

Republic of Lebanon
Telecommunications
Regulatory Authority

Improving FM Broadcasting

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Introduction

1. Legal Basis

1.1 Telecommunications Policy

1. The Government of Lebanon having determined to transform the telecommunications sector in Lebanon from a state-owned monopoly to a competitive market open to private participation promulgated the Telecommunications Law (Law No. 431/2002, hereafter called the “Law” or “Telecommunications Law”) to achieve this aim.

1.2 The Authority’s Mandate and the Telecommunications Law

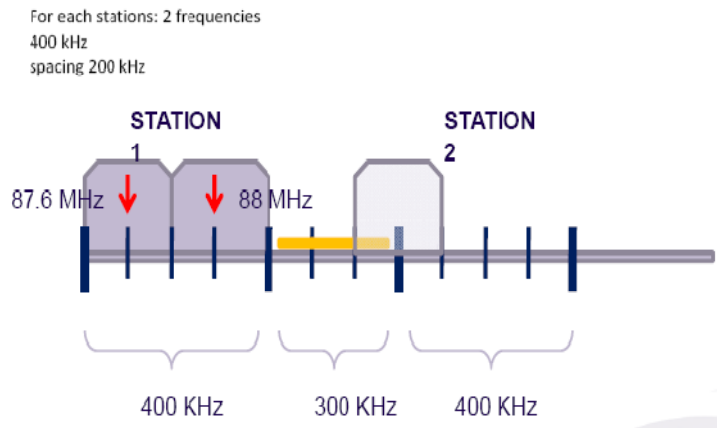
2. Article 15 of the Telecommunications Law confers on the Authority the exclusive authority to manage, allocate and monitor the use of Radio Frequency Spectrum in Lebanon. It provides for the Authority to develop an annual plan for the Allocation of Radio Frequencies, and requires the Authority to consult with the Ministry of Information and other concerned governmental agencies for the TV and Sound broadcasting frequency usage.
3. This Consultation is issued pursuant to the Authority’s powers and responsibilities in the aforementioned provisions of the Telecommunications Law.

2. Purpose of this document

4. The purpose of this document is to seek public feedback on proposals related to FM broadcasting and the associated spectrum and frequency allocation plan that the TRA is mandated to manage..
 - The objectives are to: Improve the quality of FM Broadcasting by:
 - Improving the coverage
 - Reducing the interference issues
 - Reducing the near-far problems
 - Maximise the capacity of the FM broadcasting band and allow for new entrants
 - Insure that transmission is compliant with electro-magnetic field health and safety regulation and that hazards of high power transmission to human health are reduced.
 - Reduce the potential risks of interference of sound broadcasting on safety of life services (airport air navigation).
 - Complete coordination of FM broadcasting with the neighbouring countries as far as possible
5. The TRA is now seeking comments from stakeholders on ways in which the FM Broadcasting in the 87.5 – 107.9 MHz band can be allocated and improved. Stakeholders like Broadcasters, Content providers, (potential) Broadcast Infrastructure providers, Consumer Organisations, Telecom Operators, Hardware distribution channels, Equipment vendors and other entities with an interest in the FM broadcasting policy are invited to participate.
6. The feedback will be used to advise the Government in developing new policies about using the FM Broadcasting band. Details about how to make submission are provided at the end of this document.

3. Current FM Broadcasting Situation

7. Based on the TV and Sound Broadcasting Law 382/94; Council of Ministers' Decision Number 49, 4/11/1999 Frequency Allocation Plan for FM Sound Broadcasting and Decree 7997 29/2/96, the current FM broadcasting sector situation in Lebanon is as follows:
 - Frequency band: 87.5 to 107.9 MHz
 - Broadcasters:
 - 29 initially licensed with assigned spectrum
 - Additional broadcasting licences were issued
 - A number of unauthorized broadcasters
 - 400 kHz, 2 channels, assigned for each of the initial 29 broadcasters
 - 300 kHz left between two consecutive licenses. In this 300 kHz additional broadcasters have used / been assigned just 1 channel
 - The initially intended frequency plan has been 400 kHz/Broadcaster + 300 kHz guard band



- Actual implementation is different from the initially intended frequency plan. Broadcasters used the 400 kHz in various ways including transmitting at their band edges
 - Maximum transmit power in residential areas: 25 KW ERP as defined by national regulation but many broadcasters have a much higher ERP
 - Each Broadcaster should provide national coverage, as defined by Law 382, but many of the broadcasters only provide regional coverage
 - More than 40 transmit locations distributed over the Lebanese Territory. In Beirut alone there are more than 17 transmit locations.
8. Since the broadcasters did require more than 1 channel to realise a nationwide network the typical deployments did not always stay within the allocated 400 kHz. Typically the center frequencies are either within the allocated 400 kHz or at the band edges and the spectrum does spill-over outside the allocated 400 kHz band.
 9. Typically the broadcast locations have been chosen independently for the different networks. Each of these independent networks has broadcast sites in the same area but they are not necessarily (near) co-located. Since the frequencies were distributed without additional constraints and conditions with respect to locations this implies that near-far problems are an issue. A listener to a far away FM station located close to another broadcaster on an adjacent channel is facing difficulties and quality degradation.
 10. Compatibility between FM broadcasting and air control traffic and air navigation (ILS) is not really considered. However there is a general guideline: The minimum field strength to be protected throughout the ILS localizer front course (at 30 Km from the threshold of the runway in an angle of 70 degrees) is 32 dB(μ V/m) (40 μ V/m). Also if service is provided in the ILS localizer back course coverage, the field strength to be protected is also 32 dB(μ V/m according to the ITU recommendation ITU-R SM 1009.
 11. Very high transmit power (\geq 100 KW ERP) is used in residential areas like: Beitmery, Ashrafieh and Borj Abi Haidar. This could result in violation to the limits of EMF radiation levels defined by Decree 7997.

12. Frequencies had not been registered at the BR/ITU due to incomplete coordination with neighbouring countries.
13. Hence, the quality for the listener is not optimum and there is no capacity left for new entrants. TRA believes there are opportunities to improve the FM broadcasting coverage and quality, as well as reducing the impact of so many transmit locations.
14. Effective coverage does not often meet Law 382 obligations since FM broadcasters are frequently providing regional instead of national coverage.
15. National coverage conditions as defined in Law 382 require complex coordination for each broadcasting station between broadcasters and with neighbouring countries in order to prevent harmful interference. Such conditions limit the use of frequencies to those coordinated with the neighbouring countries and registered with the ITU. The current spectrum allocation did not take into consideration the necessary restrictions to avoid the potential conflicts with frequency allocations in the neighbouring countries.

Question 1

Do you agree with the identified issues for FM broadcasting? Please identify any additional main issues, if any.

4. The Digital Transition?

16. Globally the digital transition in the FM band is still in its very early stages and no proven model has emerged yet. There have been quite a few Digital Audio Broadcasting (DAB) deployments in Band III offering a digital alternative for the analogue FM broadcasting. However global adoption of DAB by listeners has been limited and radios with DAB reception capability are still few. Other digital technologies might be deployed as well. Internationally, technologies like DRM, DRM+, HD Radio and FM Extra are being trialled or deployed at a limited scale:

- A full digital replacement, like DRM+, would require additional FM spectrum to allow for a period of simulcast. Given the current heavy usage of the FM band this may not be an easy option for deployment. Also the issue of availability and cost of digital receivers is a major concern for the consumers.
- Technologies like FM Extra do allow parallel transmission of analogue and digital within the existing frequency plan. This could facilitate digital transition but still requires a coordinated global momentum to create the market for FM receivers with digital FM Extra reception capability.

None of the digital migration solutions seems sufficiently mature to allow for a near-term implementation. TRA believes that it will be better to await global developments before deciding on the digital technology for audio broadcasting in Lebanon.

17. TRA anticipates analogue FM broadcasting to remain the mainstream national radio distribution solution. Focus on improving the existing analogue FM broadcasting situations should prevail in compliance with the ITU Standards, law 382 and the provisions of Decree 7997 especially that related to the maximum EIRP. TRA forces all broadcasters to adjust and modify their stations and networks in order to improve their coverage and quality of service.

18. Digital migration can be addressed once a more globally accepted digital migration path is emerging.

Question 2

Do you agree with the assessment that it is too early to focus on the digital migration of the FM broadcasting as a solution for the current issues?

Question 3

Please describe your views on (future) digital audio broadcasting. Which technology do you expect to use in the future? Please consider both digital audio broadcasting within the current FM band as well as options in other frequency bands.

II. Strategy Considerations

19. The TRA would like to:

- Improve the quality of FM Broadcasting by:
 - Improving the coverage
 - Reducing the internal and external interference issues
 - Reducing the near-far problems
- Maximise the capacity of the FM broadcasting band and optimise spectrum usage to allow for new entrants
- Remove the hazards of high power transmission and reduce the risk for impact on human health
- Reduce the potential risks towards safety of life services like air navigation
- Complete coordination of FM broadcasting with the neighbouring countries as far as possible
- Complete coordination with ITU to register frequencies in ITU-BR so that FM transmission is protected from neighbouring countries
- differentiate between the media/content side of the broadcast industry and the actual transmission infrastructure

20. Transmitted power

Due to the mountainous nature of the Lebanon the use of high power transmission sites (currently there are around 34 transmitters using between 100 kW and 500 KW ERP) is not very effective. The actual coverage is mostly defined by the topography and the shielding due to mountains. More broadcasting locations and lower power broadcasting would be more effective to provide the minimum required field strength to a larger percentage of the Lebanese Territory. TRA would like to reduce the power of the Transmitters and allow a better coverage for the Lebanese Territory

Question 4

Do you agree with the view that high power transmitters are not necessary to provide the required minimum field strength and that more, lower power, sites would actually provide a better coverage of the Lebanese Territory?

21. Spectrum Occupancy

There is 20.4 MHz of frequency spectrum in the 87.5-107.9 MHz band. However, not all the frequencies in the band can be used for the following reasons:

- Lebanon is in close proximity to several countries. High power FM broadcasting signals originated from Lebanon are propagates across political boundaries and vice versa.

- In order to avoid mutual interference, high power FM sound broadcasting requires adequate frequency separation among different frequency channels or adequate distance separation among different transmission stations using the same or adjacent frequency channels. Due to the small size of Lebanon, achieving distance separation can be difficult
- The ITU-R criteria also warn against using transmitters with a frequency separation of 10.7 MHz in a common coverage area. This is understood to relate to potential mixing of incoming signals in receivers (RF or mixer stages) and creating a potential interference signal at 10.7 MHz in the IF stages. International views on this subject differ and this restriction is not followed by all regulators. Tests in some countries did not reveal any significant service degradation in those cases where the restriction has not been applied. Also the current reality in Lebanon does not seem to take this 10.7 MHz separation into account.

Question 5

Please present your view on the need to avoid the 10.7 MHz separation in each area? Do you have any actual field reports related to problems caused by 10.7 MHz separation within Lebanon or in other countries?

III. Technical Considerations

5. Synchronised FM Broadcasting

22. Technological developments do enable a number of solutions to improve the quality of the FM broadcasting. An important improvement is the use of synchronised FM Broadcasting that makes sure that in the overlap area between two co-channel transmitters that carry the same programme, their delay differences are kept low. As long as the signals are synchronised and the delay differences are low the effect is comparable to regular multicast reception and good quality can be achieved. The synchronisation tuning determines the areas where the delay differences are low. Typically this would be the area where both signals are of comparable strength.

ITU BS412-9 specifies the required protection ratios for FM broadcasting as shown in the table 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 ITU Protection ratios for FM Broadcasting (Source: ITU BS 412-9)

The typical protection ratio for a co-channel stereo FM signal would be 45 dB. Annex 3 of BS 412-9 “Protection ratio for FM sound broadcasting in the case of the same programme and synchronized signals” shows that the protection ratio for a same programme synchronized FM sound broadcasting can be as low as 2 dB for mono and 6-16 dB for Stereo.

Time delay (μ s)	Protection ratios (dB)			
	Monophonic mode		Stereophonic mode	
	Impairment grade		Impairment grade	
	3	4	3	4
2	< 1	1	4	6
5	1	2	10	12
10	1	3	14	16
20	Not evaluated	11	Not evaluated	Not evaluated
40	Not evaluated	20	Not evaluated	Not evaluated

Table 2 ITU Protection ratios for synchronised FM Broadcasting (Source: ITU BS 412-9)

Various countries (like Denmark, France, Greece, Italy, Netherlands, etc.) have gained experience with synchronized FM broadcasting and very substantial quality gains and improved spectrum efficiency can be realised. In some cases even almost continuous coverage has been achieved with same program synchronised co-channel FM Broadcasting. Particular cases have provided synchronised road/tunnel coverage.

6. Single Broadcast Infrastructure

23. A single broadcast infrastructure offers a number of major benefits:
- Co-locating or near co-locating FM broadcast transmitters does prevent the near-far problems as long as similar transmit powers are being used (less than 10 dB difference).
 - Co-locating the FM broadcast transmitters does reduce the number of transmit locations. This reduces the overall costs (OPEX and CAPEX), reduces the human costs and could allow for a joint transmission infrastructure.

7. Frequency Separation

24. Many countries are currently considering the feasibility of increasing the FM broadcast band spectral efficiency and therefore increasing capacity by using 400 kHz channel spacing for stations serving the same area. The usual spacing for stations serving the same area is 800 kHz.
25. Co-located FM transmitters can be accommodated in a 400 kHz channel plan. Of course this does require proper RF filtering but it has been done in quite a few countries around the world (India, Netherlands, New Zealand, UK, etc.).
26. The theoretical maximum capacity of the FM broadcasting band with a 400 kHz channel plan would be around 50 channels. However the required implementation to realise this theoretical maximum capacity will be costly,

complicated and time consuming given the large impact on the existing broadcasters infrastructure.

27. There are several main options to address the current FM channel plans:

- **Zero-base**, basically this would consider a Greenfield situation and prepares a new FM channel plan from scratch.

Pro:

- Could achieve the best possible frequency plan taking into account available locations and agreements with the neighbouring countries
- Could maximise the number of channels available

Con:

- A very complicated and costly process
- Migration process from existing situation to the new plan can be time consuming and difficult
- Typically would affect all broadcasters quite substantially
- Typically would affect all listeners

- **Improving the existing frequency plan**, utilise the available technologies and optimise the existing situation.

Pro:

- Could be implemented gradually and with limited impact and costs
- Major quality improvements seem feasible
- Limited impact on listeners

Con:

- Does not necessarily result in the “best” solution
- Coordination with neighbouring countries remains an issue since the flexibility is restricted by the existing frequency plan.

Question 6

Do you prefer the zero-base or the improving the existing frequency plan approach? Explain your preference.

8. Adjusted Frequency Plan

28. A possibility to improve the existing frequency plan could be:

- Implement synchronisation to allow effective co-channel broadcasting.
- Maintain two interlaced frequency plans:
 - Initial plan: 400 kHz, 2 channels per broadcaster and a 300 kHz “guard” band. Actual transmission at center frequencies in each sub-band and not at band edge. Although this is not perfect the extensive use of synchronised co-channel operation would remove many potential interference areas while some adjacent channel issues, mostly for mobile reception, would continue to exist in the transition areas between different synchronised frequencies. However also the adjacent channel interference would be reduced by the synchronisation since “low” or “high” modulation would happen at the same time (correlated).

- Interlaced plan to utilise the “guard bands” for 1 channel maintaining average 450 kHz separation. Actual allocation would result in 400 and 500 kHz separation at a single transmit location
- The FM Stations and namely the transmitter location determination should result from an Engineering tool for the FM propagation based on the Standards, and particularly take into account for a Class of FM Station and the Average height above average terrain HAAT, the safe distance for co-channel interference. Based on the model and the FM propagation curves calculations, the site location should be adjusted to maintain safe distance for co-channel interference between FM stations.
- Theoretical maximum: 29-30 channels in basic initial plan, 14-15 channels in interlaced plan making 44 channels total for both site configurations

9. Implementation of the Adjusted Frequency Plan

29. Actual implementation can be done in steps
- Implement the synchronisation within each broadcast network including frequency adjustment to the adjusted frequency plan
 - Reduce the transmit power to the level provide the minimum required field strength in the intended coverage area without unnecessary spill-over to other areas and countries
 - Concentrate the transmission locations as much as possible resulting in (near) co-location and adjust transmit power to be within the same range to reduce the near-far issues.
 - Use good filters to prevent intermodulation issues and to protect the air navigation/communication band above the FM broadcasting band.

An illustration of improving the existing frequency plan is given below:

FM band - July 2008					
Freq.		Location 1	Interleaved location 1	Location 2	Interleaved location 2
87.5	87.50				
87.6		87.6			
87.7	87.70				
87.8				87.8	
87.9	87.90				
88.0					
88.1	88.10		88.1		
88.2					
88.3	88.30			88.3	
88.4					
88.5	88.50	88.5			
88.6					
88.7	88.70				88.7
88.8					
88.9	88.90				
89.0		89.0			
89.1	89.10				
89.2				89.2	
89.3	89.30				
89.4					
89.5	89.50		89.5		
89.6					
89.7	89.70			89.7	
89.8					
89.9	89.90	89.9			
90.0					
90.1	90.10				90.1
90.2					

Question 7

Please share your views with respect to this approach. Do you consider this an appropriate frequency plan for the given situation?

Question 8

Do you agree that synchronisation of co-channel same programme broadcasts can improve the spectrum use and the quality of the coverage? Do you see any hurdles to implement synchronisation? Explain your views.

Question 9

Do you agree that implementation of synchronisation is a necessity to improve road and tunnel coverage?

30. The migration to (near) co-location would resolve many near-far issues but in the proposed frequency plan this would require combining channels at 400-500 kHz separation. Typically on a single antenna system combining down to 800 kHz separation is considered possible with today's combiners. On a co-located transmit location this would require 2 antennas to realise the 400-500 kHz separation between the initial frequency plan and the interlaced frequency plan in combination with the 800 kHz combining separation requirement.

Question 10

Do you agree with the proposed combining at 400-500 KHz separation and two antennas? Do you see any real hurdles to implement this in practice? Explain your views.

31. Since the transmitters could all be part of one and the same broadcast infrastructure a joint transmission infrastructure from the FM studios to all broadcast locations seems practical.

Note: A similar broadcast facility entity might also facilitate future digital TV broadcasting infrastructure.

Question 11

Should each broadcaster provide its own transmission from Studio to the broadcast locations or would it be preferred to work towards a joint transmission solution to reduce overall costs?

How about relying on a 3rd party operator to provide service between studios and transmission sites (National Broadband Network,..)?

Question 12

What is your opinion on the differentiation between the media distribution license and the broadcast operator, handling the actual transmitter network, license?

10. EMF Safety requirement

There are international standards regarding the exposure to electromagnetic fields. ICNIRP (International Commission on Non-Ionizing Radiation Protection) has published the guidelines for exposure limits for the general public. The general public is concerned about the health impact of radio transmitters.

32. In addition, Decree 7997 (Ministry of Information, 1996) Section I.4.4 specified public and occupational EMF limits for FM to be 1Milliwatt Power Density/Square Centimetre and limited the transmission power to a maximum of 25KW ERP within populated areas (Section II.4).

Question 13a

Have you performed EMF or PFD measurement to comply with required safety levels of Decree 7997?

What are your plans to comply with EMF and ERP levels set in the decree referred above.

Question 13

What power levels should be considered in urban and rural areas in Lebanon, taking into account the health concerns of the general public? Please explain your views with respect to power level in relation to tower height, antenna pattern, distance, etc.

Do you suggest that the TRA considers even stringent requirements for EMF & ERP levels to insure health concerns are addressed adequately?

IV. Consumer aspects

33. Consumers will benefit from improved quality and coverage of FM broadcasting.
34. During the migration from the existing situation to the proposed adjusted frequency plan some minor changes in frequencies are due to happen. Consumers might have to (slightly) retune their receivers.

Question 14

How should the migration be phased to minimise the impact for the consumers?

Draft

V. New Entrants

35. The TRA wishes to ensure that there continue to be opportunities for new broadcasters and new services to enter the market. Given the current number of 39 broadcasters and the theoretical maximum capacity of the adjusted frequency plan of 44 channels only a very limited number of new entrants could be accommodated. This number could even go down depending on actual implementation restrictions and coordination requirements with the neighbouring countries.
36. Given the fact that many current broadcasters are actually not national in nature TRA could consider regional licenses.

Question 15

Do you agree that given the spectrum limitations there is no real capacity for new entrants?

Question 16

What is your opinion on issuing not only national but also regional FM broadcast licenses?

VI. Submission

The TRA requests submissions to be provided as soon as possible. The closing time for submissions is 5.00pm, 19 December 2008. This will enable the TRA to analyse the views provided and undertake any specific discussions deemed necessary.

The TRA requests that submissions are provided electronically to fmbroadcasting@tra.gov.lb in either word or PDF format. Any questions about this paper or the process should also be directed to this e-mail address.

The TRA's preferred format is:

- Respondent's name
- Organisation
- Nature of organisation's interest (like 'Broadcaster')
- Email address or other address for written communications
- Response to Question 1
- Response to Question 2
- etc.
- Any other matters that you believe the TRA should consider in reviewing the present digital conversion policies.

The TRA intends to publish all submissions on the TRA web site. If a respondent considers that there are grounds for the TRA to withhold key information in a submission for publication then this information should be clearly marked and the relevant reason stated so that the TRA can handle the submission appropriately.