kHz	117	137	150	164		
	400 kHz	68	73	77	84		
Class C1	**Co-channel**	223	243	256	270	291	
	200 kHz	148	168	181	195	216	
	400 kHz	90	95	99	106	119	
Class C	**Co-channel**	238	258	271	285	306	317
	200 kHz	166	186	199	213	234	245
	400 kHz	101	106	110	117	131	139
	Relationship	**Class A1**	**Class A**	**Class B1**	**Class B**	**Class C1**	**Class C**

Table 1.4 : Table of Minimum Domestic Separation Distances (km)

1.15 A propos the above, consultation issues were posed for comments of the stakeholders. In Chapter 2, the comments of the stakeholders have been examined and the recommendations have been framed.

[10] FM Classes:
Class A1: a maximum ERP or 250 W with an EHAAT of 100 metres.
Class A: a maximum ERP or 6 KW with an EHAAT of 100 metres.
Class B1: a maximum ERP or 25 KW with an EHAAT of 100 metres.
Class B: a maximum ERP or 50 KW with an EHAAT of 150 metres.
Class C1: a maximum ERP or 100 KW with an EHAAT of 300 metres.
Class C: a maximum ERP or 100 KW with an EHAAT of 600 metres.

Chapter-II

Issues under Reference: Analysis and Recommendations

2.1. The issues raised in the consultation paper dated 8th December 2011, the views of the stakeholders thereon, the analysis of the issues and the recommendation of the Authority are elaborated in the subsequent paragraphs.

2.2. There are basically three aspects that need to be analysed for deciding the issue of reduction in channel spacing in the FM radio sector. These may be categorized into –a) technical aspects & implementation aspects., b) commercial aspects

Technical & implementation aspects

Comments of the stakeholders

2.3. As far as technical feasibility of reduction in channel spacing is concerned, the operators have aligned their views in line with their demand for or against the idea of reduction in channel spacing. Those who are against the idea of reduction in channel spacing, suggest that around 15-20% listeners still have low-end analogue receivers which may not be capable of receiving the channels faithfully if the channel spacing is less than 800 KHz. Whereas those who are in favour of reduction in channel spacing have referred to the RAM survey (extracts at Annexure II) which indicate that a large majority of consumers tune in FM radio on digital devices such as mobile sets, digital car radio etc which are capable of receiving FM channels operating with channel spacings of 400 KHz or less. Example of Vadodara has also been cited by one of the operators where two channels are already operating with a channel spacing of 400 KHz from a co-sited transmitter setup, though radiated through different antennae.

2.4. It has been suggested by some of the operators as well as by BECIL that before deciding on the issue of reduction in channel spacing it would be prudent to undertake a reception survey with a variety of receivers available with the consumers/available in the markets.

Analysis

2.5. If the minimum channel spacing within a license service area is reduced, the issue of providing necessary isolation between the two adjacent channels, both at the transmitter and receiver end, would be required to be looked into. Also, as the channel spacing is reduced to maintain desired isolation, the transmitting set

may require modifications with cost implications besides the fact that the consumer receiver should have the requisite selectivity to be capable of faithfully receiving the closely spaced channels. However, with time, receiver technology has improved in terms of selectivity of commercial radio receivers and the penetration of digital receivers among the masses has also improved, addressing largely the issue of receiver capability for reception of channels with reduced channel spacing. One of the findings of the survey report - 'Radio Establishment Survey- Universe Update 2011', published by TAM, which is based on a survey/study conducted in June-Aug. 2010 with a sample size of 3000 in each of the Radio Audience Measurement cities (RAM cities: Delhi, Kolkata, Bangalore and Mumbai) also suggests that as compared to the year 2007, in the year 2011 the mobile phone ownership among the FM owners has significantly increased whereas other radio devices like radio sets, 2-in-1, Hi-Fi music systems etc. have witnessed a fall.

2.6. As far as transmission set up is concerned, alternative solutions are available which makes it feasible to air multiple channels with reduced channel spacing of 400 KHz. In one such scheme as suggested by the FM operators in their proposal to Ministry of Information and broadcasting(Appendix 2 to Annexure I), the combining system is broken into two sets, each using a separate combiner, designed for combining 800 KHz spaced channels. The channel frequencies are chosen such that within each set, the channels are spaced at 800 KHz, however, these channels are effectively spaced at 400 KHz when both the sets are put together. Each of the combiners then feed a separate antenna mounted on the same tower on two different apertures of the tower. The figure 2.1 below illustrates this arrangement.

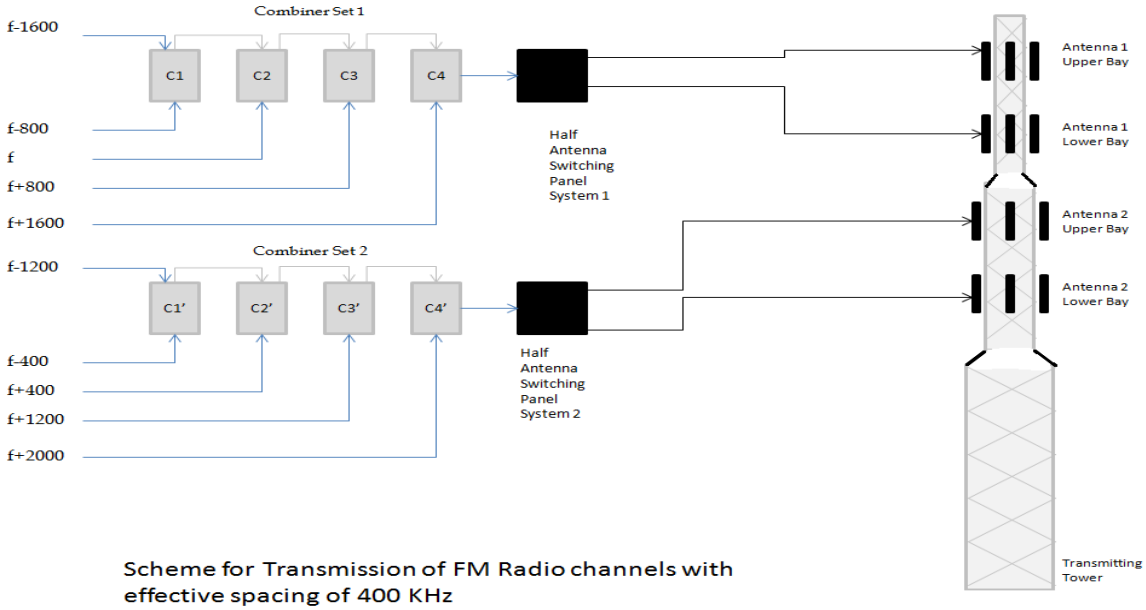

Figure 2.1- Scheme for transmission of FM radio channels with effective spacing of 400 KHz.

The other solution suggested by the FM operators calls for replacement of the existing combiners with new combiners, capable of combining channels spaced at 400 KHz. However, the cost/ availability of such combiners may be an issue.

2.7. In order to achieve FM radio operations with effective channel spacing of 400 KHz, in a license service area, the exact frequency allocation would be required to be planned and coordinated by the Ministry of Information & Broadcasting in consultation Wireless Planning and Coordination Wing (WPC). Special care would also be required for allocating the exact frequencies, taking into account the frequencies already allocated in the adjoining areas, so that requisite parameters like protection ratios for steady and tropospheric interference, criteria for repetition of frequencies etc are accounted for.

2.8. The FM transmitting site at Vadodara, operating at a channel spacing of 400 KHz, was also visited by the officials of TRAI and no interference issues were observed. The FM radio receivers, both with analog and digital tuning, were used with price ranging from Rs. 80 to Rs. 550. A low end mobile phone costing Rs. 800 was also used.

Commercial aspects

Comments of the stakeholders

2.9. The operators have quite divergent views on the commercial aspects and the viability of FM operations in the scenario where the minimum channel spacing is reduced to 400 KHz and new channels are introduced in the existing markets.

2.10. The arguments of the operators who are against the idea of reduction in channel spacing are:

i. As most of the channels are still operating with losses, introduction of new channels by way of reduction in channel spacing, would further fragment the market and thus push such channels into deep losses and ultimately make them unviable.

ii. Reduction in channel spacing would lead to change in the frequency allocation to the existing operators requiring them to rebrand their services which are unnecessary burden to them as establishing a rebranded service is a costly and time consuming process.

iii. The phase II operators planned their business model and priced their bids according to a limited number of competing channels and 10 year license period. In case the channel spacing is reduced for phase III operators then in the middle of their business cycle the existing operators would be further competing with new channels that have acquired license at a presumably lower price, have longer license period (15 years), have no

loss burden and so would have better investors' confidence. This will jeopardize the viability of the existing operators.

2.11. The arguments of the operators who are in favour of reduction in channel spacing are:

i. In the phase III policy a single entity can have more than one channel in a license area & the cost of making an incremental channel operational being substantially low the viability of additional channels would be much better. Introduction of more channels in the A+ and A cities would allow the operators to offer a variety of content which will not only be a favour to the listeners but would also result in increase in the penetration of FM radio in different markets and would result in growth of the advertisement revenue, the only source of revenue for the FM industry.

ii. With more number of channels, though the market fragmentation does take place but at the same time the size of the market also expands. Experience of the radio industry in India as well as abroad suggests that the radio sector has grown when the channels in a license area have been increased.

iii. The competition of radio channels is not amongst the radio channels but from the internet where a large number of channels, both Indian and foreign, are available to the consumers offering a wide variety of content. More radio channels having rich variety of content can only survive the radio industry. The reduction in channel spacing can enable introduction of more channels.

iv. Unless more channels are allowed, by way of reduction in channel spacing, the auction for channels in phase III would not be rational and likely to result in unrealistically very high channel prices. Since highest price obtained in the auction/bidding process is generally taken as the reference price for the future auction/bidding process, this will have perpetual aberration effect.

Analysis

2.12. Some of the stakeholders have raised the issue of commercial viability of additional channels being released by way of reduction in the minimum channel spacing, in case of A+ and A category cities. Before further analyzing the issue it may be prudent to examine the FM radio market.

2.13. As per the FICCI-KPMG India Media and Entertainment Industry Report 2011, the radio industry grew from Rs. 700 Cr. in the year 2007 to Rs. 1000 Cr in the year 2010 with a CAGR of 11%. The industry is expected to grow at 20% CAGR till 2015. In the year 2010, the radio industry registered a growth of around 24%. Growth was driven by both metros and non-metros markets. The average

growth rate for the larger, established players like Radio Mirchi, Big FM, and Radio city was in the range of 15-20%. For others like Fever FM, Red FM, Radio One and MY FM, the average growth rate was in the range of 45-50%. It is stated in the report that the industry showed a significant improvement in profitability during the year 2010. Profit margins (PBIT) improved by 5-15 % for the established players and 25-30% for the smaller players. A significant increase in revenues, on a largely fixed cost base was one of the major drivers for the profit improvement.

2.14. The FICCI-KPMG report 2010 also indicates that the share of local advertisements in the total advertisement revenue has increased from 20% in the year 2007 to 40% in the year 2009. With improved penetration and increase in number of channels, the local advertisers will be more attracted towards FM radio as an affordable source of advertisement. This will lead to increase in overall revenue of FM players.

2.15. As per PwC Report "India Entertainment and Media Outlook 2011", not only the advertisement revenue of the radio sector is improving, the share of radio advertisement in the overall advertisement kitty is also improving. The table 2.1 below clearly shows that the advertisement revenue share of Radio sector in the overall advertisement revenue has increased from 3.1% in the year 2006 to 4.4% in the year 2010. There is enough scope for further growth as globally, radio accounts for 10 to 12% of the total entertainment and media advertising pie, while the similar figure in India is still less than five per cent.

	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010
Radio Advertisement Revenue (in Cr.)	500	690	830	900	1080
Radio's share in advertisement pie of Media and Entertainment Industry	3.1%	3.6%	3.8%	4.2%	4.4%

Table 2.1 - Advertisement revenue share of Radio sector in the overall advertisement revenue

(Source: PwC Report "India Entertainment and Media Outlook 2011")

2.16. TAM in its survey report-'Radio Establishment Survey- Universe Update 2011', showed a significant increase in FM penetration in the four RAM markets, from 59% in 2007 to 77% in 2011. Penetration significantly increased in Mumbai, Delhi and Bangalore while Kolkata remained flat. These points show a potential for increase in FM Radio penetration, over the time, in other cities as well.

2.17. It may be pertinent to note here that the Government, in its phase III policy, has notified the number of frequencies, city wise, that are proposed to be allocated in the phase III auctions. Barring a few A+ cities, as also mentioned in MIB reference dated 8th Aug. 2011, all the other cities have a cushion to put up more frequencies for auction even without reducing the channel spacing. Perhaps a conscious decision has been taken by the Government to put up a particular number of frequencies for auction, taking into consideration the viability of FM operations in these cities. Therefore, these frequencies that would be put up for auction, need not have any impact on the viability of the FM business, whether these frequencies are released at a minimum channel spacing of 400 KHz or 800 KHz[11]. Thus, the issue of minimum channel spacing may not be linked to the viability as the minimum channel spacing and the number of frequencies to be put up for auction may be two different delinked decisions. Rather allocating the channels with minimum channel spacing of 400 KHz would lead to efficient utilization of the scarce resource of spectrum and, depending upon the viability of introduction of more channels in a city, appropriate number of frequencies can be put to use for FM operations at suitable points of time.

2.18. One of the operators was apprehensive that the reduction in channel spacing would mean complete reallocation of frequencies. This would lead to rebranding which would not only be resulting into financial burden to the operators but would also be inconvenient to both the operators and the consumers. Reduction in channel spacing from 800 to 400 KHz is not likely to lead to such a situation. However, if need be, on case to case basis, the Government may take precaution, while allocating frequencies with channel spacing of 400 KHz, to allocate only those additional frequencies which do not require any such reallocation of the frequency of the existing FM operators.

[11] In phase III, upto two additional channels are being introduced in 67 cities including three A+ and nine A category cities. So, irrespective of reduction in channel spacing, additional channels are planned to come in the existing markets.

2.19. **A propos the above, the Authority recommends the following:**

I. The frequencies for FM Radio channels, within a license service area, may be released with a minimum spacing of 400 KHz.

II. The FM channels operating with channel spacing of 400 KHz should be radiated from effectively co-located sites and transmitted with equal power. The co-location of transmitters has already been recommended by TRAI in its earlier recommendations pertaining to expansion of FM radio broadcasting through private participation.

III. The exact allocation of frequencies may be done taking into account the frequencies and power of the existing set-ups/ allocated frequencies in the adjacent license service areas so that the criteria for the re-use of the frequencies are satisfied. All the future planning of allocation of frequencies and development of the infrastructure should be done accordingly.

Chapter III

Summary of Recommendations

3.1. **The frequencies for FM Radio channels, within a license service area, may be released with a minimum spacing of 400 KHz.**

3.2. **The FM channels operating with channel spacing of 400 KHz should be radiated from effectively co-located sites and transmitted with equal power. The co-location of transmitters has already been recommended by TRAI in its earlier recommendations pertaining to expansion of FM radio broadcasting through private participation.**

3.3. **The exact allocation of frequencies may be done taking into account the frequencies and power of the existing set-ups/ allocated frequencies in the adjacent license service areas so that the criteria for the re-use of the frequencies are satisfied. All the future planning of allocation of frequencies and development of the infrastructure should be done accordingly.**

GLOSSARY

S. No.	Abbreviation	Description
1.	BECIL	Broadcast Engineering Consultants India Ltd
2.	CTI	Common Transmission Infrastructure
3.	EHAAT	Effective Height of Antenna above Average Terrain
4.	ERP	Effective Radiated Power
5.	FCC	Federal Communications Commission
6.	ITU-R	International Telecommunication Union-Radio
7.	LPFM	Low Power FM radio
8.	LTI	Land and Transmission Infrastructure
9.	Ofcom	Office of Communications
10.	OTEF	One Time Entry Fee
11.	RF	Radio Frequency
12.	UHF	Ultra High Frequency
13.	VHF	Very High Frequency

Annexure I

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सत्यमेव जयते

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GOVERNMENT OF INDIA
MINISTRY OF INFORMATION & BROADCASTING
NEW DELHI-110115

D.O.No. 102/2/2008-FM(Vol.IV)

8th August, 2011

Dear Dr. Sarma,

As you might be aware, the Cabinet has recently approved policy guidelines for expansion of FM Radio Broadcasting services through private agencies (Phase-III). A copy of these guidelines is being enclosed for reference. FM Phase-III policy extends FM radio services to about 227 new cities in addition to present 86 cities, with a total of 839 new FM radio channels in 294 cities.

2. The FM Phase III Policy is primarily based on the recommendations of TRAI made in 2008. TRAI in its recommendations had examined the issue of co-channel spacing and had recommended that the same may be kept at 800 khz within a district and should not be reduced any further. While making such recommendations, TRAI had *inter alia* taken into account various technical factors including transmitter power, quality and level of port to port isolation at combiners, channels selectivity of FM receivers etc.

3. The FM Radio Policy provides for 9 channels in A+ category cities and 6 channels generally in category A cities except for Bangalore and Hyderabad where total number of channels has been kept at 8. In B & C category cities, the total number of channels proposed is 4, and in D category cities the total number of channels proposed is 3. Apart from the co- channel spacing, one of the factors that was considered in finalizing the total number of channels in a city category has also been the viability of operations of FM radio channels considering revenue potential of that city category.

4. The Ministry is in receipt of a number of representations from the FM Radio industry wherein it has been demanded that co-channel spacing be reduced and additional frequencies released especially in A+ and A category cities. The arguments being given are that since 2008 significant technological developments have taken place making possible the release of additional frequencies for FM radio operations and thereby have the potential of generating additional revenue for the Government by efficient utilization of the ear-marked spectrum for FM Radio operations. It has also been suggested that increased availability of frequencies will lead to rational bidding and will also help in providing a greater variety of music and other programmes to listeners thereby leading to enhanced growth of radio sector.

.....2/-

5. In this context, it is also pertinent that while in A category cities it may be possible to release some additional frequencies even without reducing the co-channel spacing, but in A+ cities release of additional frequencies will not be possible unless the co-channel spacing is reduced.

6. Keeping in view the demand of the FM radio operators, the technological developments and viability of the FM operations in a city category, TRAI is requested to reconsider the issue of reduction in co-channel spacing and release of additional frequencies in A+ and A category cities. Some of the inputs given by FM radio operators on technological developments are being enclosed for reference. TRAI is requested to give its recommendations as per Section 11(1)(a)(viii) of TRAI Act, 1997.

With kind regards,

Yours sincerely,

(Raghu Menon)

Dr. J.S. Sarma,
Chairman,
The Telecom Regulatory Authority of India,
Mahanagar Doorsanchar Bhawan,
Jawaharlal Nehru Marg,
Old Minto Road
New Delhi 110 002.

Encl :a/a

Appendix 1

Why we believe that TRAI's 2008 recommendations are outdated

May we first point out the obvious: That in spite of our tremendous economic success, India is today the most backward nation when it comes to the availability of FM channels in our cities. Almost any global city (New York, London etc) today boasts of as many as 50-75 FM channels each. Even **Colombo has 25 channels on offer.** These are cities with lower population than most Indian metros. How then can the major cities in India not have at least 25 channels?

If the reasons are technical, then there are solutions readily available.

TRAI, in its 2008 recommendations, has raised certain objections with reducing the separation between two FM channels to 400 Khz. Some of these are:

1. Port-to-port isolation of minimum 50 db required in the combiner:

This is a valid observation made by TRAI even though my experts tell me that the isolation required is 35 db and that is what the current combiner at the transmitter location has as its specification. Whether it is 50 db or 35 db is immaterial; the point raised, is that this is the minimum isolation required in the combiner. If more channels were mounted on the existing combiner, it would lead to unwanted mixing of channels and consequently an unpleasant listening experience. This is indeed true.

Solutions:

There are two solutions readily available to overcome this problem:

(i) The first is that the existing combiner should be replaced with another combiner that can handle more FM channels while maintaining the needed isolation. However, a new combiner would entail fresh costs which would have to be incurred by the existing broadcasters. As per an initial estimation, this would be approx Rs 1.5 crore for buying a new combiner, even though a buy back of the present combiner would help in reducing costs substantially. Even if a buy back was done, each existing broadcaster would have to spend fresh monies to make the switch-over.

This would be objected to by them as they gain nothing directly by allowing more broadcasters in. The new broadcasters would be the real beneficiaries of the extra spectrum created and one simple solution would be to make **them (the new broadcasters) pay for the new combiner.** If this were made

part of the tender conditions. new bidders could factor the cost into their business plans and bid accordingly. It would be just another component of the project cost for them. **Alternatively, the government could decide to pick up the costs of the new combiner since it would also be a big beneficiary of the additional spectrum created.....the OTEF generated would be very substantial.**

The advantage in changing the combiner is that the current tower infrastructure could continue to be used. It is also the more practical of the two solutions.

(ii) The second solution is to **house the new channels in a *new* tower.** At this new tower facility, a new combiner with the requisite technical features could be ordered. This solution entails identifying a new and suitable tower location and building a new tower there (if there is no existing facility available). If an existing tower can be spared for housing new FM channels, then a new tower need not be created. Building a new tower is a fairly expensive proposition, but again, **if it were built into the tender terms for new bidders, they would bid keeping this cost in mind.**

Both of these solutions are practical – the first one more so – and relatively easy to implement. There are certain monetary costs involved, but in the larger interest of developing the radio industry, these costs need to be incurred.

Not increasing frequencies should not be seen as an option by the government as it would harm the radio industry in more ways than can be imagined right now. In many ways creating more spectrum is akin to the government buying land from the public to build industrial parks –costs need to be incurred in doing so, but is there any alternative to industrial growth? In this case, as long as existing broadcasters do not have to incur any costs, they should be fine with the plan.

I am attaching a note written by our expert in the field of telecommunications.

2. <u>Selectivity of FM receivers:</u>

TRAI was probably right in making this observation in the year 2008. At that time, mobile penetration was not as high as it is today.

However, today, as per an independent survey done by TAM (the research agency which measures TV and radio consumption), as much as 90-99% of the audience in the four major metros of Delhi, Mumbai, Kolkata and Bangalore has access to FM radio channels on their mobile phones. You may yourself have seen people traveling in buses and trains listening to radio on their mobile phones. The relevant pages of this research are attached along with this letter.

It is a well known fact that mobile phones are capable of tuning into FM channels which are separated by as low as 200 Khz. The other devices used to listen to FM channels are the car stereos or the home stereo systems –both of which are usually digital by design and can easily tune into channels separated by even 200 Khz.

The common belief that some of us have that people listen to FM radio on cheap hand-held devices is misplaced. There was a time when this was true, but that is no longer the case. In fact, today there is no manufacturer of FM radio sets left in the country (to the best of my knowledge). No one buys a "radio set" any longer – it is always built into either a mobile phone or a car stereo or a home stereo system.

In smaller markets where mobile penetration is low –say less than 70% or so-- selectivity of FM receivers may be an issue today. But even in these towns, the situation is changing on a daily basis.

By the time, the new Phase-III stations become operational, mobile penetration would have further increased in even these towns. **In any case, we are asking for the channel separation to be reduced only in the major markets right now –maybe only in the A+ and A category towns to start with.**

To sum up, in today's times, selectivity of FM receivers is not an area of worry at all.

3. No demand for more FM spectrum:

The third objection raised by TRAI in reducing the channel separation to 400 Khz is that in the smaller C and D category towns, there really is no need to have more channels. This is a fair point given the fact that the radio market size in these towns is quite small. However, even in these towns, there should be at least six channels available.....this would lead to 2-3 contemporary music channels, 1-2 retro music channels and 1-2 regional music channels emerging. At a later point in time, the government may want to reassess the demand situation and launch more frequencies at that time. In the larger towns however, there is a big demand for radio spectrum and the proposal to reduce channel separation should be considered seriously for these towns initially.

4. Signal interference in adjacent districts:

The fourth objection raised by TRAI is about allocation of frequencies in two adjacent districts and the interference that would happen if channel separation was reduced to 400 Khz. As per experts in the transmission business, frequency planning in an efficient manner is a well known science. The WPC (Wireless Planning Cell) in the DoT is well equipped to carry out this task. Worldwide, planning spectrum allocation in an optimal manner is a routine exercise

undertaken by the authorities. We do not see any major problem in planning that we in India cannot overcome. Given the advantages of frequency reduction, the additional effort required is well worth it.

Appendix 2: Expert's opinion

Reducing the separation between FM channels in a centre to 400 KHz instead of the existing 800 KHz

Large metropolitan stations that rarely exceeded 10 combined FM broadcast stations in the 1990s are now routinely being replaced by systems in several countries with room for 20 stations or more. At the same time the changes in the FM spectrum with usage of sub-carriers transmission has made increased filtration a necessity, the FM channel itself became increasingly complicated. In the 1980s, the 67 KHz Subsidiary Communications Authorization (SCA) became more widely used. The 93 KHz SCA quickly followed this, pushing critical information to the ±100 KHz fringe of the FM channel and closer to potentially interfering signals. In India, however, as on date the broadcasters are not authorized to utilize sub-carrier transmissions.

As the FM channel becomes larger and more complex, filters and combiners have had to evolve to provide the necessary isolation between closer-spaced signals at the same time that their own pass bands must be more tightly controlled to pass the desired channel. Today's combiners are even being used to isolate separate signals on the same channel to facilitate the combining of analog and digital signals.

Important characteristics of combiners are frequency response, insertion loss, group delay, impedance, physical size, port-to-port isolation and tuning compromises. Improving one parameter may result in a reduction in another. Excessive group delay within the pass band can result in signal distortion. Combiners are often made up of multiple elements, which as a system provide the desired results. Separating the elements can lead to mismatches or other incompatibilities.

In fact some of the frequencies allocated for Community FM Radio, in our country, is in the same service area of the commercial FM channels and are spaced within 400 KHz spacing.

A comparison of possible options for implementing the new FM channels with 400 KHz spacing is indicated below:

Parameter	Option-1 Implementation in Existing CTIs		Option-2 Implementation in separate & additional CTIs		Remarks
	Merits	Demerits	Merits	Demerits	
Power Combiner	Additional channels are available	A new combiner chain is needed. The cost of this would be quite high (say 200% of 800 KHz combiners) as multi stage filtering	Additional channels are available without affecting the existing operators	New Tower will be needed	The specifications of the new combiner need to be evaluated for the group delay performance, which is likely to deteriorate with 400

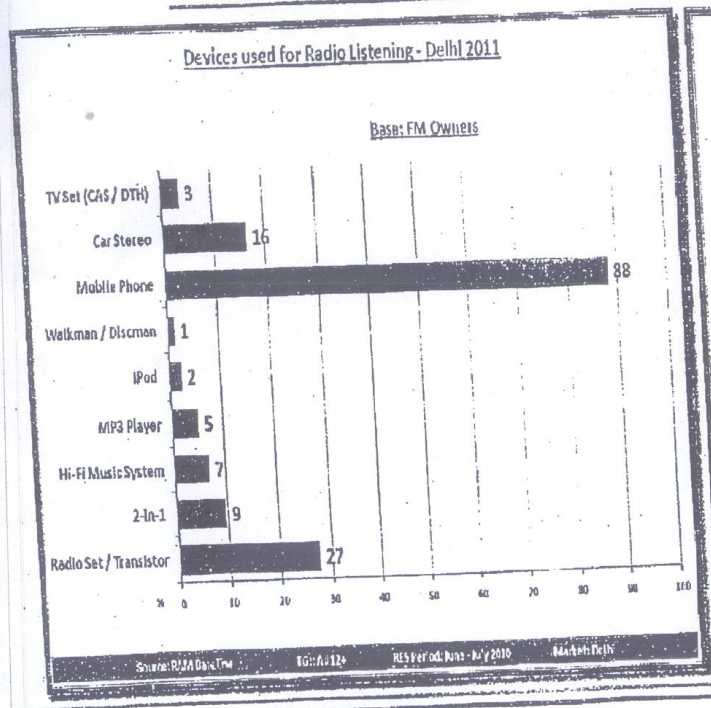
		would be needed to provide isolation. The existing operators may be reluctant to share this additional cost.			KHz separation due to multistage filtering. Similarly. the isolation from WB to NB needs to be maintained by increasing the filtering.
Power handling of Antenna & feeder System		The existing antenna & feeder system needs to be replaced leading to discontent among the existing operators	Since the entire set up is designed to cater for all the channels, no problem is envisaged		
Tower	Existing tower could be utilized			A new tower is needed	

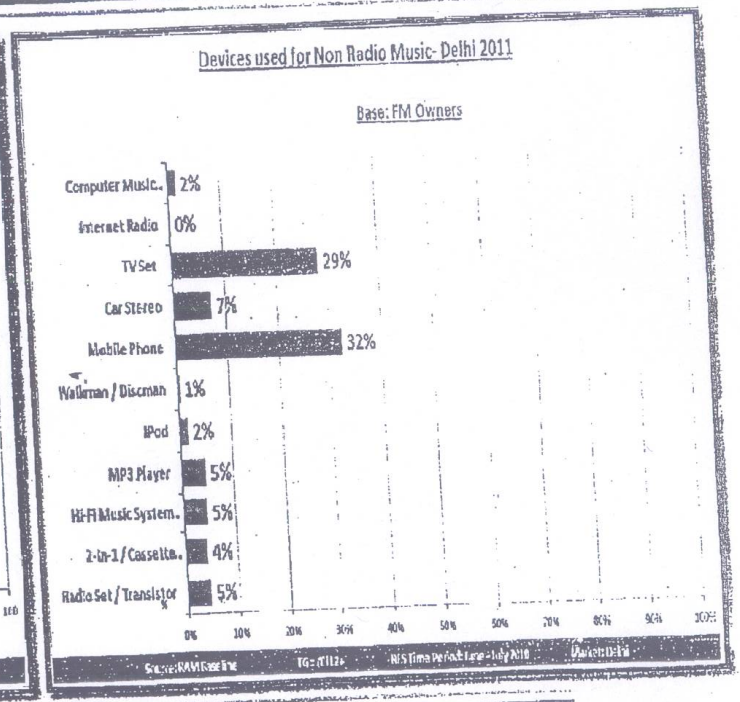
Conclusion:

In view of the above, it is concluded that the 400 KHz separation between FM channels could be implemented with the new / additional CTIs to be setup in the same city/town. However, by suitably placing the new FM frequencies, which fall in between the existing frequencies (spaced at 800 KHz), in the new CTI, the combiner designed for 800 KHz spacing could be used in the new CTI to avoid a new design based on 400 KHz spacing and thus avoid group delay & isolation problems.

Since the digital receivers are capable of narrow band tuning, the 400 KHz spacing would not be a problem at the receiving end.

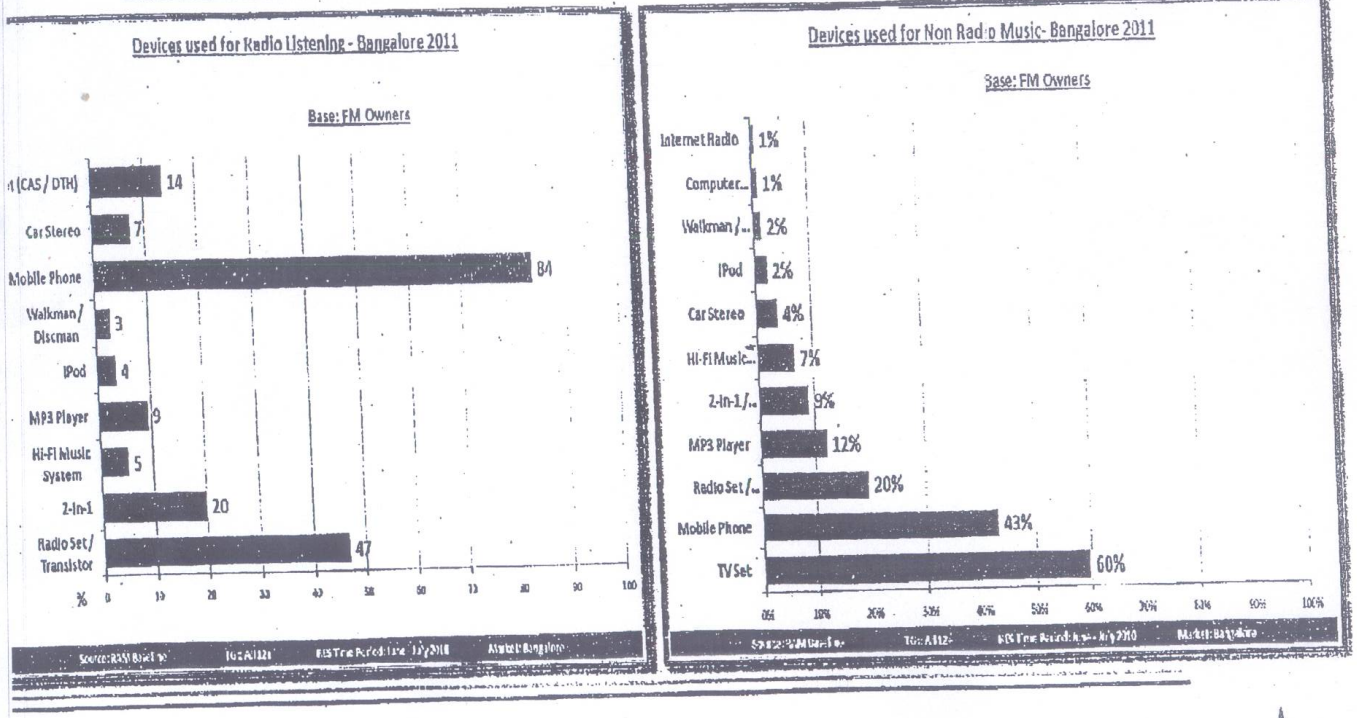
Mobile phones has been used maximum for radio and non radio music listening





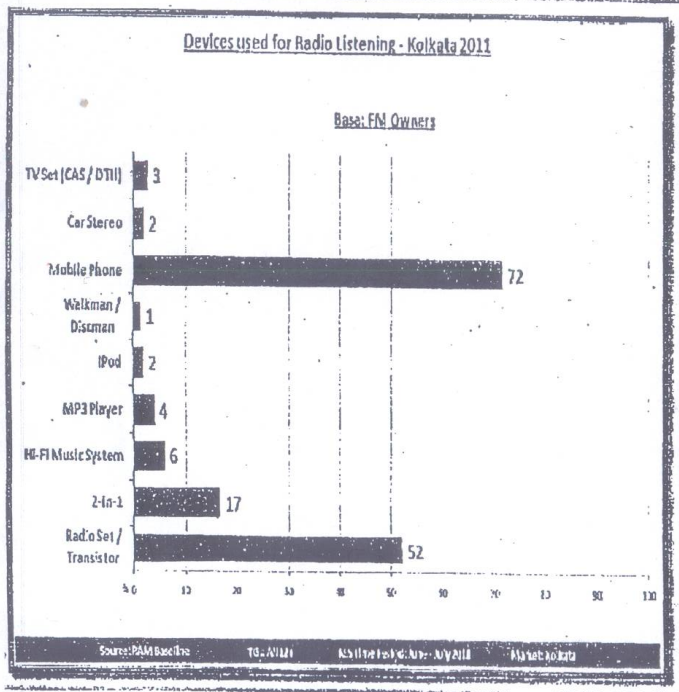
RAM

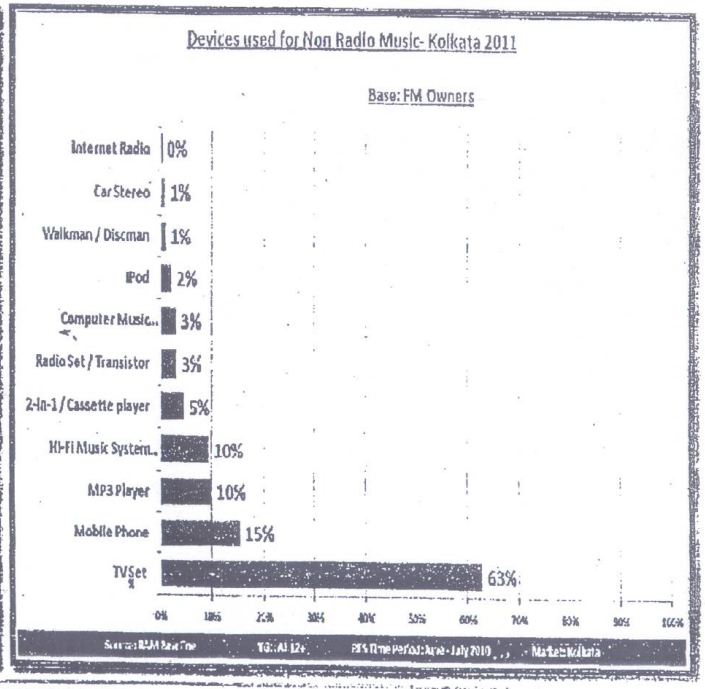
jority of the radio listening is preferred on Mobile Phones whereas T.V. sets are used maximum for non radio music.



RAM

Mobile phones followed by Radio Set/ Transistors has been preferred maximum for Radio Listening whereas TV sets are used maximum for non radio music.





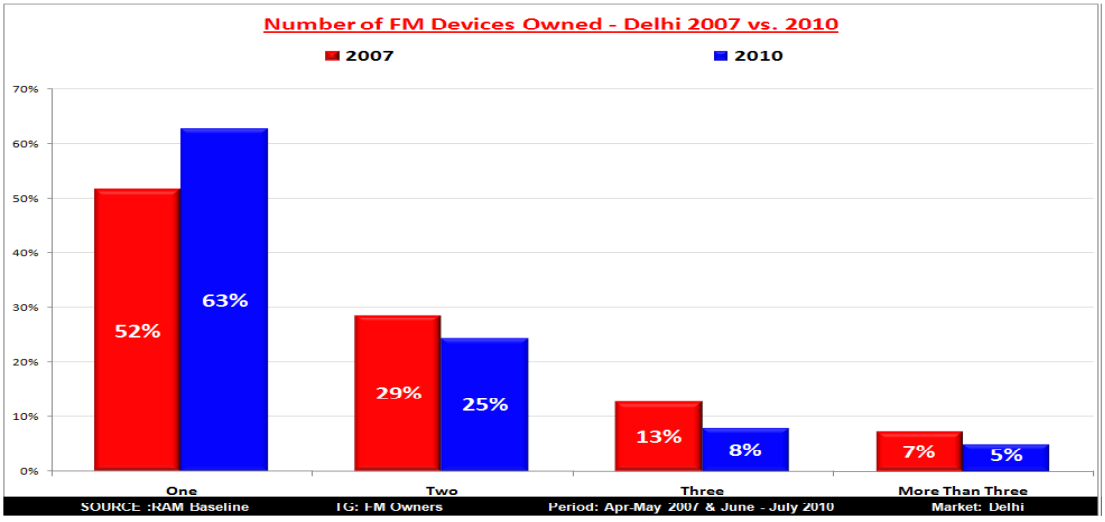
RAM

Annexure- II

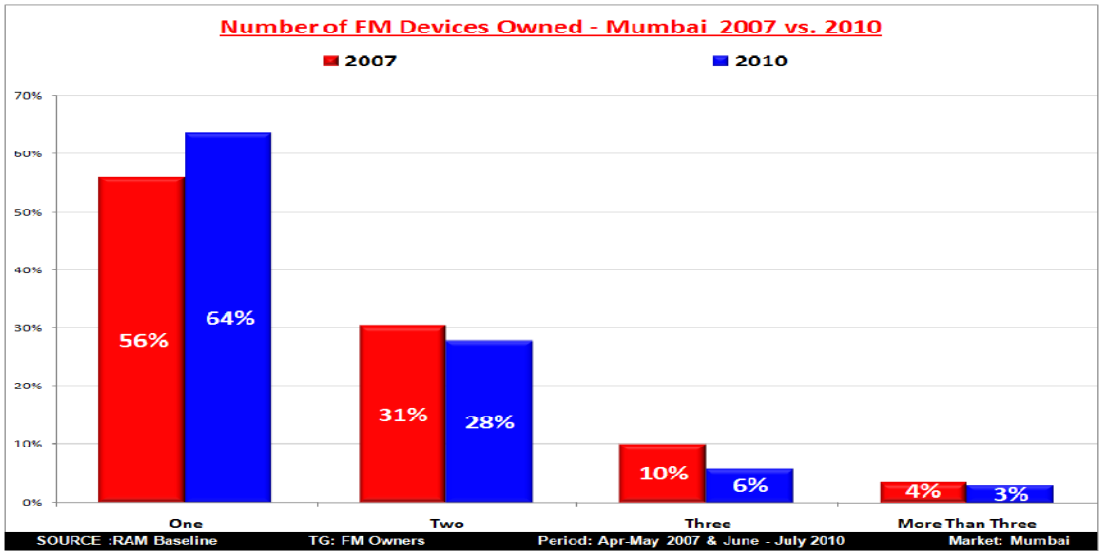
Extract from 'Radio Establishment Survey-Universe Update 2011'

Number of FM devices Owned:

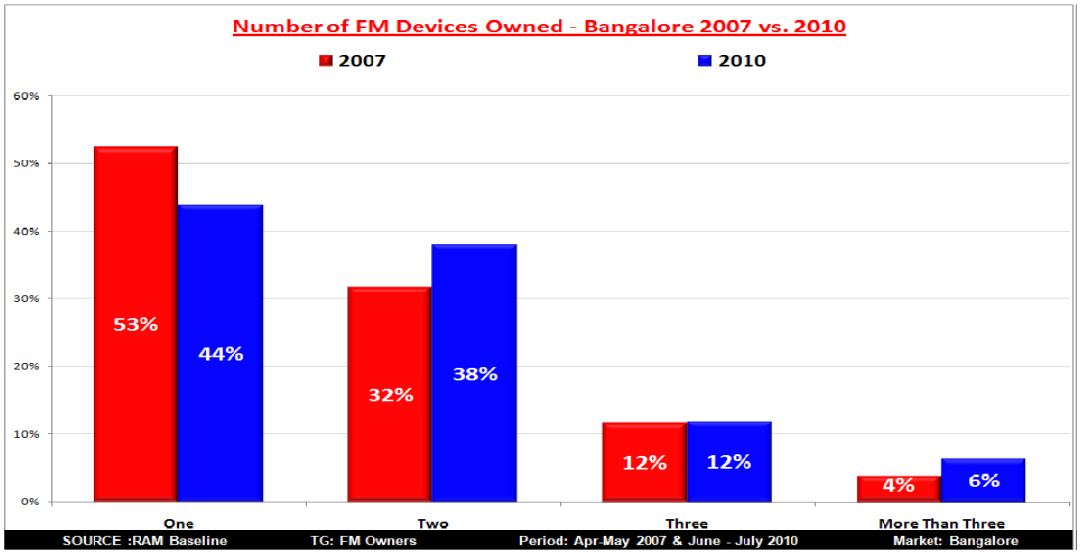
Delhi: Listeners owning only 1 device has seen an increase from 52% in 2007 to 63% in 2010



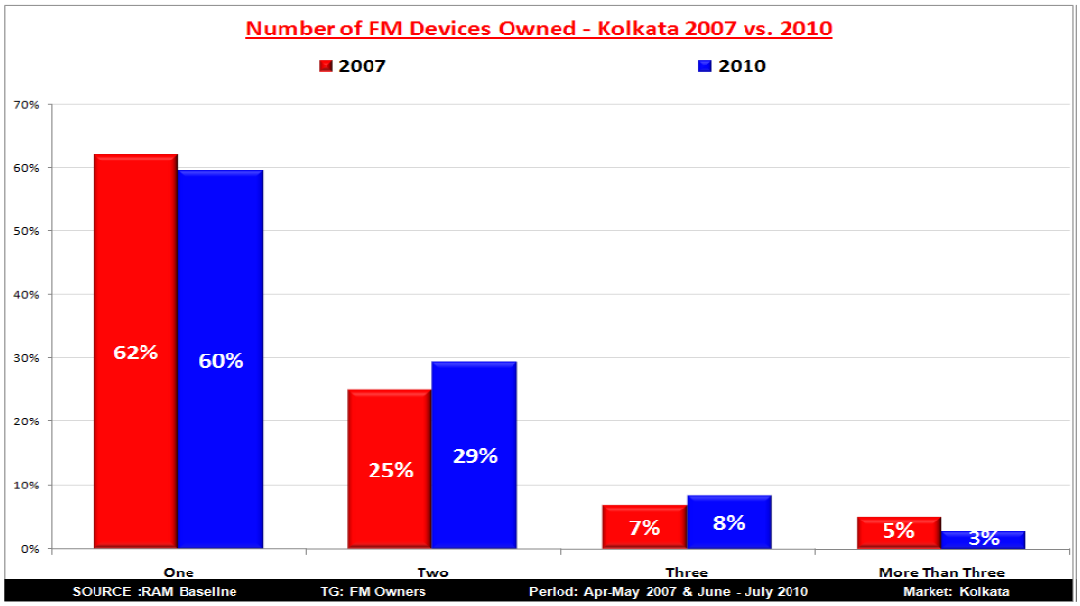
Mumbai: Listeners owning only 1 device has seen an increase from 56% in 2007 to 64% in 2010.



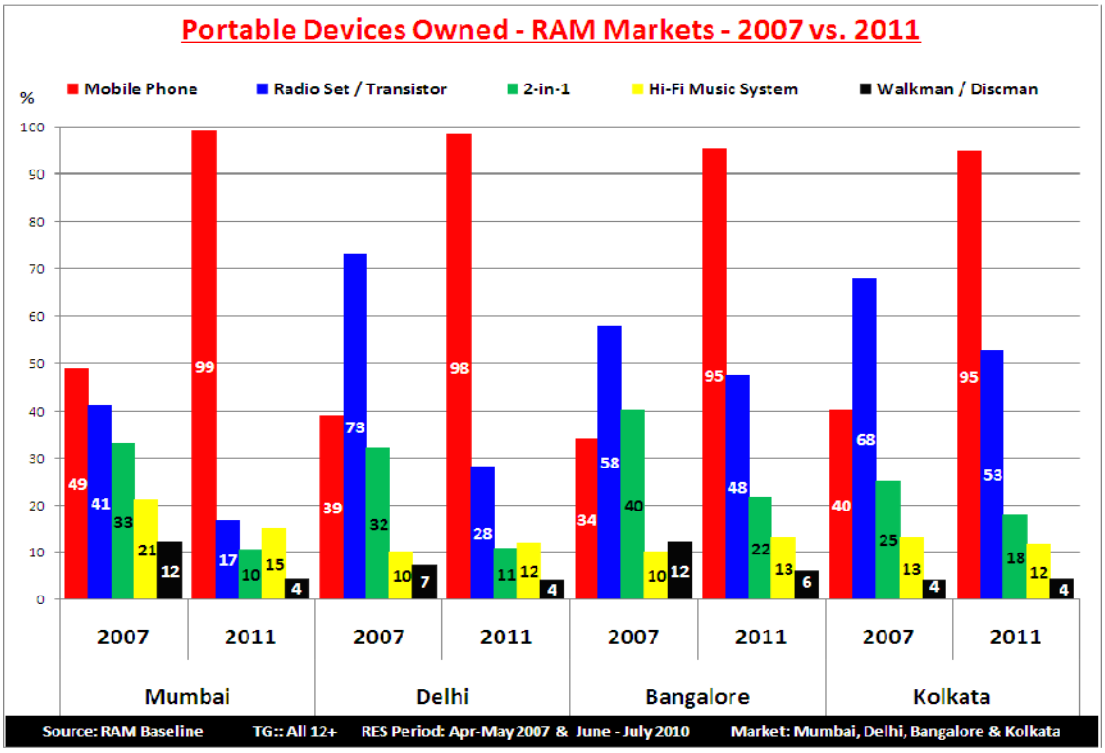
Bangalore: Bangalore is the only market which observes heavy number of listeners owning two devices (38%) for radio listening.



Kolkata: Majority of the listeners have access to FM only through 1 device.

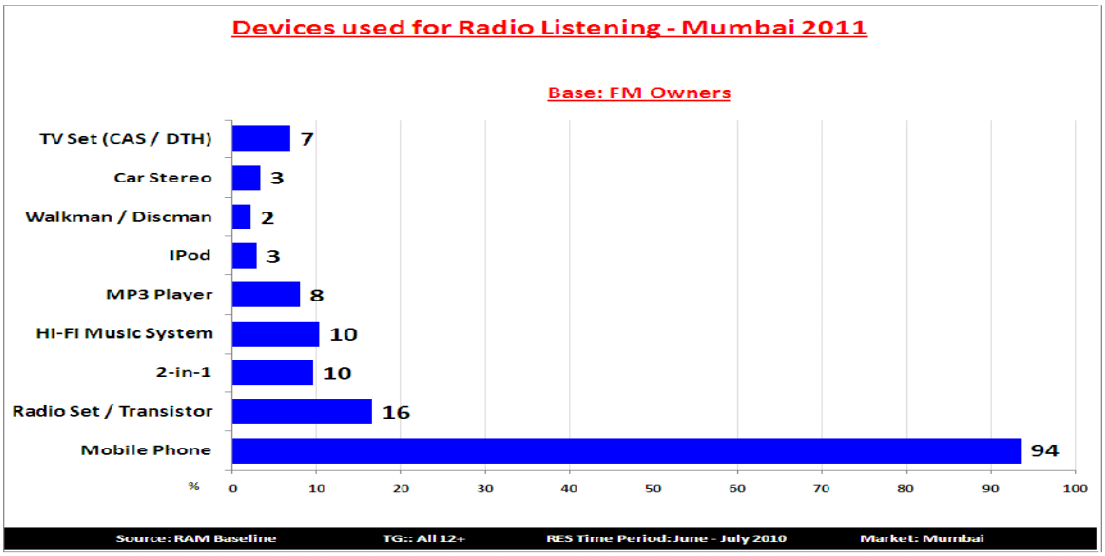


Comparison of devices owned by FM owners between 2007 and 2011:

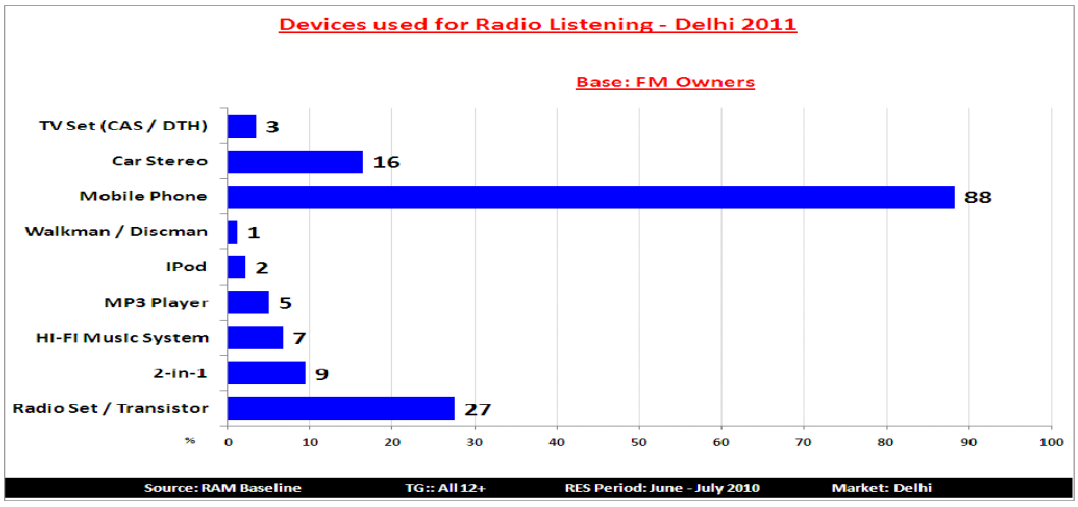


<u>Device used for listening to FM Radio (%):</u>

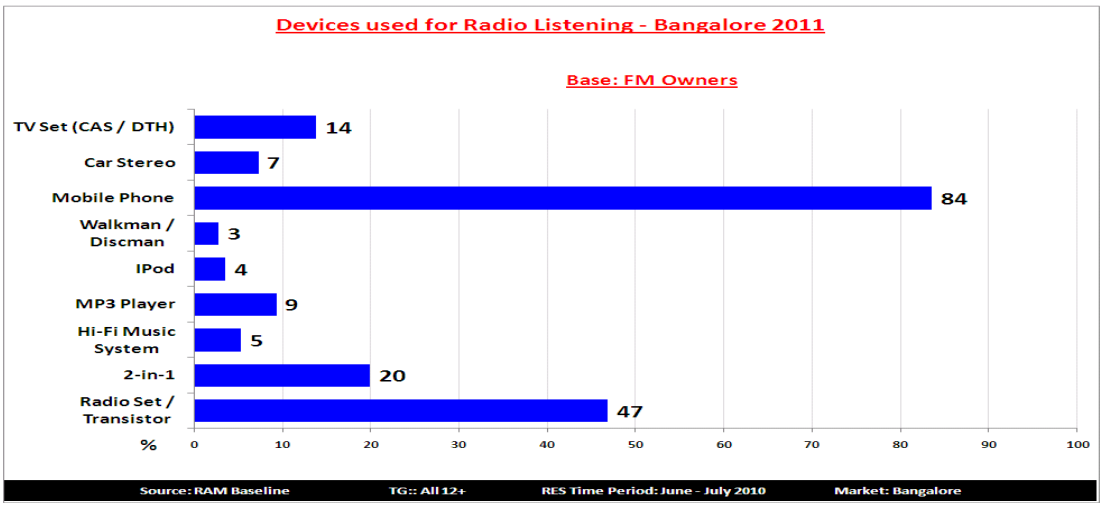
Mumbai: Majority of the radio listening is preferred on Mobile Phones



Delhi: Mobile phones has been used maximum for radio music listening.



Bangalore: Majority of the radio listening is preferred on Mobile Phones.



Kolkata: Mobile phones followed by Radio Set/ Transistors has been preferred maximum for Radio Listening.