Practical Principle and Technical Standards for FM Planning

NBTC Thailand – 11.05.2015

FM Planning – Methodology

The following methodology has been undertaken to repack and provide new spectrum for FM Community radio stations in Thailand:

- A minimum of 20% of the total FM spectrum must be allocated to the Community Services
- The new plan aims for new spectrum availability, spectrum efficiency and least impact on existing FM broadcasting stations
- Ensure compatibility with the Malaysian cross-border coordination requirements
- If possible, provide 2 new assignments for the following provinces: Angthong, Ayutthaya, Chachoengsao, Nakornprathom, Nonthaburi (Bangkok), Prathumthani (Bangkok), Samutprakan (Bangkok), Samutsakorn (Bangkok) and Saraburi

FM Planning – Emission and Transmitter Specifications

- The Consultant recommends that FM systems to be considered for deployment and operation in Thailand, should meet the following characteristics:
  - Stereophonic
  - Deviation: 75 kHz
  - Channel Bandwidth: 200 kHz
  - Band: 87.5 to 108 MHz
  - Channel Spacing: 0.2 MHz
- For all other aspects of transmitter characteristics, the Consultant recommends that the NBTC adopts the international standard entitled IEC 60244 “Methods of measurement for radio transmitters”. These standards are available in several documents, where the relevant parts for FM broadcasting are:
  - *Part 1: General characteristics for broadcast transmitters*
  - *Part 6 (including Supplement A): Cabinet radiation at frequencies between 130 kHz and 1 GHZ*
  - *Part 13: Performance characteristics for FM sound broadcasting*

  These documents are available for download at the IEC Webstore (webstore.iec.ch).

FM Planning - Protection Contour and Planning

Unless specified otherwise, it is recommended to follow the regulations proposed in the document entitled “FINAL ACTS – of the Regional Administrative Conference for the Planning of VHF Sound Broadcasting (Region 1 and Part of Region 3), Geneva, 1984”, also known as the GE84 document.

The planning contours have been calculated based on the ITU-R BS.412-9 recommendations specified in “**Planning standards for terrestrial FM sound broadcasting at VHF**”. The relevant parameters are listed in the table below (in bold):

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
200	6.0	6.0	**7.0**	7.0
400	–20.0	–20.0	**–20.0**	–20.0

In the simulations presented in this document, the recommendation is to apply the steady interference signal value (with the statistics of 50% of time and 50% of location). This allows for an easy and quicker assessment of planning requirements and provides similar results to the tropospheric approach compared to simulations that are carried out based on a statistical time of 1%.

FM Planning - New Frequency Allocations

- It is recommended to make use of the following table to re-allocate existing channels (all values in MHz):

Actual Frequency	New Freq	Actual Frequency	New Freq	Actual Frequency	New Freq	Actual Frequency	New Freq
87.5	92.3	92.75	96.5	98	100.7	103.25	104.9
87.75	92.5	93	96.7	98.25	100.9	103.5	105.1
88	92.7	93.25	96.9	98.5	101.1	103.75	105.3
88.25	92.9	93.5	97.1	98.75	101.3	104	105.5
88.5	93.1	93.75	97.3	99	101.5	104.25	105.7
88.75	93.3	94	97.5	99.25	101.7	104.5	105.9
89	93.5	94.25	97.7	99.5	101.9	104.75	106.1
89.25	93.7	94.5	97.9	99.75	102.1	105	106.3
89.5	93.9	94.75	98.1	100	102.3	105.25	106.5
89.75	94.1	95	98.3	100.25	102.5	105.5	106.7
90	94.3	95.25	98.5	100.5	102.7	105.75	106.9
90.25	94.5	95.5	98.7	100.75	102.9	106	107.1
90.5	94.7	95.75	98.9	101	103.1	106.25	107.3
90.75	94.9	96	99.1	101.25	103.3	106.5	107.5
91	95.1	96.25	99.3	101.5	103.5	106.75	107.7
91.25	95.3	96.5	99.5	101.75	103.7	107	107.9
91.5	95.5	96.75	99.7	102	103.9	107.25	91.7
91.75	95.7	97	99.9	102.25	104.1	107.5	91.9
92	95.9	97.25	100.1	102.5	104.3	107.75	92.1
92.25	96.1	97.5	100.3	102.75	104.5		
92.5	96.3	97.75	100.5	103	104.7		

FM Planning – Allocation Table Discussion

The frequencies listed in the previous table have been derived by assigning the highest frequency used in Bangkok (107.0 MHz) to its new assignment at 107.9 MHz. Frequencies above 107.25 MHz are therefore reassigned starting at 91.7 MHz. Consequently, this leaves the 87.5 to 91.5 MHz band for Community stations (for a total spectrum occupancy of 4.2 MHz, which corresponds to 20.38% of the total FM band).

All existing stations have been reassigned to a new frequency based on the table above, with the exception of the stations near the Malaysian border located in the following provinces:

- Song Khla
- Trang
- Narathiwat and Sungai Kolok
- Yala and Betong District)
- Satun

The stations located in the above provinces and areas have been coordinated based on the minimum separation provided in the table below.

FM Planning – Allocation Table Discussion cont'd

- It was possible to find compatible frequencies for every existing station, with the exception of the Royal Thai Army station in Song Khla broadcasting at 107.75 MHz.

- It was also noted that existing stations are not currently meeting the agreed coordination regulation criteria in place with Malaysia.

- This international coordination agreement with Malaysia does not take into account the real impact of each station and, therefore, is not optimised.

- It can be assumed that if the coordination process between Malaysia and Thailand would be based on the proposed ITU GE84, more stations could be coordinated between the 2 countries, and therefore additional frequencies may become available for the area.

FM Planning – NAV/COM

The Recommendations in ITU-R SM.1009-1 define different types of interference:

- Type A interference is caused by unwanted emissions into the aeronautical band from one or more broadcasting transmitters:
  - Type A1: A single transmitter may generate spurious emissions or several broadcasting transmitters may intermodulate to produce components in the aeronautical frequency bands.
  - Type A2: A broadcasting signal may include non-negligible components in the aeronautical bands; this interference mechanism, will in practice arise only from broadcasting transmitters having frequencies near 108 MHz and will only interfere with ILS localizer/VOR services with frequencies near 108 MHz.

FM Planning – NAV/COM cont'd

- Type B interference is that generated in an aeronautical receiver resulting from broadcasting transmissions on frequencies outside the aeronautical band.
  - Type B1: Intermodulation may be generated in an aeronautical receiver as a result of the receiver being driven into non-linearity by broadcasting signals outside the aeronautical band. In order for this type of interference to occur, at least two broadcasting signals need to be present and they must have a frequency relationship which, in a non-linear process, can produce an intermodulation product within the wanted RF channel in use by the aeronautical receiver. One of the broadcasting signals must be of sufficient amplitude to drive the receiver into regions of non-linearity but interference may then be produced even though the other signal(s) may be of significantly lower amplitude.
  - Type B2: Desensitization may occur when the RF section of an aeronautical receiver is subjected to overload by one or more broadcasting transmissions; this is termed Type B2 interference.

Conclusion:

It should be noted that, although frequency located nearby the aeronautical band (107 to 107.9 MHz) could be more susceptible to create interference of types A1, A2 and B2, all other broadcasting stations in the vicinity of an airport can generate the intermodulation causing types B1 interference. Therefore, it is strongly recommended that a thorough analysis, using LEGBAC software, is undertaken prior to any frequency approval/deployment. Broadcasters can implement mitigation measures (filters, etc.) to minimize most types of interference.

FM Planning – Community Stations

In order to facilitate the introduction of Community Stations, the following rules are proposed:

- Two scenarios have been evaluated:
  - Scenario 1: Limitation of 500W ERP at 60m EFFHGT or equivalent parameters
  - Scenario 2: Limitation of 100W ERP at 60m EFFHGT or equivalent parameters
- Operating band of 87.5 MHz to 91.5 MHz (by channel increment of 200 kHz)
- Protected contour of 74 dBµV/m
- The interfering contours (Protected contours minus D/U ratio as in the table on page 8) are the following:
  - Co-channel: 41 dBµV/m (including antenna discrimination)
  - First Adjacent: 67 dBµV/m
  - Second Adjacent: 94 dBµV/m
    - Considering the high value of second adjacent planning contour and the relative low power of the proposed stations, it is recommended that only the co-channel and first adjacent planning be considered.

FM Planning – Community Stations

Based on the previous assumptions, it was possible to derive the following minimum separation distances for the planning of the Community Stations:

Parameter	Scenario 1 – 500W	Scenario 2 – 100W
Protected contour distance (74 dBµV/m):	8.75 km	5.7 km
Co-channel contour distance (41 dBµV/m):	45.5 km	33.2 km
Minimum separation to co-channel:	**54.25 km**	**38.9 km**
First Adjacent contour distance (67 dBµV/m):	12.7 km	8.6 km
Minimum separation to first adjacent:	**21.45 km**	**14.3 km**

The distances evaluated in the table 6 above have been calculated using the ITU-R 1546 database propagation model over a flat cold sea, which represents the worst practical distances that can be considered for planning. In real terrain conditions, transmitters could be located at a shorter distance without causing interference to each other.

FM Planning – Community Stations Example

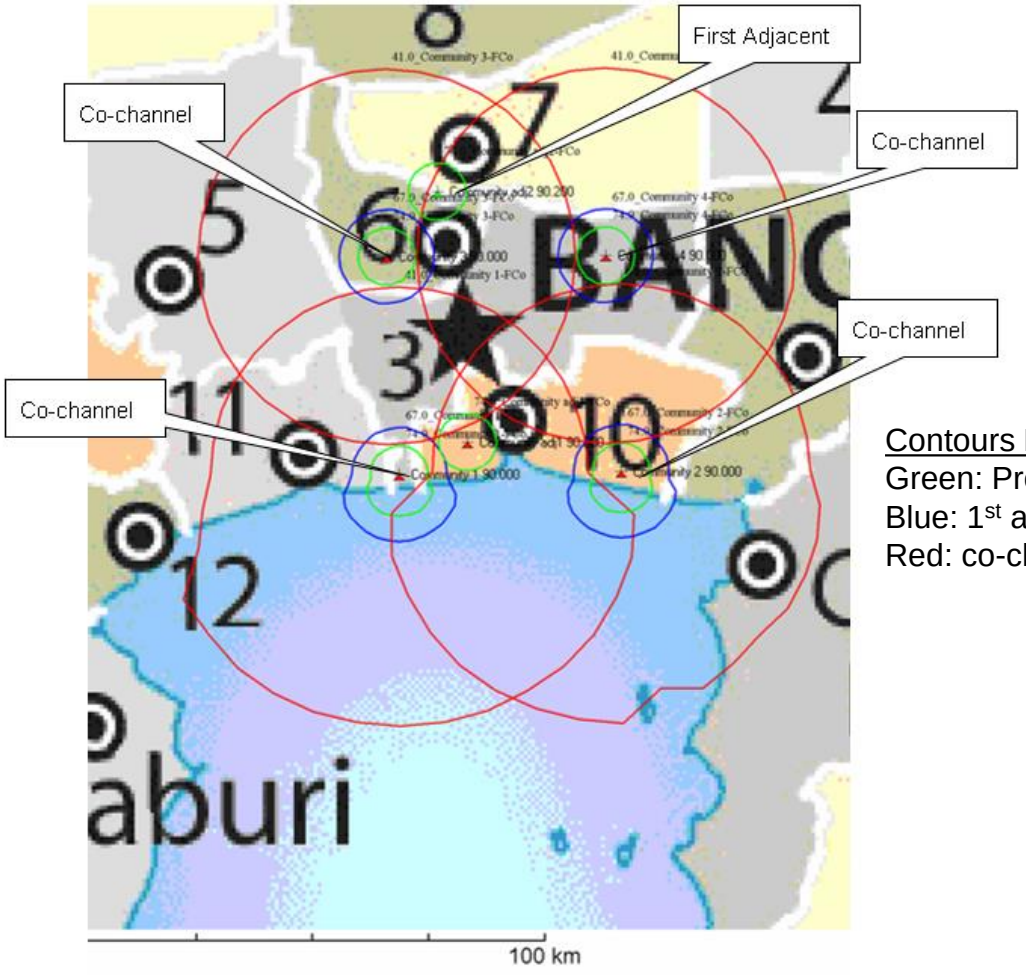

Figure 2: Example of transmitter density for 500W ERP

Contours Definition:
Green: Protected contour (74 dBµV/m)
Blue: 1st adjacent interfering contour (67 dBµV/m)
Red: co-channel interfering contour (41 dBµV/m)

FM Planning – Results: New FM Allotments

It was possible to add the following new FM allotments:

#	Name	Province	FIPS	Latitude	Longitude	Call Sign	Freq. (MHz)	ERP (kw)	AGL (m)
1	Angthong 1	Angthong	TH35	14N35 00.149	100E26 56.718	HSA35A-FM	97.7	4.0	120
2	Angthong 2	Angthong	TH35	14N35 00.149	100E26 56.718	HSA35B-FM	104.9	4.0	120

It was not possible to find additional allotments in the other proposed provinces.

FM Planning – Results: Total FM Coverage

The Consultant has determined that the total coverage of the FM service in Thailand (for a 54 dBµV/m service availability) is:

- Population Covered: 47,712,432 (which corresponds to 74.02% of the total Thailand population of 64,456,693)

- Area Covered: 346,533 sq.km (which corresponds to 67.83% of the total Land Area of 510,890 sq.km)

FM Planning – Conclusions and Recommendations

- A unique Call Sign should be used to clearly identify each FM station. This Call Sign could also be used as a reference for the licensing process.
- A unique PI Code can be evaluated based on the proposed Call Sign convention. Only regular stations should be assigned a PI Code.
- The FM frequency band should be reorganised such as:
  - 87.5 to 91.5 should be reserved for Community Stations, which represents 20.4% of the total FM spectrum usage;
  - 91.7 to 107.9 should be reserved for Public and Commercial stations; all existing regular FM stations will have to change frequency.
- FM channels should meet the following specifications:
  - Stereophonic
  - Deviation: 75 kHz
  - Band: 87.5 to 108 MHz
  - Channel Spacing: 0.2 MHz
- FM transmitters specifications shall be compatible with the relevant international standard IEC 60244.
- FM channel planning compatibility shall follow the GE84 planning specifications as described in section 3.4 of this report.
- Coordination with Malaysia has been found to be non-optimal. The Consultant recommends that Thailand proposes to Malaysia that the international coordination rules defined in GE84 should be adopted between the two countries.
- For all station implementation, a LEGBAC analysis shall be undertaken in order to assess the compatibility with the NAV/COM service prior to any frequency approval/deployment.
- Community Stations shall be implemented based on the recommendation described in section 3.8 of this report.

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