Practical Principle and Technical Standards for FM Planning

Deliverable No. 4

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Notice

This document is provided in good faith and is based on the consultants' understanding of the NBTC's Radio Frequency Plan Project requirements. We would be pleased to discuss the contents of this document with you, particularly if NBTC's requirements have changed in any way.

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Date: 11.05.2015

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1. Summary

The Office of the National Broadcast and Telecommunications Commission, herein in this report referred to as “NBTC”, has the mandate to implement and promote the Thai Government’s policy objectives for the broadcast and telecommunications sector in Thailand. In addition, the NBTC is mandated to establish and monitor the regulatory framework for the guidance of the telecommunications and broadcasting industries.

In the execution of its mandate to regulate the broadcasting sector in Thailand in line with the duties and responsibilities laid out in the Telecom Act BE2555 sections 27(1) and (5), the NBTC has embarked on a Radio Frequency Plan Project, hereinafter referred to as “RFPP”, with the main objective of developing a forward-looking radio frequency plan. This plan includes related policies and implementation strategies for the introduction and management of digital radio services in Thailand based on, among others, international best practises established through a comparative assessment and benchmark study of Thailand and the benchmark countries subject to this study.

The PRACTICAL PRINCIPLE AND TECHNICAL STANDARDS FOR FM PLANNING, hereafter provided, consists of the FM Allotment Frequency plan and recommendations as requested by the NBTC.

2. Scope of the Document

As defined in the terms of reference document ***"TOR-radio v10 27 08-55_ENG_edit.doc"***, which provides the contractual basis of this study, the NBTC requested that the Consultant provides the following scope of work:

> 3.7 Develop a radio frequency plan for FM radio to be used for *public, local, and commercial services (local, regional, and national levels) including conditions for use of radio frequency. The radio frequency plan has to cover the following topics (at least):*
>
> *3.7.1 Plan the radio frequency channels*
>
> *3.7.2 Determine the radio frequency channels for each service area in the specified portion for public, community, and commercial services (local, regional, and national levels) aiming for efficiency and least impact to the existing licenses.*
>
> *3.7.3 Determine relevant technical parameters*
>
> *3.7.4 Conditions for use of radio frequency, including conditions for use of radio frequency along border areas.*
>
> *[…]*
>
> 3.9 develop a frequency tuning plan and/or a plan to adjust the radio frequency channel in case of changing the channel spacing or changing the radio frequency channel different from existing plan."
>
> *"**Phase 3 Develop the technical standards for sound broadcasting service"***
>
> 3.10 Develop the technical standard for sound broadcasting service (transmitter) in FM radio system. The technical standard for transmitter has to cover the following topics (at least):
>
> 3.10.1 Radio frequency requirement such as transmitted power, frequency error, frequency deviation, spurious emission, and out-of-band emission
>
> 3.10.2 Electrical Safety
>
> 3.10.3 Radiation Exposure Requirement

Additionally, the NBTC provided clarifications to the scope of work in response to the clarification requests sent by the Consultant in form of Memo ***ME-RFP014*** and ***ME-RFP015***. These Memos provided a summary of the discussions that were held at NBTC meetings during the week of October 20-24, 2014. The following clarifications and mutually agreed technical conditions have been followed in creating a frequency allotment plan for FM services:

- The Consultant has been using the ITU-R BS.412-9 recommendations to define the planning contours between FM stations (Figure 1 and Table 3 for stereophonic FM deviation of 75 kHz).
- The FM plan followed the Consultant's proposal to make use of an FM channel spacing of 200 kHz, where the minimum spacing for major stations in the same market will be 400 kHz.
- The Consultant has been using the ***"FM_Database V16 150857 (ERPGaindBW)"*** file provided by the NBTC as the basis regarding the information of the existing regular FM stations.
- As much as it was technically possible, the FM band has been divided into 3 different sections: Community, Public and Commercial. A minimum of 20% of spectrum usage must be made available for Community Radio services.
- For new allotments, the following parameters have been considered as much as it was technically possible:
  - For cities where at least one tower exists, the highest tower (located near the city center) has been considered for the coordinates of the allotment.
  - For cities where no towers exist, a 120m height tower has been considered in the city center for planning purposes.
  - Maximum ERP that were considered are:
    - 20 kW in the metropolitan Bangkok
    - 4 kW in other areas
  - Unless special requirements had to be taken into consideration (coordination with other stations or other countries), antennas with an omni directional radiation pattern have been used.
  - The Consultant was tasked to propose, provided availability of spectrum, 2 new allotments for each of the following provinces:
    - Angthong
    - Ayutthaya
    - Chachoengsao
    - Nakornprathom
    - Nonthaburi (Bangkok)
    - Prathumthani (Bangkok)
    - Samutprakan (Bangkok)
    - Samutsakorn (Bangkok)
    - Saraburi

Detailed information on the applied FM planning parameter specification is provided in the following sections.

3. Proposed New Technical Parameters

3.1 Call Sign

After discussion with the NBTC regarding the analysis of the existing FM station parameters, it was noted that the lack of a unique identifier could lead to confusion between licensees. For this reason, the Consultant is highly recommending the implementation and use of a unique Call Sign for each existing station (and for new allotments) as early as possible.

As per Appendix 42 of the ITU Radio Regulation (RR-2012-Vol-II-eA5), the reserved Call Signs for Thailand are defined within the following ranges:

- E2A-E2Z
- HSA-HSZ

In order to define a unique number for each radio station, the Consultant has also considered the FIPS (derived from the Federal Information Processing Standards) Code as defined by the Thailand National Statistical Office. This table is represented in Appendix A of this document.

In order to create a unique Call Sign for each FM station, the Consultant has developed the following naming convention recommendation:

1. All broadcast station Call Signs should start with the prefix "**HS**".
2. The next letter should usually be **"A"**, but in the FIPS area where many stations are located (like in Bangkok), the Consultant recommends to also make use of the letter "**B**".
3. The next field would represent the FIPS Code, e.g. "**40**" for the Bangkok province.
4. The next following field would be a letter from "**A**" to "**Z**" representing the FM stations in the province defined by the previous field. This letter is arbitrary and does not represent an increase or a position in the frequency band. Once 26 stations are present in the same Province, the 3rd letter (see point #2 above) should be incremented from "**A**" to "**B**" and the field following the FIPS code restarted at "**A**" up to "**Z**". In the field following the FIPS Code, regular stations shall use the ranges from "**A**" to "**F**", while Community Stations should use "**G**" up to "**Z**". This will make sure that the station type can be rapidly identified.
5. The unique Call Sign sequence should be completed with the suffix "**-FM**".

As an example, a station in Bangkok could have the following call sign number: **HSA40A-FM**

In this document, the Consultant has defined a new unique Call Sign recommendation for the existing stations and new allotments. Appendix B enclosed to this document lists the recommended call sign numbers defined for each existing and new allotment station based on the Consultant's recommendations.

3.2 PI Code Generator

In order to provide the best experience with the FM RDS system, each broadcasting station must ensure that it uses a unique PI (Program Identification) Code. This PI code is used by the receivers in order to differentiate between the various originating programs. Therefore, it is critical that this code is unique and no two stations in the same area use the same PI Code.

In order to generate these unique PI codes, the Consultant proposes to use a formula derived from the unique Call Sign convention recommendation. The formula is based on the following information:

- PI Codes have a maximum of 16 bits, where the most significant bit must be “1”, as per RDS specifications. This leaves 15 bits to encode the PI, resulting in a maximum of 32,768 possible stations (PI Codes).
- RDS standards usually use the first 4 most significant bits for the coding of the country. Unfortunately, only 16 different country codes exist and are all currently assigned to European countries. To allow the encoding of Thailand, the first country code should be “2”, while the Extended Country Code field should be “F3”. If the first 4 bits are utilized for the country coding, this will leave 12 bits for each single PI Codes (so 4096 possibilities).
- Since no indication regarding frequency linkage has been expressed by the NBTC, the Consultant does not recommend any specific coding which would allow for large area FM network linkage. Individual station linkage shall be possible using the AF (Alternate Frequency) mechanism.
- To calculate the PI Code, the Consultant proposes using the last 4 digits of the Call sign:
  - i.e. for HSA40C-FM, using A40C.
  - Using 7 bits (128 possibilities) to encode the province code “40”.
    - 40 in binary = 0101 000
  - Using 5 bits (32 possibilities) to encode the station specific code, using this rule :
    - Use the 5 least significant bits for the last letter, where A = 0, B=1, …, Z = 25
      - In our example: “C” = 00010
  - Only one province (Bangkok) has currently more than 26 stations. In order to ensure that each regular station has its unique PI Code, the Consultant recommends that Bangkok is split in 2 province code areas:
    - 40: for “A” series (3rd digit of the call letter)
    - 80: for “B” series (80 in binary is: 101 0000)
    - If in future another province has more than 26 stations or if Bangkok has more than 52 stations, the province codes 81 to 127 can be used as this code numbers are still unused.
  - The complete PI Code, for HSA40C would then be:
    - 1010 0101 0000 0010 (bin) or A502 (hex) or 42242 (dec)
    - Where:
      - 1010 : First bit “1” for reserved bit usage & 010-> “2”: reserved code for Extended Country Code usage (Thailand should use F3 for ECC)
      - 0101 000 : 40, province code for Thailand
      - 0 0010 : 2, representing “C”
  - Another example for HSB40E, would be:
    - 1010 1010 0000 0100 (bin) or AA04 (hex) or 43524 (dec)
- The Consultant has provided NBTC with an MS Excel based calculator to compute the PI Code.
- The Consultant does not recommend defining PI codes for community stations, because there are too many community stations for the maximum number of PI Code and that it is unlikely that those low power stations will be using RDS transmission.

3.3 FM EMISSION AND TRANSMITTER SPECIFICATIONS

The Consultant recommends that all FM systems, including Commercial, Public and Community stations, to be considered for deployment and operation in Thailand, should meet the following characteristics:

- Stereophonic: For stereophonic transmission, under all conditions of modulation by the composite baseband signal, the maximum instantaneous carrier frequency deviation shall not exceed ±75 kHz.
    - The pilot-tone system shall be employed for the transmission of stereophonic signals. In this system the baseband signal consists of a:
        a compatible signal, M, which shall produce a deviation of the main carrier of not more than ±67.5 kHz; and
        b double sideband, amplitude modulated, suppressed sub-carrier signal generated by the modulating signal S. This signal shall produce a frequency deviation of the main carrier not exceeding ±67.5 kHz when L and R signals are equal and of opposite phase; and
        c pilot signal which shall have a frequency equal to one half of that of the sub-carrier, and shall produce a frequency deviation of the main carrier of not less than ±6 kHz and no more than ±7.5 kHz.
- The pre-emphasis characteristic of the audio signal shall be in accordance with the admittance/frequency characteristic of a parallel resistance-capacitance circuit having a time constant of 50 microseconds (see below).
- Band: 87.4 MHz to 108.0 MHz
- Channel Spacing: Shall be 0.2 MHz with the lowest channel centre frequencies being 87.5 MHz and the highest channel centre frequency being 107.9 MHz.
- Channel Bandwidth: 200 kHz.
- Frequency stability: ±1 kHz.
- Signal Polarisation: The Operator must signify the signal polarization (horizontal, vertical, circular or elliptical) to the NBTC.
- Out-of-band and Spurious Emissions: Transmitters shall not exceed the following limits (see also Figure 1):
    - Between 120 kHz and 240 kHz from the carrier frequency: -25 dBc
    - More than 240 kHz and up to 600 kHz: -35 dBc
    - More than 600 kHz: $-(43 + 10*\log(P_c))$ dBc or -80 dBc (whichever is the stronger)
        - Where P_C is the transmitter power in W

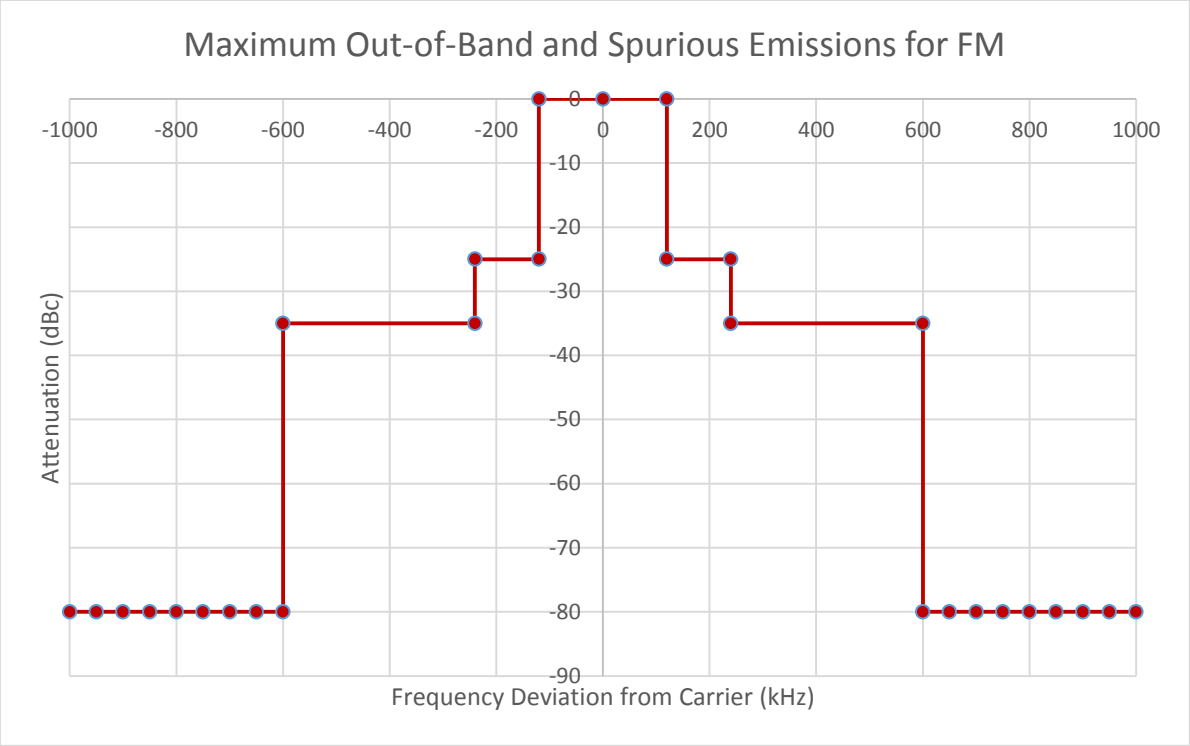

Figure 1: Maximum Out-of-band and Spurious Emission for FAM Transmitters

EMC Specifications: FM transmitters should be compliant with the ElectroMagnetic Compatibility (EMC) standard for radio equipment and services EN 301 489-11.

Radio Exposure: The FM transmitter and its installation shall be compatible with the International Commission on non-ionizing radiation protection's "Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), including the information provided in the ICNIRP "Statement on the "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)" and the high frequency review of 2009.

With respect to the pre-emphasis characteristics, the ITU-R BS.450-3 "**Transmission standards for FM sound broadcasting at VHF**" recommendations include the different pre-emphasis values that are used all around the world. The choice of making use of a pre-emphasis of 75 µs instead of 50 µs is a decision taken by individual countries and differs between countries and, although North America uses 75 µs while Europe mainly uses 50 µs, most Asia-Pacific countries use 50 µs (with the exception of Korea).

The use of a 50 µs pre-emphasis instead of a 75 µs pre-emphasis will change the audio cut off frequency and minimise the high frequency "hiss" noises, at the price however of additional audio signal distortion above this cut off frequency. Some audio engineers are of the opinion that a pre-emphasis of 50 µs does provide a better sound quality for higher frequencies, while a pre-emphasis of 75 µs provides a better hiss immunity.

The Consultant identified that most receivers in Thailand use a de-emphasis of 50 µs. In the case that the NBTC decided to change the national standard to 75 µs, the demodulated audio would feel a treble (1 kHz to 6 kHz) boost of about 3.5 dB, which could be annoying to listeners.

Therefore, the Consultant recommends that Thailand continue their current usage of a 50 µs pre-emphasis.

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 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).

3.4 PROTECTION CONTOURS AND PLANNING

Unless specified otherwise, the consultant recommends following 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 rules in this document have been in place for the past 30 years and have been well accepted by all participating countries. The following discussion highlights the different characteristics of the proposal.

The planning contours have been calculated by the Consultant based on the ITU-R BS.412-9 recommendations described in "**Planning standards for terrestrial FM sound broadcasting at VHF**". Table 3 of ITU-R BS.412-9 (Table 1 in this document) defines the protection ratio for a maximum frequency deviation of 75 kHz.

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: FM Protection Ratios[1]

[1] ITU-R BS.412-9 "**Planning standards for terrestrial FM sound broadcasting at VHF**" recommendation, Table 3.

In the simulations presented in this document, the Consultant decided 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%.

Therefore, the protection ratio (Stereophonic, Steady interference) for this study has been defined with:

- Co-channel: 45.0 dB
- 1st Adjacent channel (200 kHz separation): 7.0 dB
- 2nd Adjacent channel (400 kHz separation): -20 dB

The co-channel interference value is very stringent and limits the distance of co-channel re-use. These values are derived by considering a reception antenna height of 10m. At this height, a directional antenna, which has a front-to-back ratio discrimination as defined in the ITU-R BS.599 recommendation in "**Directivity of antennas for the reception of sound broadcasting in band 8 (VHF)**", can be considered for planning, as per the following figure:

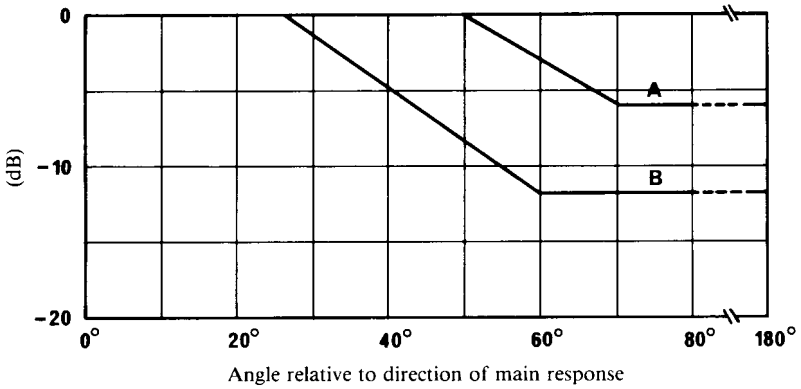

FIGURE 1 – *Discrimination obtained by the use of directional receiving antennas*

Curves A: monophonic-sound broadcasting
B: stereophonic-sound broadcasting

D01-sc

Figure 2: Discrimination of directional antenna for FM[2]

[2] ITU-R BS.599 "**Directivity of antennas for the reception of sound broadcasting in band 8 (VHF)**" recommendation, Figure 1

Since the co-channel stations will usually be located at great distances from each other, a person trying to receive one station will generally locate his antenna, at more than 60 degrees of separation between the 2 stations. Therefore, an additional 12 dB of discrimination can be considered for Stereophonic stations. The following figure shows an example of the locations where antenna discrimination can be considered:

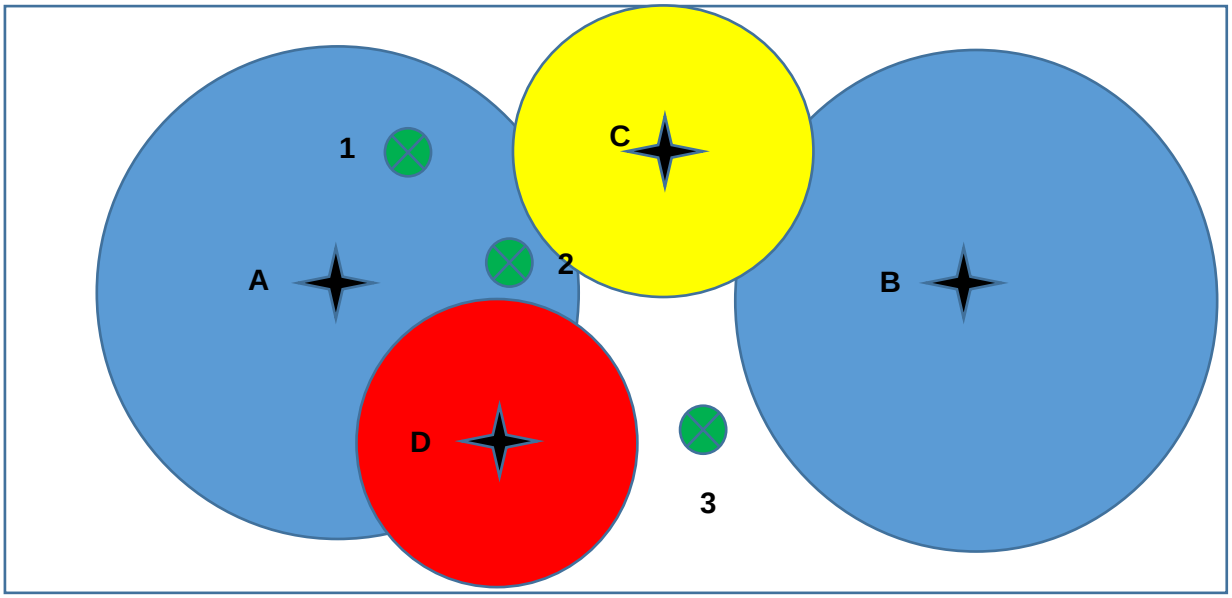

Figure 3 : Example of Antenna Discrimination

In Figure 3, the following represents:

- A Blue Circle: Wanted signal under reception
- B Blue Circle: Unwanted co-channel
- C Yellow Circle: Unwanted 1st adjacent
- D Yellow Circle: Unwanted 2nd adjacent
- Test points: 1, 2 and 3

Evaluating the different reception angle for a directional antenna used to decode the signal coming from transmitter A, we find for each cases:

- Test Point 1:
  - Wanted signal: we aim our antenna at 0 degree
  - Unwanted Co-channel B: approx. 145 degrees separation from A
  - Unwanted 1st adjacent C: approx. 155 degrees separation from A
  - Unwanted 2nd adjacent D: approx. 30 degrees separation from A
- Test Point 2:
  - Wanted signal: we aim our antenna at 0 degree
  - Unwanted Co-channel B: approx. 180 degrees separation from A
  - Unwanted 1st adjacent C: approx. 160 degrees separation from A
  - Unwanted 2nd adjacent D: approx. 90 degrees separation from A

- Test Point 3:
  - Wanted signal: antenna is aimed at 0 degree
  - Unwanted Co-channel B: approx. 140 degrees separation from A
  - Unwanted 1st adjacent C: approx. 60 degrees separation from A
  - Unwanted 2nd adjacent D: approx. 30 degrees separation from A

As anticipated, the co-channel angular separation was always well above 60 degrees, which is anticipated since the co-channel will always be separated by great distanced from each other.

Furthermore, the Consultant understands that nowadays FM reception is generally achieved by using non-directional antennas at a lower height (such as car receivers, clock radios or kitchen table top receivers). Nevertheless, as confirmed in other reports (such as in the report entitled "Prediction of the 'useable' coverage of FM radio services" by AEGIS and presented to Ofcom, UK), the improved performance of today's receivers compensate for the loss of antenna height (denser clutter) and directivity. Therefore, most agree that the overall planning results are similar. In fact, the AEGIS report says:

> *"It may seem that some of these assumptions completely fail to reflect the way in which FM radio is generally received today (in particular the reference to a directional aerial at a height of 10 m* [but also including 12 dB of front/back ratio]*). In practice, however, most engineers feel that these limits give coverage areas that are pragmatically appropriate."*

It should also be noted that the 10m antenna height planning parameter is still applied when interference problems occurs and remedy situations are required. Field inspectors will usually use a 10m boom with a directional antenna (as per ITU-R BS.599) to ensure that the protected and interfering signals are being received at their correct levels. Accurate measurements of FM propagation using a 1.5m antenna height produces more variable results which are difficult to interpret when it is time to verify detailed Desired to Undesired ratios.

For 1st and 2nd adjacent stations, since they can be located closer to the main station, the Consultant did not consider the antenna discrimination for the calculations of the planning contours. The reason is that the probability that the antenna reception angle between the wanted and unwanted stations is less than 60°, is much greater than in the co-channel case. The Consultant notes that CHIRplus_BC can simulate the effect of the antenna front-to-back ratio for all cases since it recalculates the impact for every single point. This is represented on the service coverage map.

The minimum protection contours are defined in ITU-R BS.412-9 as the following:

Areas	Services	
	Monophonic dB(µV/m)	Stereophonic dB(µV/m)
Rural	48	54
Urban	60	66
Large cities	70	74

Table 2: Minimum Protection Contours

Integrating the information from Table 1, Figure 1 and Table 2, the Consultant has derived the following planning contours:

- Co channel:
  - Protected contour: 54 dBµV/m
  - Protection ratio: 45 dB
  - Antenna discrimination: 12 dB
  - Interfering contour: 54 - 45 + 12 = 21 dBµV/m
- First adjacent channel:
  - Protected contour: 54 dBµV/m
  - Protection ratio: 7 dB
  - Antenna discrimination: 0 dB
  - Interfering contour: 54 - 7 + 0 = 47 dBµV/m
- Second adjacent channel:
  - Protected contour: 54 dBµV/m
  - Protection ratio: -20 dB
  - Antenna discrimination: 0 dB
  - Interfering contour: 54 - (-20) + 0 = 74 dBµV/m

3.5 NEW FREQUENCY ALLOCATIONS

The Consultant's current situation analysis established that the FM spectrum in Bangkok is fully congested. The current channel allotments in Thailand are generally spaced by 250 kHz, where each second adjacent channel is used in Bangkok at a spacing of 500 kHz.

As is demonstrated in ITU-R BS.412-9, the protection ratio for channels spaced by 400 kHz or more is identical (-40 dB of protection ratio). Consequently, in order to reduce the spacing in Bangkok, as well as in other areas, the Consultant is proposing to use a channel raster of 200 kHz.

Other countries in the world have successfully used a channel spacing of 400 kHz or less for stations operating in the same locality, including in the UK, USA (New York City), France (Paris), et cetera. A detailed discussion regarding the usage of this spacing will be provided in the Benchmark Report.

Also, as indicated in section 2 in this document, one of the study's original objectives was to divide the new allocation band into 3 sections, which can be represented as:

- Community stations
- Public stations
- Commercial stations

Since the FM station database provided by the NBTC did not specify which existing stations were Community, Public or Commercial, the Consultant assumed that all existing stations will be moved into the Public and Commercial sections of the band. Also, it has been found that in order to maximise the transition of all existing stations (with the exception of one, to be discussed later), the maximum bandwidth that could be allocated for the community stations was approximately 20% (see below).

It should be noted that the Thailand Broadcasting Act was specifying that a minimum of 20% of the FM band should be reserved for the community stations.

For the reallocation process, the Consultant has created the following table as a recommendation to re-classify the existing stations to their new frequency allocation.

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

Table 3: New Frequency Allotments

The frequencies listed in Table 3 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 (91.6-87.4), which corresponds to 20.38% (4.2/(108-87.4)) of the total FM band).

All existing stations have been reassigned to a new frequency based on Table 3 above, with the exception of the stations near the Malaysian border located in the following provinces:

- Song Khla
- Trang
- Naratiwat
- Naratiwat (Sungai Kolok District)
- Yala
- Yala (Betong District)
- Satun

For stations located in the above mentioned provinces, the new frequencies have been selected individually in order to meet the required minimum frequency separation with Malaysia as provided in the following table:

Minimum Frequency Separation in MHz							
		THAILAND					
		SONGKHLA	SATUN	YALA	BETONG	NARATHIWAT	SUNGAI KOLOK
MALAYSIA	GNG. RAYA (KEDAH)	0.3	0.4	0.2	0.1	0.1	0.1
	JERAI (KEDAH)	0.3	0.3	0.1	0.2	0.1	0.1
	DEDAP (KEDAH)	0.0	0.0	0.2	0.2	0.0	0.0
	TELIPOT (KELANTAN)	0.1	0.0	0.3	0.1	0.3	0.4
	PERINGAT (KELANTAN)	0.1	0.0	0.3	0.1	0.3	0.4
	TANGKI AIR (KELANTAN)	0.0	0.0	0.2	0.1	0.2	0.3
	PANAU (KELANTAN)	0.1	0.0	0.3	0.2	0.3	0.4
	BKT.BAKAR (KELANTAN)	0.2	0.0	0.3	0.2	0.3	0.4
	BKT.BINTANG (TERENGGANU)	0.0	0.0	0.2	0.0	0.2	0.3
	GERIK (PERAK)	0.0	0.0	0.2	0.2	0.0	0.0

Table 4: Minimum Separation with Malaysia

The process for selecting the new frequencies was the following:

- The frequencies in Malaysia considered for this study were provided by NBTC in the Excel file entitled "**FM_StationMalaysia_v3 241114.xlsx**".
- The list of frequencies was sorted based on the province criteria in order to verify the compatibility with the frequencies in the coordination zone with Malaysia as per Table 4 above.
- Current Thailand frequencies in the coordination zone that were compatible with the new proposed plan were kept at the same frequency and were not reassigned. It should be noted that some existing stations were not compatible with this table, which made the process more difficult.
- Other frequencies were modified as per Table 3 above. After modifications, the Consultant has verified that the reassigned frequencies were compatible with Malaysian frequencies in the coordination zone as shown in the Table 4. In cases were the initially reassigned frequencies did not meet the Table 3 compatibility requirements, a different frequency was selected.
- For each province, the Consultant tested every possible frequency in order to ensure compatibility with the Table 4 requirements and with the newly re-assigned frequencies in the surrounding Thailand provinces as per Table 3.

The resulting new frequency allotments are available in Appendix B enclosed to this document. The Consultant has been able 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. The reason was this station is rejected is only due to the fact that the consultant started the planning from the lower frequency stations to the higher ones. The RTA station was the last one to be coordinated for this region. The Consultant notes that some existing stations in the Thai-Malaysia coordination zones are not compatible with the parameters in Table 4.

The Consultant also notes that the methodology proposed in the Malaysian – Thailand coordination agreement is not the most optimal solution and a methodology based on coordination contour evaluation (such as the current proposal based on GE84) would probably allow for the usage of additional frequencies.

3.6 NAV/COM COMPATIBILITY

Aeronautical radio-navigation and communications (NAV/COM) services are assigned from the 108-137 MHz frequency band, upper adjacent to the FM band. As a result, there exists a potential for interference with these aeronautical services. Therefore, every transmitting FM station must undertake to prove that the station is not interfering with the NAV/COM services using the criteria in a NAV/COM compatibility analysis (such as provided by LS telcom's LEGBAC module).

A common misbelief is that only the stations in the 107 MHz to 108 MHz range are susceptible to create interference with NAV/COM services, but interference can also be created by the intermodulation product coming from all frequencies.

Consequently, should NBTC decides to implement this FM plan, all new proposed allotment are subject to a final LEGBAC analysis and should not be implemented before the analysis is proven compatible. Furthermore, in the event that NBTC decides not to implement this FM plan, all existing

FM operating stations in Thailand must be studied using LEGBAC in order to ensure that their current operation is compatible with NAV/COM.

The Recommendations in ITU-R SM.1009-1[3] define different types of interference:

Type A interference – Introduction

Type A interference is caused by unwanted emissions into the aeronautical band from one or more broadcasting transmitters.

Type A1 interference

A single transmitter may generate spurious emissions or several broadcasting transmitters may intermodulate to produce components in the aeronautical frequency bands; this is termed Type A1 interference.

Type A2 interference

A broadcasting signal may include non-negligible components in the aeronautical bands; this interference mechanism, which is termed Type A2 interference, 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.

Type B interference – Introduction

Type B interference is that generated in an aeronautical receiver resulting from broadcasting transmissions on frequencies outside the aeronautical band.

Type B1 interference

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; this is termed Type B1 interference. 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.

Only third-order intermodulation products are considered; they take the form of:

$f_{intermod} = 2\ f1 - f2$ two-signal case or

$f_{intermod} = f1 + f2 - f3$ three-signal case

where:

$f_{intermod}$: intermodulation product frequency (MHz).

f1, f2, f3 : broadcasting frequencies (MHz) with $f1 \geq f2 > f3$.

[3] ITU-R SM.1009-1, « Compatibility between the sound broadcasting service in the band of about 87-108 MHz and the aeronautical services in the band 108-137 MHz », Geneva, 2010.

Type B2 interference

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.

The importance of evaluating the potential interference to the NAV/COM service is critical to ensure the security of all airplane passengers. First, the software will analyse the station itself to ensure that no interference of overloading type (mainly Type A2) might be present. Then, one critical component is the analysis to ensure that no intermodulation products could result in harmful interference. For this part, it is critical that the LEGBAC software has access to the FM database and the airport ILS/VOR database, which should be well maintained and always accurate and up-to-date with the latest information.

Once a potential interference is identified, mitigation measures could be undertaken (additional filtering to reduce spurious emissions, etc.). For some sites, and rare occasions, the only possible mitigation is a change of channel to avoid intermodulation product interference.

3.7 NEW ALLOTMENTS

The NBTC has asked if the consultant could coordinate 2 additional channels for the following provinces:

- Angthong
- Ayutthaya
- Chachoengsao
- Nakornprathom
- Nonthaburi (Bangkok)
- Prathumthani (Bangkok)
    - Samutprakan (Bangkok)
    - Samutsakorn (Bangkok)
    - Saraburi

The Consultant was able to find the following additional frequencies and relating operating parameters:

#	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

Table 5: New FM Allotments

It was not possible to find additional allotments for the other regions because they are all located within the 1st adjacent planning zones of the Bangkok stations. Therefore, no further allotments are available.

These allotments are listed in Appendix B and the resulting coverages are available in Appendix C.

3.8 COMMUNITY STATIONS FM PROPOSAL

In order to facilitate the introduction of the Community Stations, the Consultant is proposing the following rules:

- 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 Table 1) 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, the Consultant recommends that only the co-channel and first adjacent planning be considered.

Based on the above assumptions, the Consultant has derived 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**

Table 6: Minimum Separation for Community Stations

The distances evaluated in Table 6 have been calculated using the ITU-R 1546 Database propagation model over a flat cold sea. These calculations are providing greater distances for the planning between 2 stations, which represents a worst case scenario. The reason for this is, should the regulator decides to coordinate Community Stations based on the distances provided in Table 6, no additional calculation or simulation will be required to ensure full compatibility.

Detailed planning of the Community Stations should however be undertaken to take into consideration the geography and other signal limiting obstacle. These detailed calculations should be undertaken by using the methodology described below to determine the possible planning in the Bangkok area.

As an example, when considering the propagation over a cluttered area (with the ITU-R 1546 Database model) the maximum network density of community channels can be represented by the following figure:

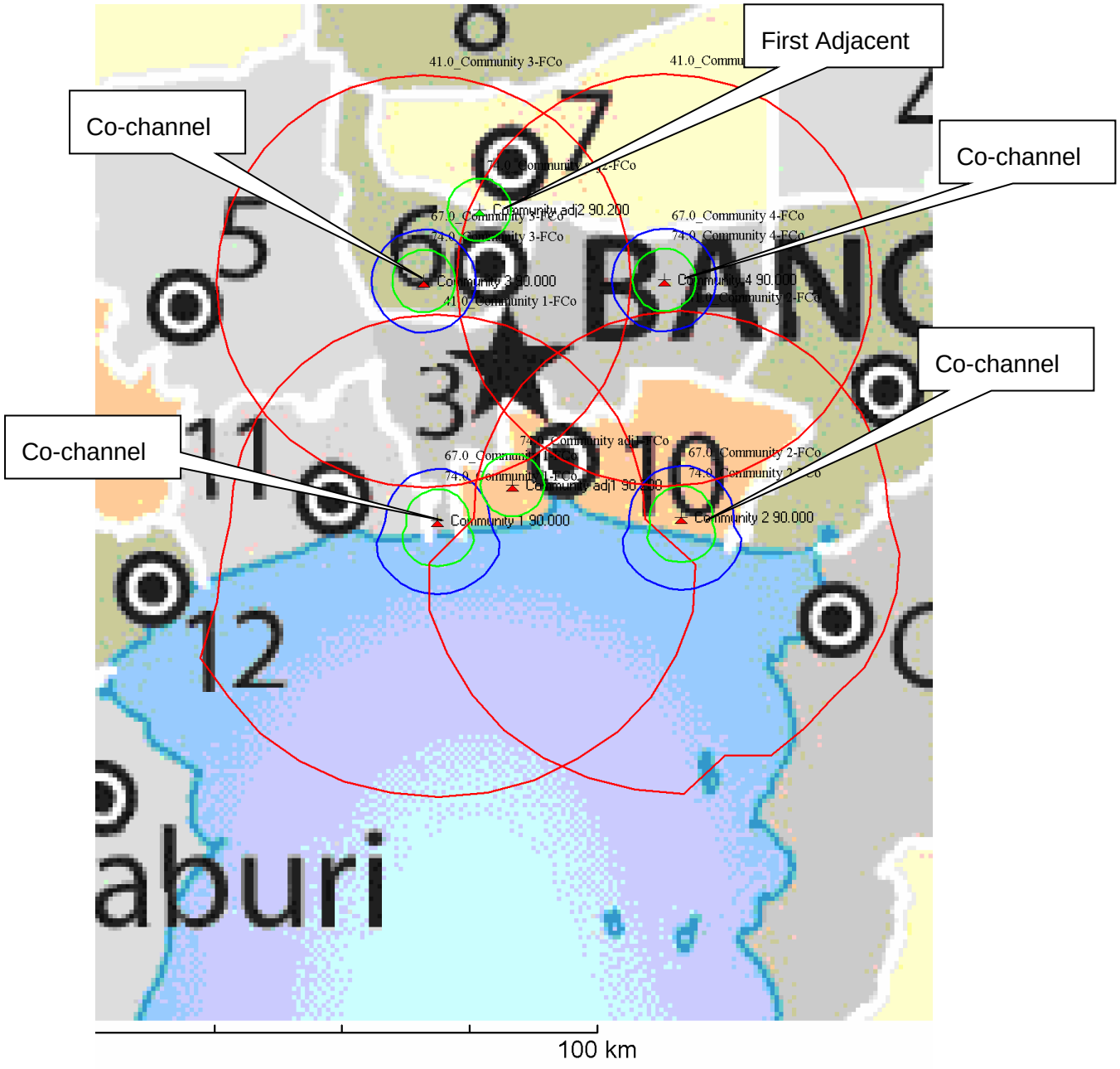

Figure 4: Example of transmitter density for 500W ERP

In the previous figure, the following contours represent:

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

To understand the planning criteria, each co-channel stations must have their interfering contours (red), protecting the protected contour (green) of the surrounding stations. For first-adjacent station, the blue interfering contour must protect the green protected contour.

As shown in Figure 4, the distance overland between 2 transmitters is approximately 37.2 km. This value is obtained by directly measuring the distance between the 2 transmitters (using CHIRplus_BC line tool) when the transmitters are positioned so that the protected contour of the 1st station does not overlap with the interfering contour of the second station. The simulation of these contours was computed with ITU-1546 model, using the actual terrain database. For this reason, the distances are shorter than those in Table 6 which considered only “flat-cold-sea” for the propagation. This provides a good example that the detailed simulation method can increase the density of Community Stations by a considerable factor (37.2 km of separation instead of 54.25 km from Table 6). One solution could be to perform detailed simulations for densely populated areas and use the Table 6 for quick assessments in rural areas.

The NBTC should evaluate if a 5.7 km radius for 100 W ERP stations is sufficient or if a 8.75 km radius should be considered for Community Stations.

4. Conclusion

After the repacking process, the Consultant has calculated the overall coverage (area of 54 dBµV/m and above) of the FM service in Thailand to be:

- 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)

Additionally, the Consultant proposes the following recommendations:

- A unique Call Sign shall 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 derived based on the proposed Call Sign convention. Only regular stations will be assigned a PI Code;
- The FM frequency band shall be split in to the following sub-bands:
  - 87.5 to 91.5 shall be reserved for Community Stations, which represents 20.4% of the total FM spectrum usage;
  - 91.7 to 107.9 shall be reserved for Public and Commercial Stations; all existing regular FM stations will have to change frequency.
- FM channels shall have 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 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 frequency approvals/deployments;
- Community Stations shall be implemented based on the recommendation described in section 3.8 of this report.

Appendix A – FIPS Code for Thailand

The following table has been extracted from the web site: http://www.statoids.com/uth.html. This data used the 2000 Thailand population census as the source of information.

Province	FIPS
Amnat Charoen	TH77
Ang Thong	TH35
Bangkok Metropolis	TH40
Bueng Kan	TH81
Buri Ram	TH28
Chachoengsao	TH44
Chai Nat	TH32
Chaiyaphum	TH26
Chanthaburi	TH48
Chiang Mai	TH02
Chiang Rai	TH03
Chon Buri	TH46
Chumphon	TH58
Kalasin	TH23
Kamphaeng Phet	TH11
Kanchanaburi	TH50
Khon Kaen	TH22
Krabi	TH63
Lampang	TH06
Lamphun	TH05
Loei	TH18
Lop Buri	TH34
Mae Hong Son	TH01
Maha Sarakham	TH24
Mukdahan	TH78
Nakhon Nayok	TH43
Nakhon Pathom	TH53
Nakhon Phanom	TH73
Nakhon Ratchasima	TH27
Nakhon Sawan	TH16
Nakhon Si Thammarat	TH64
Nan	TH04
Narathiwat	TH31
Nong Bua Lam Phu	TH79
Nong Khai	TH17
Nonthaburi	TH38
Pathum Thani	TH39
Pattani	TH69
Phangnga	TH61
Phatthalung	TH66
Phayao	TH41
Phetchabun	TH14

Province	FIPS
Phetchaburi	TH56
Phichit	TH13
Phitsanulok	TH12
Phrae	TH07
Phra Nakhon Si Ayutthaya	TH36
Phuket	TH62
Prachin Buri	TH74
Prachuap Khiri Khan	TH57
Ranong	TH59
Ratchaburi	TH52
Rayong	TH47
Roi Et	TH25
Sa Kaeo	TH80
Sakon Nakhon	TH20
Samut Prakan	TH42
Samut Sakhon	TH55
Samut Songkhram	TH54
Saraburi	TH37
Satun	TH67
Sing Buri	TH33
Si Sa Ket	TH30
Songkhla	TH68
Sukhothai	TH09
Suphan Buri	TH51
Surat Thani	TH60
Surin	TH29
Tak	TH08
Trang	TH65
Trat	TH49
Ubon Ratchathani	TH75
Udon Thani	TH76
Uthai Thani	TH15
Uttaradit	TH10
Yala	TH70
Yasothon	TH72

Appendix B – New Frequency Allocations

Column description:

Column 1	#	Row number
Column 2	English Name	Name of the station, as defined by NBTC
Column 3	Province	Thailand Province where the transmitter is located
Column 4	FIPS	FIPS Code as per Thailand National Statistical Office
Column 5	Assign Frequency	Actual Frequency of the station in MHz
Column 6	New frequency	Proposed new frequency in MHz
Column 7	Proposed Call Sign	New proposed unique call sign
Column 8	AGL (m)	Antenna height Above Ground Level in metres
Column 9	ERP (W)	Station's ERP in Watt
Column 10	Pop 54 dBu	Population included in the 54 dBµV/m contour
Column 11	Pop 66 dBu	Population included in the 66 dBµV/m contour
Column 12	Pop 74 dBu	Population included in the 74 dBµV/m contour

NOTE: This table is not completed. Some frequency allocations are still marked in yellow.

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
1	Parliament	Bangkok	TH40	87.50 MHz.	92.30	HSA40A-FM	110	10000	9569450	6772940	3383992
2	PRD	Bangkok	TH40	88.00 MHz.	92.70	HSA40B-FM	150	40000	11043130	9232958	7323576
3	Royal Thai Navy	Bangkok	TH40	88.50 MHz.	93.10	HSA40C-FM	110	4000	8697239	5026624	2027414

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
4	Royal Thai Army	Bangkok	TH40	89.00 MHz.	93.50	HSA40D-FM	120	10000	9736871	7194424	3835468
5	Ministry of Education	Bangkok	TH40	89.50 MHz.	93.90	HSA40E-FM	120	20000	10073374	8018903	5190719
6	Royal Thai Army	Bangkok	TH40	90.00 MHz.	94.30	HSA40F-FM	120	10000	9662133	7010710	3922676
7	Office of the Permanent Secretary of Defence	Bangkok	TH40	90.50 MHz.	94.70	HSA40G-FM	124	1000	6615312	2311024	894934
8	Royal Thai Police	Bangkok	TH40	91.00 MHz.	95.10	HSA40H-FM	50	10000	7900307	3725902	1814504
9	Royal Thai Army	Bangkok	TH40	91.50 MHz.	95.50	HSA40I-FM	120	10000	9729393	7183089	3821657
10	Ministry of Education	Bangkok	TH40	92.00 MHz.	95.90	HSA40J-FM	120	5000	9193156	6103246	2852887
11	PRD	Bangkok	TH40	92.50 MHz.	96.30	HSA40K-FM	150	40000	11007709	9217234	7286207
12	Royal Thai Navy	Bangkok	TH40	93.00 MHz.	96.70	HSA40L-FM	110	4000	8682190	4997315	2001532
13	PRD	Bangkok	TH40	93.50 MHz.	97.10	HSA40M-FM	150	40000	10999653	9214116	7278360
14	Royal Thai Army	Bangkok	TH40	94.00 MHz.	97.50	HSA40N-FM	125	1500	8215086	3624198	1485809
15	Royal Thai Army	Bangkok	TH40	94.50 MHz.	97.90	HSA40O-FM	120	5000	9277496	5873825	2661399
16	MCOT	Bangkok	TH40	95.00 MHz.	98.30	HSA40P-FM	126	20000	10089289	6883607	3928224
17	PRD	Bangkok	TH40	95.50 MHz.	98.70	HSA40Q-FM	150	40000	10987584	9206169	7258666
18	Royal Thai Army	Bangkok	TH40	96.00 MHz.	99.10	HSA40R-FM	105	10000	9390731	6464176	3558740
19	MCOT	Bangkok	TH40	96.50 MHz.	99.50	HSA40S-FM	126	20000	10085952	6869975	3917772
20	PRD	Bangkok	TH40	97.00 MHz.	99.90	HSA40T-FM	150	40000	10977593	9202645	7245902
21	MCOT	Bangkok	TH40	97.50 MHz.	100.3	HSA40U-FM	126	20000	10083640	6863551	3912789
22	Royal Thai Army	Bangkok	TH40	98.00 MHz.	100.70	HSA40V-FM	120	10000	9642077	6959115	3868192
23	NBTC	Bangkok	TH40	98.50 MHz.	101.10	HSA40W-FM	110	7000	9255362	5916908	2667096

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
24	MCOT	Bangkok	TH40	99.00 MHz.	101.5	HSA40X-FM	126	20000	10079084	6848991	3902936
25	Supreme Command Headquarter	Bangkok	TH40	99.50 MHz.	101.90	HSA40Y-FM	120	10000	9638652	6948274	3859013
26	Royal Thai Army	Bangkok	TH40	100.00 MHz.	102.30	HSA40Z-FM	120	5000	9259691	5825818	2633185
27	MCOT	Bangkok	TH40	100.50 MHz.	102.70	HSB40A-FM	126	20000	10075094	6838653	3894705
28	Supreme Command Headquarter	Bangkok	TH40	101.00 MHz.	103.10	HSB40B-FM	40	5000	6931275	2437412	1011946
29	Ministry of University Affairs	Bangkok	TH40	101.50 MHz.	103.50	HSB40C-FM	150	19236	10299473	8315696	6009805
30	Royal Thai Army	Bangkok	TH40	102.00 MHz.	103.90	HSB40D-FM	100	10000	9412632	6182709	3004818
31	Royal Thai Air Force	Bangkok	TH40	102.50 MHz.	104.30	HSB40E-FM	90	5000	8631475	5037466	1965928
32	Royal Thai Army	Bangkok	TH40	103.00 MHz.	104.70	HSB40F-FM	120	5000	9251642	5798607	2619326
33	Royal Thai Army	Bangkok	TH40	103.50 MHz.	105.10	HSB40G-FM	120	5000	9203644	5619635	2560687
34	Bureau of the Royal Household	Bangkok	TH40	104.00 MHz.	105.50	HSB40H-FM	75	10000	8818409	5535931	2585582
35	Royal Thai Army	Bangkok	TH40	104.50 MHz.	105.90	HSB40I-FM	100	5000	8859827	4776739	2093695
36	PRD	Bangkok	TH40	105.00 MHz.	106.30	HSB40J-FM	150	40000	10935692	9178274	7180725
37	MCOT	Bangkok	TH40	105.50 MHz.	106.70	HSB40K-FM	110	10000	8517984	3104212	1519053
38	Royal Thai Navy	Bangkok	TH40	106.00 MHz.	107.10	HSB40L-FM	110	4000	8628289	4911775	1945549
39	NBTC	Bangkok	TH40	106.50 MHz.	107.50	HSB40M-FM	110	10000	9580568	6666872	3336986
40	MCOT	Bangkok	TH40	107.00 MHz.	107.90	HSB40N-FM	110	20000	9837014	6355970	3468195
41	Parliament	Kanchana Buri	TH50	106.25 MHz.	107.3	HSA50A-FM	100	2000	258741	132805	96019
42	MCOT	Kanchana Buri	TH50	107.25 MHz.	91.7	HSA50B-FM	120	4000	1167445	439492	203228
43	Royal Thai Army	Kanchana Buri	TH50	92.75 MHz.	96.5	HSA50C-FM	120	1000	362229	152906	74864

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
44	PRD	Kanchana Buri	TH50	94.25 MHz.	97.5	HSA50D-FM	100	4000	8311	2810	984
45	Royal Thai Police	Kanchana Buri	TH50	97.75 MHz.	100.5	HSA50E-FM	120	1000	200053	105883	49094
46	PRD	Chainat	TH32	91.75 MHz.	95.7	HSA32A-FM	80	4000	474739	175661	77533
47	Parliament	Chainat	TH32	96.25 MHz.	99.3	HSA32B-FM	80	2000	363612	127754	61516
48	Royal Thai Army	Nakhon Nayok	TH43	89.75 MHz.	94.1	HSA43A-FM	116	1000	268810	105764	33004
49	PRD	Phetchaburi	TH56	95.75 MHz.	98.9	HSA56A-FM	75	4000	506793	284517	191516
50	Royal Thai Army	Prachinburi	TH74	88.25 MHz.	92.9	HSA74A-FM	81	5000	404238	174437	106887
51	Royal Thai Army	Ratchaburi	TH52	99.25 MHz.	101.7	HSA52A-FM	115	1500	734307	273425	124629
52	Royal Thai Army	Lop buri	TH34	98.75 MHz.	101.3	HSA34A-FM	100	1500	570541	256419	171341
53	Marine Department	Samut Songkhram	TH54	107.50 MHz.	91.9	HSA54A-FM	95	1000	546751	217760	130475
54	MCOT	Singburi	TH33	105.3 MHz.	106.5	HSA33A-FM	140	4000	963697	298696	137645
55	PRD	Suphan buri	TH51	102.25 MHz.	104.1	HSA51A-FM	100	4000	866090	257930	135990
56	Parliament	Ubon Ratchathani	TH75	87.50 MHz.	92.3	HSA75A-FM	120	2000	604616	209023	51076
57	Royal Thai Army	Ubon Ratchathani	TH75	95.75 MHz.	98.9	HSA75B-FM	120	1000	554217	313572	181155
58	PRD	Ubon Ratchathani	TH75	98.50 MHz.	101.1	HSA75C-FM	120	4000	738420	313164	90796
59	Royal Thai Police	Ubon Ratchathani	TH75	99.50 MHz.	101.9	HSA75D-FM	120	1000	125096	34414	12763
60	NBTC	Ubon Ratchathani	TH75	102.00 MHz	103.9	HSA75E-FM	150	1000	602212	336845	211842
61	Royal Thai Navy	Ubon Ratchathani	TH75	104.00 MHz.	105.5	HSA75F-FM	100	1000	460139	220370	92274
62	Royal Thai Air Force	Ubon Ratchathani	TH75	105.25 MHz.	106.5	HSA75G-FM	102	1000	473916	209074	775678
63	MCOT	Ubon Ratchathani	TH75	107.00 MHz.	107.9	HSA75H-FM	120	4000	726029	374285	215932
64	Royal Thai Army	Surin	TH29	90.25 MHz.	94.5	HSA29A-FM	110	1000	441023	182974	112927

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
65	PRD	Surin	TH29	93.50 MHz.	97.1	HSA29B-FM	50	4000	373591	166846	92756
66	PRD	Surin	TH29	97.50 MHz.	100.3	HSA29C-FM	70	4000	493606	203874	122182
67	MCOT	Surin	TH29	99.75 MHz.	102.1	HSA29D-FM	110	4000	749220	295622	144025
68	Royal Thai Air Force	Surin	TH29	107.50 MHz.	91.9	HSA29E-FM	105	1000	427917	156451	82974
69	PRD	Yasothorn	TH72	90.00 MHz.	94.3	HSA72A-FM	100	4000	545254	198091	104346
70	MCOT	Yasothorn	TH72	95.25 MHz.	98.5	HSA72B-FM	120	4000	656377	241909	116628
71	Royal Thai Army	Yasothorn	TH72	100.00 MHz.	102.3	HSA72C-FM	120	1000	421309	121183	39003
72	Royal Thai Police	Yasothorn	TH72	105.00 MHz.	106.3	HSA72D-FM	120	1000	396503	138888	40237
73	PRD	Roiet	TH25	94.00 MHz.	97.5	HSA25A-FM	100	4000	774763	300934	162595
74	Royal Thai Army	Roiet	TH25	95.50 MHz.	98.7	HSA25B-FM	120	1000	604011	153354	56371
75	Royal Thai Police	Roiet	TH25	98.75 MHz.	101.3	HSA25C-FM	100	1000	490552	181524	76992
76	MCOT	Roiet	TH25	101.00 MHz.	103.1	HSA25D-FM	150	4000	1124976	419450	219598
77	Department of Fisheries	Roiet	TH25	101.60 MHz.	103.7	HSA25E-FM	100	1000	457904	169887	65564
78	MCOT	Sisaket	TH30	95.00 MHz.	98.3	HSA30A-FM	110	4000	740741	258711	116010
79	PRD	Sisaket	TH30	100.25 MHz.	102.5	HSA30B-FM	80	4000	563792	196093	108768
80	PRD	Mukdahan	TH78	99.25 MHz.	101.7	HSA78A-FM	95	4000	232290	100081	71330
81	PRD	Amnat Charoen	TH77	103.25 MHz.	104.9	HSA77A-FM	90	4000	429520	159196	73022
82	Royal Thai Army	Chiang Rai	TH03	90.75 MHz.	94.9	HSA03A-FM	48	10000	297280	197576	140234
83	Royal Thai Police	Chiang Rai	TH03	92.75 MHz.	96.5	HSA03B-FM	60	1000	130667	45271	22305
84	Royal Thai Air Force	Chiang Rai	TH03	94.25 MHz.	97.7	HSA03C-FM	60	1000	557026	290416	173019
85	PRD	Chiang Rai	TH03	95.75 MHz.	98.9	HSA03D-FM	60	4000	962785	412966	273731

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
86	Supreme Command Headquater	Chiang Rai	TH03	100.25 MHz.	102.5	HSA03E-FM	120	5000	616892	336960	145447
87	MCOT	Chiang Rai	TH03	101.25 MHz.	103.3	HSA03F-FM	60	4000	957914	412240	273553
88	Department of Fisheries	Chiang Rai	TH03	103.00 MHz.	104.7	HSA03G-FM	60	1000	182511	53193	16304
89	PRD	Phrae	TH07	91.00 MHz.	95.1	HSA07A-FM	60	4000	846188	436358	203470
90	MCOT	Phrae	TH07	93.00 MHz.	96.7	HSA07B-FM	60	4000	842891	435271	203059
91	Royal Thai Army	Phrae	TH07	103.50 MHz.	105.1	HSA07C-FM	120	1000	280379	170428	81025
92	Royal Thai Police	Phrae	TH07	106.00 MHz.	107.1	HSA07D-FM	100	1000	182051	80218	48084
93	MCOT	Nan	TH04	92.00 MHz.	95.9	HSA04A-FM	60	4000	215148	152592	116608
94	PRD	Nan	TH04	94.75 MHz.	98.1	HSA04B-FM	60	4000	221248	154135	120218
95	Royal Thai Air Force	Nan	TH04	96.00 MHz.	99.1	HSA04C-FM	60	1000	158679	118724	74093
96	Royal Thai Army	Nan	TH04	99.50 MHz.	101.9	HSA04D-FM	120	1000	196368	147229	104485
97	PRD	Phayao	TH41	95.25 MHz.	98.5	HSA41A-FM	100	4000	258577	173119	101611
98	MCOT	Phayao	TH41	97.25 MHz.	100.1	HSA41B-FM	45	4000	273658	145632	41320
99	Royal Thai Police	Phayao	TH41	106.25 MHz.	107.3	HSA41C-FM	108	1000	206306	93061	37835
100	Royal Thai Army	Phayao	TH41	107.25 MHz.	91.7	HSA41D-FM	95	1000	204925	104986	40411
101	NBTC	Lampang	TH06	90.00 MHz	94.3	HSA06A-FM					
102	Royal Thai Police	Lampang	TH06	91.50 MHz.	95.5	HSA06B-FM	100	1000	355482	174040	70854
103	PRD	Lampang	TH06	97.00 MHz.	99.9	HSA06C-FM	100	4000	561733	416572	332034
104	MCOT	Lampang	TH06	99.00 MHz.	101.5	HSA06D-FM	70	4000	634181	453787	358237
105	Royal Thai Army	Lampang	TH06	101.75 MHz.	103.7	HSA06E-FM	120	1000	350364	168096	65277
106	Royal Thai Police	Uttaradit	TH10	90.50 MHz.	94.7	HSA10A-FM	120	1000	268313	136059	66638

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
107	PRD	Uttaradit	TH10	96.75 MHz.	99.7	HSA10B-FM	100	4000	319201	185857	131148
108	Royal Thai Army	Uttaradit	TH10	97.50 MHz.	100.3	HSA10C-FM	108	1000	241673	137694	66374
109	MCOT	Uttaradit	TH10	98.50 MHz.	101.1	HSA10D-FM	120	4000	351709	200469	142784
110	Prince of Songkla University	Song Khla	TH68	88.00 MHz.	93.3	HSA68A-FM	10	1000	1053514	639001	416812
111	PRD	Song Khla	TH68	89.50 MHz.	97.5	HSA68B-FM	20	4000	1258189	855935	619632
112	PRD	Song Khla	TH68	90.50 MHz.	94.7	HSA68C-FM	20	40000	1831617	1190092	931354
113	Royal Thai Navy	Song Khla	TH68	94.50 MHz.	99.1	HSA68D-FM	35	1000	1068894	675321	429654
114	MCOT	Song Khla	TH68	96.50 MHz.	101.3	HSA68E-FM	50	4000	1187733	770842	533595
115	PRD	Song Khla	TH68	102.25 MHz.	104.1	HSA68F-FM	30	4000	1254567	860571	624085
116	Parliament	Song Khla	TH68	103.25 MHz.	103.1	HSA68G-FM	20	2000	1171836	738837	497390
117	Royal Thai Police	Song Khla	TH68	104.00 MHz.	91.7	HSA68H-FM	80	1000	452717	330505	150628
118	Royal Thai Air Force	Song Khla	TH68	107.00 MHz.	107.9	HSA68I-FM	20	1000	1057766	646083	424231
119	Royal Thai Army	Song Khla	TH68	107.75 MHz.	No Freq	HSA68J-FM	25	1000			
120	PRD	Trang	TH65	91.25 MHz.	95.3	HSA65A-FM	86	4000	404548	230699	157235
121	Royal Thai Army	Trang	TH65	103.00 MHz.	104.7	HSA65B-FM	95	1000	363012	185797	78576
122	MCOT	Trang	TH65	106.25 MHz.	107.3	HSA65C-FM	115	4000	459148	289375	159498
123	Royal Thai Police	Trang	TH65	106.75 MHz.	107.7	HSA65D-FM	89	1000	355956	201298	131318
124	Royal Thai Police	Naratiwat	TH31	88.25 MHz.	91.7	HSA31A-FM	80	1000	265521	107160	81122
125	Royal Thai Army	Naratiwat	TH31	92.50 MHz.	92.3	HSA31B-FM	95	5000	372480	169858	40449
126	Royal Thai Navy	Naratiwat	TH31	94.75 MHz.	93.1	HSA31C-FM	115	1000	316918	159596	83105
127	MCOT	Naratiwat	TH31	96.00 MHz.	94.9	HSA31D-FM	70	4000	344258	175049	100796

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
128	PRD	Naratiwat	TH31	98.25 MHz.	95.7	HSA31E-FM	95	20000	585031	317414	193581
129	Supreme Command Headquater	Naratiwat	TH31	99.10 MHz.	103.9	HSA31F-FM	23	10000	221814	100241	80883
130	PRD	Naratiwat (Sungai Kolok)	TH31	106.50 MHz.	107.7	HSA31G-FM	95	20000	328607	212822	160932
131	Royal Thai Army	Phatthalung	TH66	89.25 MHz.	93.7	HSA66A-FM	92	1000	261338	110910	38505
132	Royal Thai Police	Phatthalung	TH66	90.75 MHz.	94.9	HSA66B-FM	110	1000	325967	92993	35549
133	MCOT	Phatthalung	TH66	95.75 MHz.	98.9	HSA66C-FM	110	4000	472099	218773	110761
134	PRD	Phatthalung	TH66	98.00 MHz.	100.7	HSA66D-FM	90	4000	348405	193875	100259
135	Parliament	Yala	TH70	89.00 MHz.	93.3	HSA70A-FM	50	2000	1795846	1006534	392276
136	PRD	Yala	TH70	92.00 MHz.	95.9	HSA70B-FM	40	40000	2233986	1830916	1415073
137	PRD	Yala (Betong)	TH70	93.00 MHz.	96.3	HSA70C-FM	95	4000	49867	47142	41499
138	PRD	Yala	TH70	94.25 MHz.	95.1	HSA70D-FM	40	4000	1828711	1149086	471779
139	PRD	Yala	TH70	95.00 MHz.	103.7	HSA70E-FM	40	4000	1812900	1135083	468482
140	Royal Thai Army	Yala	TH70	100.00 MHz.	106.1	HSA70F-FM	80	5000	1564097	1056937	560348
141	MCOT	Yala	TH70	102.50 MHz.	107.3	HSA70G-FM	45	4000	1903599	1335375	604792
142	Royal Thai Police	Satun	TH67	91.75 MHz.	91.9	HSA67A-FM	94	1000	152607	52035	28396
143	MCOT	Satun	TH67	93.25 MHz.	93.3	HSA67B-FM	70	4000	240303	143469	97441
144	PRD	Satun	TH67	95.50 MHz.	95.7	HSA67C-FM	64	4000	215875	134164	90233
145	PRD	Satun	TH67	99.50 MHz.	98.7	HSA67D-FM	64	4000	236640	142761	97301
146	MCOT	Pattani	TH69	91.00 MHz.	95.1	HSA69A-FM	100	4000	554677	298910	188756
147	Royal Thai Army	Pattani	TH69	93.50 MHz.	97.1	HSA69B-FM	100	10000	887656	371662	197159
148	PRD	Pattani	TH69	101.00 MHz.	103.1	HSA69C-FM	90	4000	533073	280043	175429

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
149	Prince of Songkla University	Pattani	TH69	107.25 MHz.	91.5	HSA69D-FM	100	1000	416748	210465	125278
150	Royal Thai Navy	Chanthaburi	TH48	88.75 MHz.	93.3	HSA48A-FM	90	1000	243876	161723	114401
151	PRD	Chanthaburi	TH48	90.25 MHz.	94.5	HSA48B-FM	55	4000	253025	181112	127801
152	Royal Thai Air Force	Chanthaburi	TH48	93.25 MHz.	96.9	HSA48C-FM	62	1000	213320	137754	85750
153	MCOT	Chanthaburi	TH48	95.25 MHz.	98.5	HSA48D-FM	60	4000	272145	185696	122367
154	Royal Thai Army	Chon buri	TH46	98.25 MHz.	100.9	HSA46A-FM	55	1000	971948	438347	243313
155	PRD	Chon buri	TH46	99.75 MHz.	102.1	HSA46B-FM	50	4000	2274624	777371	416334
156	Royal Thai Navy	Chon buri	TH46	104.75 MHz.	106.1	HSA46C-FM	40	4000	687088	365045	230803
157	MCOT	Chon buri	TH46	107.75 MHz.	92.1	HSA46D-FM	45	4000	2233158	765825	411462
158	PRD	Trat	TH49	92.75 MHz.	96.5	HSA49A-FM	85	4000	138654	90819	65533
159	Royal Thai Navy	Trat	TH49	93.75 MHz.	97.3	HSA49B-FM	100	1000	141307	39510	13372
160	MCOT	Trat	TH49	107.25 MHz.	91.7	HSA49C-FM	85	4000	189340	72946	20977
161	Parliament	Rayong	TH47	87.75 MHz.	92.5	HSA47A-FM	55	2000	1131463	531671	310384
162	PRD	Rayong	TH47	91.75 MHz.	95.3	HSA47B-FM	55	4000	1335310	609114	400149
163	MCOT	Rayong	TH47	96.75 MHz.	99.7	HSA47C-FM	96	4000	1370746	621088	413225
164	Department of Fisheries	Rayong	TH47	100.75 MHz.	102.9	HSA47D-FM	43	1000	173733	45829	24937
165	Royal Thai Police	Rayong	TH47	102.75 MHz.	104.5	HSA47E-FM	90	1000	347901	194058	116654
166	Thai Meteorological Department	Rayong	TH47	105.25 MHz.	106.5	HSA47F-FM	90	4000	390607	217933	133133
167	PRD	Sakaeo	TH80	103.25 MHz.	104.9	HSA80A-FM	95	4000	271322	115734	66772
168	Royal Thai Army	Khon Kaen	TH22	88.25 MHz.	92.9	HSA22A-FM	109	1000	606528	332119	228857
169	MCOT	Khon Kaen	TH22	90.75 MHz.	94.9	HSA22B-FM	105	4000	850611	384984	137057

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
170	PRD	Khon Kaen	TH22	93.25 MHz.	96.9	HSA22C-FM	90	4000	412453	187096	99360
171	PRD	Khon Kaen	TH22	98.50 MHz.	101.1	HSA22D-FM	88	4000	889289	455483	305405
172	PRD	Khon Kaen	TH22	99.50 MHz.	101.9	HSA22E-FM	113	4000	977079	493072	328821
173	Ministry of University Affairs	Khon Kaen	TH22	103.00 MHz	104.7	HSA22F-FM	109	6500	1091697	539558	367891
174	Royal Thai Police	Khon Kaen	TH22	104.50 MHz.	105.9	HSA22G-FM	92	5000	773336	410308	296579
175	Royal Thai Air Force	Khon Kaen	TH22	107.75 MHz.	92.1	HSA22H-FM	47	1000	466883	248292	105514
176	Royal Thai Army	Loei	TH18	90.00 MHz.	94.3	HSA18A-FM	110	1000	113515	60160	25138
177	Royal Thai Police	Loei	TH18	92.50 MHz.	96.3	HSA18B-FM	110	1000	192978	88377	30976
178	PRD	Loei	TH18	95.25 MHz.	98.5	HSA18C-FM	32	4000	485176	232330	109366
179	MCOT	Loei	TH18	100.00 MHz.	102.3	HSA18D-FM	161	4000	602853	302932	147387
180	MCOT	Kalasin	TH23	92.00 MHz.	95.9	HSA23A-FM	108	4000	690506	212928	88698
181	PRD	Kalasin	TH23	93.00 MHz.	96.7	HSA23B-FM	90	4000	554386	212895	113158
182	Royal Thai Air Force	Mahasarakham	TH24	98.00 MHz.	100.7	HSA24A-FM	80	1000	356193	133327	68219
183	MCOT	Mahasarakham	TH24	100.50 MHz.	102.7	HSA24B-FM	70	4000	571792	206790	109129
184	Mahasarakham University	Mahasarakham	TH24	102.25 MHz.	104.1	HSA24C-FM	95	4990	750979	271277	134145
185	Royal Thai Army	Mahasarakham	TH24	105.50 MHz.	106.7	HSA24D-FM	100	10000	939493	327439	174169
186	PRD	Mahasarakham	TH24	106.50 MHz.	107.5	HSA24E-FM	108	4000	737212	246746	124292
187	PRD	Nong Bua Lamphu	TH79	97.25 MHz.	100.1	HSA79A-FM	89	4000	246718	88306	48713
188	Parliament	Nakhon Ratchasima	TH27	87.50 MHz.	92.3	HSA27A-FM	110	2000	805952	400295	210853
189	Royal Thai Police	Nakhon Ratchasima	TH27	89.25 MHz.	93.7	HSA27B-FM	110	1000	631886	414187	198066
190	Royal Thai Air Force	Nakhon Ratchasima	TH27	90.50 MHz.	94.7	HSA27C-FM	100	1000	647704	417915	266040

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
191	Thai Meteorological Department	Nakhon Ratchasima	TH27	94.25 MHz.	97.7	HSA27D-FM	110	4000	891095	377917	155061
192	MCOT	Nakhon Ratchasima	TH27	95.75 MHz.	98.9	HSA27E-FM	105	4000	935687	475476	268297
193	PRD	Nakhon Ratchasima	TH27	105.25 MHz.	106.5	HSA27F-FM	110	4000	934725	474873	268191
194	PRD	Nakhon Ratchasima	TH27	106.25 MHz.	107.3	HSA27G-FM	110	4000	633671	414244	291140
195	Royal Thai Army	Nakhon Ratchasima	TH27	107.25 MHz.	91.7	HSA27H-FM	110	1000	265843	108313	52963
196	Royal Thai Police	Chaiyapoom	TH26	88.75 MHz.	93.3	HSA26A-FM	100	1000	360867	180711	94039
197	PRD	Chaiyapoom	TH26	92.75 MHz.	96.5	HSA26B-FM	92	4000	437868	210203	106616
198	MCOT	Chaiyapoom	TH26	102.00 MHz.	103.9	HSA26C-FM	120	4000	639222	272527	128128
199	MCOT	Burirum	TH28	92.00 MHz.	95.9	HSA28A-FM	94	4000	371388	158480	74466
200	Royal Thai Air Force	Burirum	TH28	98.25 MHz.	100.9	HSA28B-FM	88	1000	371388	158480	74466
201	Royal Thai Army	Burirum	TH28	100.75 MHz.	102.9	HSA28C-FM	113	1000	509668	182105	79988
202	PRD	Burirum	TH28	101.75 MHz.	103.7	HSA28D-FM	112	4000	673121	283893	158353
203	Parliament	Udonthani	TH76	87.50 MHz.	92.3	HSA76A-FM	94.5	2000	654682	256713	75446
204	MCOT	Udonthani	TH76	91.50 MHz.	95.5	HSA76B-FM	104	4000	800129	331725	104859
205	PRD	Udonthani	TH76	93.75 MHz.	97.3	HSA76C-FM	91.5	4000	736250	315053	95959
206	NBTC	Udonthani	TH76	99.00 MHz	101.5	HSA76D-FM	85	1000	459054	269975	149398
207	Royal Thai Police	Udonthani	TH76	100.25 MHz.	102.5	HSA76E-FM	95	1000	482266	246852	133345
208	Royal Thai Air Force	Udonthani	TH76	104.00 MHz.	105.5	HSA76F-FM	90	1000	466489	278664	186530
209	Royal Thai Police	Udonthani	TH76	105.75 MHz.	106.9	HSA76G-FM	85	1000	461195	273644	149944
210	PRD	Nakhon Phanom	TH73	90.25 MHz.	94.5	HSA73A-FM	93	4000	234249	108927	72957
211	MCOT	Nakhon Phanom	TH73	93.50 MHz.	97.1	HSA73B-FM	109	4000	226824	102361	66343

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
212	Royal Thai Navy	Nakhon Phanom	TH73	97.50 MHz.	100.3	HSA73C-FM	89	4000	198257	89476	61992
213	Royal Thai Army	Nakhon Phanom	TH73	98.75 MHz.	101.3	HSA73D-FM	110	1000	262875	61783	23518
214	Parliament	Sakhon Nakhon	TH20	87.75 MHz.	92.5	HSA20A-FM	70	2000	946764	390771	213603
215	PRD	Sakhon Nakhon	TH20	91.25 MHz.	95.3	HSA20B-FM	70	4000	1209487	464792	278863
216	Supreme Command Headquater	Sakhon Nakhon	TH20	94.75 MHz.	98.1	HSA20C-FM	110	25000	797380	358058	216999
217	Royal Thai Air Force	Sakhon Nakhon	TH20	96.75 MHz.	99.7	HSA20D-FM	80	1000	260824	120078	57268
218	Royal Thai Police	Sakhon Nakhon	TH20	101.75 MHz.	103.7	HSA20E-FM	115	1000	327930	157808	88804
219	MCOT	Sakhon Nakhon	TH20	107.00 MHz.	107.9	HSA20F-FM	47	4000	1105788	440493	258133
220	PRD	Nong Khai	TH17	90.50 MHz.	94.7	HSA17A-FM	112	4000	454596	181796	111858
221	Royal Thai Navy	Nong Khai	TH17	95.75 MHz.	98.9	HSA17B-FM	110	1000	345767	112288	41712
222	MCOT	Nong Khai	TH17	102.50 MHz.	104.3	HSA17C-FM	108	4000	620803	226076	109156
223	PRD	Buengkan	TH81	104.25 MHz	105.7	HSA81A-FM	108	4000	192629	69857	43611
224	Royal Thai Navy	Chiang Mai	TH02	88.00 MHz.	92.7	HSA02A-FM	95	4000	877539	535859	274604
225	PRD	Chiang Mai	TH02	89.25 MHz.	93.7	HSA02B-FM	90	4000	190171	120609	74289
226	PRD	Chiang Mai	TH02	93.25 MHz.	96.9	HSA02C-FM	70	4000	1634804	1174532	994239
227	PRD	Chiang Mai	TH02	98.00 MHz.	100.7	HSA02D-FM	70	4000	1624272	1173790	993617
228	Chiang Mai University	Chiang Mai	TH02	100.00 MHz.	102.3	HSA02E-FM	75	4000	963250	668167	387385
229	MCOT	Chiang Mai	TH02	100.75 MHz.	102.9	HSA02F-FM	60	4000	1659977	1183630	1002132
230	Royal Thai Army	Chiang Mai	TH02	101.50 MHz.	103.5	HSA02G-FM	90	1000	696335	320750	121244
231	Royal Thai Air Force	Chiang Mai	TH02	102.50 MHz.	104.3	HSA02H-FM	40	1000	574867	223907	93211
232	Royal Thai Police	Chiang Mai	TH02	105.75 MHz.	106.9	HSA02I-FM	75	1000	681543	314526	132700

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
233	Parliament	Chiang Mai	TH02	106.75 MHz.	107.7	HSA02J-FM	75	2000	1375153	1113567	894170
234	PRD	Mae Hong Son	TH01	90.50 MHz.	94.7	HSA01A-FM	40	4000	55441	43951	38263
235	MCOT	Mae Hong Son	TH01	99.50 MHz.	101.9	HSA01B-FM	55	4000	93337	53481	32133
236	PRD	Mae Hong Son	TH01	102.00 MHz.	103.9	HSA01C-FM	36	20000	30852	26680	22508
237	PRD	Mae Hong Son	TH01	104.00 MHz.	105.5	HSA01D-FM	50	20000	144834	72034	49450
238	PRD	Lamphun	TH05	95.00 MHz.	98.3	HSA05A-FM	100	4000	816484	345712	155112
239	MCOT	Lamphun	TH05	96.50 MHz.	99.5	HSA05B-FM	110	4000	844763	350302	154473
240	Royal Thai Police	Lamphun	TH05	105.00 MHz.	106.3	HSA05C-FM	110	1000	612091	185468	82255
241	Royal Thai Army	Lamphun	TH05	107.50 MHz.	91.9	HSA05D-FM	100	1000	694121	235655	97673
242	Parliament	Phitsanulok	TH12	92.25 MHz.	96.1	HSA12A-FM	95	2000	608295	273798	107799
243	PRD	Phitsanulok	TH12	94.25 MHz.	97.7	HSA12B-FM	110	4000	634046	340430	207189
244	Royal Thai Air Force	Phitsanulok	TH12	95.75 MHz.	98.9	HSA12C-FM	50	1000	355266	213286	131834
245	Thai Meteorological Department	Phitsanulok	TH12	104.25 MHz.	105.7	HSA12D-FM	100	4000	459358	218987	117044
246	MCOT	Phitsanulok	TH12	106.25 MHz.	107.3	HSA12E-FM	90	4000	750502	359328	174569
247	Naresuan University	Phitsanulok	TH12	107.25 MHz.	91.7	HSA12F-FM	100	4000	622697	256477	137546
248	PRD	Sukhothai	TH09	93.75 MHz.	97.3	HSA09A-FM	108	4000	369305	177697	102370
249	MCOT	Sukhothai	TH09	99.25 MHz.	101.7	HSA09B-FM	120	4000	617243	165605	70710
250	Royal Thai Army	Sukhothai	TH09	102.25 MHz.	104.1	HSA09C-FM	110	1000	334375	67406	18122
251	Royal Thai Police	Phichit	TH13	88.25 MHz.	92.9	HSA13A-FM	90	1000	281157	109419	54805
252	MCOT	Phichit	TH13	107.75 MHz.	92.1	HSA13B-FM	111	4000	526016	143504	59169
253	Supreme Command Headquat	Phetchabun	TH14	99.00 MHz.	101.5	HSA14A-FM	108	1000	191902	131298	79228

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
	er										
254	PRD	Phetchabun	TH14	102.75 MHz.	104.5	HSA14B-FM	88	1000	203137	110753	51781
255	Royal Thai Police	Phetchabun	TH14	104.75 MHz.	106.1	HSA14C-FM	102	4000	307445	170486	90116
256	PRD	Nakhon Sawan	TH16	93.25 MHz.	96.9	HSA16A-FM	100	4000	804035	379879	257207
257	Royal Thai Air Force	Nakhon Sawan	TH16	95.25 MHz.	98.5	HSA16B-FM	30	1000	70152	37952	31185
258	Royal Thai Army	Nakhon Sawan	TH16	98.25 MHz.	100.9	HSA16C-FM	70	1000	343824	204415	127002
259	Royal Thai Police	Nakhon Sawan	TH16	105.75 MHz.	106.9	HSA16D-FM	70	1000	329573	199540	128257
260	Supreme Command Headquater	Uthaithani	TH15	88.75 MHz.	93.3	HSA15A-FM	90	1000	275005	93551	41250
261	MCOT	Uthaithani	TH15	101.75 MHz.	103.7	HSA15B-FM	111	4000	581941	188453	83443
262	Royal Thai Police	Tak	TH08	94.75 MHz.	98.1	HSA08A-FM	112	1000	137280	85354	45024
263	MCOT	Tak	TH08	97.25 MHz.	100.1	HSA08B-FM	90	4000	482466	235971	83309
264	PRD	Tak	TH08	102.00 MHz.	103.9	HSA08C-FM	80	4000	137483	83997	54908
265	PRD	Tak (Mae sod)	TH08	103.75 MHz.	105.3	HSA08D-FM	90	4000	123826	92882	76849
266	Royal Thai Police	Kamphaeng Phet	TH11	90.75 MHz.	94.9	HSA11A-FM	120	1000	277890	121946	81567
267	MCOT	Kamphaeng Phet	TH11	92.75 MHz.	96.5	HSA11B-FM	104	4000	383893	168365	100106
268	PRD	Kamphaeng Phet	TH11	97.75 MHz.	100.5	HSA11C-FM	86	4000	314742	133604	94793
269	Royal Thai Army	Kamphaeng Phet	TH11	105.00 MHz.	106.3	HSA11D-FM	90	1000	223543	113319	79090
270	Royal Thai Navy	Phuket	TH62	88.00 MHz.	92.7	HSA62A-FM	30	4000	455648	332327	296693
271	NBTC	Phuket	TH62	89.00 MHz.	93.50	HSA62B-FM	100	1000	340082	280196	215932
272	PRD	Phuket	TH62	90.50 MHz.	94.7	HSA62C-FM	35	4000	460560	333010	296974

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
273	Royal Thai Police	Phuket	TH62	95.00 MHz.	98.3	HSA62D-FM	100	1000	300477	230120	188619
274	PRD	Phuket	TH62	96.75 MHz.	99.7	HSA62E-FM	25	4000	443088	318080	284337
275	Parliament	Phuket	TH62	99.25 MHz.	101.7	HSA62F-FM	40	2000	400532	307237	268708
276	MCOT	Phuket	TH62	101.50 MHz.	103.5	HSA62G-FM	60	4000	482436	325714	290566
277	Royal Thai Army	Phuket	TH62	102.25 MHz.	104.1	HSA62H-FM	100	10000	410646	318456	264298
278	Thai Meteorological Department	Phuket	TH62	107.25 MHz.	91.7	HSA62I-FM	25	4000	449941	331822	296104
279	PRD	Phangnga	TH61	90.25 MHz.	94.5	HSA61A-FM	25	4000	74206	57755	45775
280	MCOT	Phangnga	TH61	91.75 MHz.	95.7	HSA61B-FM	100	4000	179970	65928	34448
281	Royal Thai Navy	Phangnga	TH61	97.75 MHz.	100.5	HSA61C-FM	100	1000	66488	30593	23130
282	PRD	Phangnga	TH61	100.00 MHz.	102.3	HSA61D-FM	100	4000	185256	70305	36733
283	Royal Thai Police	Phangnga	TH61	106.50 MHz.	107.5	HSA61E-FM	120	1000	81400	32942	22782
284	PRD	Krabi	TH63	98.50 MHz.	101.1	HSA63A-FM	100	4000	202484	124676	97464
285	MCOT	Krabi	TH63	105.00 MHz.	106.3	HSA63B-FM	120	4000	211956	130865	99059
286	Royal Thai Police	Nakhon Sri Thamarat	TH64	91.50 MHz.	95.5	HSA64A-FM	87	1000	477958	249165	134442
287	Royal Thai Police	Nakhon Sri Thamarat	TH64	92.50 MHz.	96.3	HSA64B-FM	102	1000	540197	265365	156648
288	PRD	Nakhon Sri Thamarat	TH64	93.50 MHz.	97.1	HSA64C-FM	88	4000	678902	372273	191991
289	PRD	Nakhon Sri Thamarat	TH64	97.00 MHz.	99.9	HSA64D-FM	48	4000	714552	376670	180926
290	MCOT	Nakhon Sri Thamarat	TH64	104.50 MHz.	105.9	HSA64E-FM	51	4000	1933622	1235066	750483
291	Parliament	Surat Thani	TH60	87.50 MHz.	92.3	HSA60A-FM	59	2000	498140	307519	213605
292	PRD	Surat Thani	TH60	89.75 MHz.	94.1	HSA60B-FM	45	4000	542128	346635	241512

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
293	Royal Thai Army	Surat Thani	TH60	92.25 MHz.	96.1	HSA60C-FM	86	1000	309555	205685	153652
294	PRD	Surat Thani	TH60	95.50 MHz.	98.7	HSA60D-FM	46	4000	542391	346635	242271
295	PRD	Surat Thani	TH60	96.75 MHz.	99.7	HSA60E-FM	54	4000	308114	122067	65880
296	Royal Thai Air Force	Surat Thani	TH60	98.25 MHz.	100.9	HSA60F-FM	55	1000	440494	258912	188935
297	Royal Thai Police	Surat Thani	TH60	99.00 MHz.	101.5	HSA60G-FM	86	1000	293862	209404	116691
298	MCOT	Surat Thani	TH60	102.00 MHz.	103.9	HSA60H-FM	55	4000	580179	361521	249741
299	MCOT	Ranong	TH59	100.50 MHz.	102.7	HSA59A-FM	51	4000	235568	96356	83914
300	PRD	Ranong	TH59	105.75 MHz.	106.9	HSA59B-FM	34	4000	110219	84455	65337
301	PRD	Ranong	TH59	107.25 MHz.	91.7	HSA59C-FM	112	4000	135839	90025	79647
302	MCOT	Chumphon	TH58	90.75 MHz.	94.9	HSA58A-FM	120	4000	246945	167560	105098
303	Thai Meteorological Department	Chumphon	TH58	94.25 MHz.	97.7	HSA58B-FM	90	4000	222108	147995	117024
304	PRD	Chumphon	TH58	100.00 MHz.	102.3	HSA58C-FM	60	4000	223401	153068	94183
305	Royal Thai Police	Chumphon	TH58	104.25 MHz.	105.7	HSA58D-FM	110	1000	191954	113686	61609
306	MCOT	Chumphon	TH58	104.75 MHz.	106.1	HSA58E-FM	80	4000	215450	139607	79545
307	Royal Thai Army	Chumphon	TH58	107.50 MHz.	91.9	HSA58F-FM	120	1000	184333	102799	55550
308	Parliament	Prachuap Khiri Khan	TH57	89.25 MHz.	93.7	HSA57A-FM	120	2000	111615	70568	49640
309	Royal Thai Air Force	Prachuap Khiri Khan	TH57	91.25 MHz.	95.3	HSA57B-FM	21	1000	130252	66037	52727
310	Royal Thai Army	Prachuap Khiri Khan	TH57	96.25 MHz.	99.3	HSA57C-FM	120	1000	166439	95213	72859
311	PRD	Prachuap Khiri Khan	TH57	98.75 MHz.	101.3	HSA57D-FM	60	4000	386295	226170	118731
312	Royal Thai Police	Prachuap Khiri Khan	TH57	100.25 MHz.	102.5	HSA57E-FM	60	1000	277526	155953	88326
313	PRD	Prachuap Khiri Khan	TH57	102.25 MHz.	104.1	HSA57F-FM	120	4000	126523	78027	57878

#	English Name	Province	FIPS	*Assign Freq. (MHz)	New Freq. (MHz)	Proposed Call Sign	AGL (M)	ERP (W)	Pop 54 dBu	Pop 66 dBu	Pop 74 dBu
314	MCOT	Prachuap Khiri Khan	TH57	106.75 MHz.	107.7	HSA57G-FM	100	4000	148433	87809	51560
315	New Allotment 1 - Angthong	Angthong	TH35	NEW	97.7	HSA35A-FM	120	4000	1227995	972827	193395
316	New Allotment 2 - Angthong	Angthong	TH35	NEW	104.9	HSA35B-FM	120	4000	1213174	369927	192260

Appendix C – Station's Coverage

Each station's individual coverage has been provided as individual PDF file map. These files are provided in conjunction to this report and are annexed to the soft copy version of this report.