FREQUENCY PLANNING FOR DIGITAL RADIO NETWORK IN THAILAND

INTRODUCTION

In 2023, Office of the NBTC and Thammasat University Research and Consultancy Institute carried out a project titled "Survey of Demand for Radio Services, Cost Assessment, and Development of Investment Models for Digital Radio Broadcasting Services in Thailand," which included technical analysis and frequency planning for the DAB+ network in Thailand. Experts from Progira (Mats Ek) and S-Comm Technologies (Dr. Les Sabel) contributed to the technical aspects of the project, working alongside the team from the Broadcasting Technology and Engineering Bureau, Office of the NBTC.

In the frequency planning process, an attempt was made to divide Thailand into 77 allotment areas based on the administrative boundaries (77 provinces). However, these allotment areas would have been too small, limiting spectrum efficiency. Taking into account several factors of each province such as area size, economy, culture, and dialect, the decision was made to divide the country into 10 regions with 34 allotment areas. Each allotment area consists of either a single province or a group of provinces (with a maximum of 6 provinces).

After the completion of the project, the output on frequency planning was considered for developing the NBTC Notification on DAB+ Frequency Plan. This plan underwent drafting, public hearing, and approval processes before being published in the Government Gazette on 11 October 2024. The scopes of DAB+ Frequency Plan are as follows:

- Frequency range: 174 – 230 MHz (frequency block 5A to 12C)
- Frequency plan for future assignment: Allotment plan (indication of frequency blocks to be assigned to each area)
- System: DAB+ Audio with MPEG-4 HE AAC v2 Frequency Planning

During the planning phase, frequency blocks were allocated to each allotment area, and iterative calculations were performed to assess interference and compatibility. In the calculation process, several factors were considered, including the limitation of 12C block (due to its domestic use until 2026), cross-border agreements, and the frequency channels used in neighboring countries. As a result, the allotment plan was finalized with 5-6 frequency blocks assigned to each allotment area. The first two frequency blocks of each area are adjacent and reserved for national or large regional networks, with mandatory infrastructure sharing to prevent interference. Additionally, the following ERP recommendations have been made:

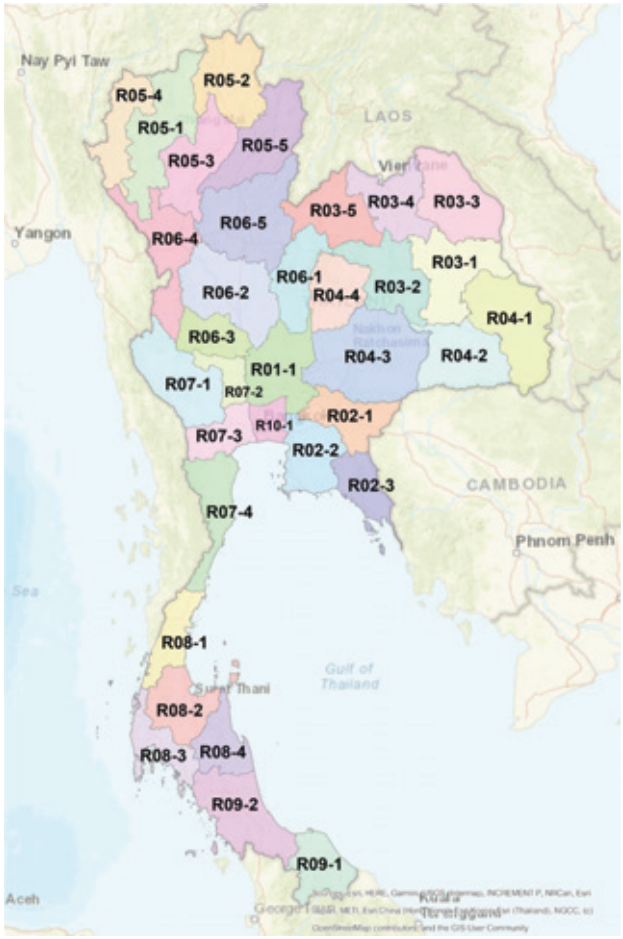
1. A maximum of 10 kW ERP for large city areas
2. A maximum of 4 kW ERP for other areas
3. A maximum of 1 kW ERP for gap fillers or stations located near the borders of the allotment areas

The frequency allotment plan for DAB+ in Thailand is shown in ***Table 1*** and ***Figure 1***.

Table 1: *Frequency allotment plan for DAB+ in Thailand (Table)*

Region	Allotment Area	Frequency Blocks					
		1	2	3	4	5	6
R01	R01-1	5A	5B	5D	6C	8C	9C
R02	R02-1	11A	11B	11D	5C	8D	11C
	R02-2	10A	10B	10D	8A	8B	7C
	R02-3	7A	7B	7D	5A	6C	5D
R03	R03-1	6A	6B	6D	9A	11C	9D
	R03-2	10A	10B	10D	6C	8C	-
	R03-3	5A	5B	5D	7A	10C	7D
	R03-4	8A	8B	8D	12A	12B	12D
	R03-5	5A	5B	5D	7A	7B	7D
R04	R04-1	8A	11B	8D	12A	12B	12D
	R04-2	7C	8B	9C	5A	5B	5D
	R04-3	12A	12B	12D	7A	7B	7D
	R04-4	11A	11B	11D	5C	7C	10C
R05	R05-1	9B	7A	8A	11A	10C	11D
	R05-2	5A	5B	5D	6C	7B	7D
	R05-3	6A	6B	6D	11C	8C	7C
	R05-4	6A	6B	6D	12A	11C	12D
	R05-5	8A	8B	8D	5C	11B	11D
R06	R06-1	6A	6B	6D	8A	8B	8D
	R06-2	7A	7B	7D	9A	9B	9D
	R06-3	11A	11B	11D	5C	10C	-
	R06-4	5A	5B	5D	9C	6C	-
	R06-5	10A	10B	10D	12A	12B	12D
R07	R07-1	8A	8B	8D	10A	10B	10D
	R07-2	12A	12B	12D	11C	7C	-
	R07-3	7A	7B	7D	11A	11B	11D
	R07-4	5A	5B	5D	6C	8C	9C
R08	R08-1	10A	10B	10D	11C	8A	8D
	R08-2	6A	6B	6D	9A	9C	11B
	R08-3	10C	8B	8C	6C	5C	11D
	R08-4	5A	5B	5D	7C	9C	11C
R09	R09-1	6A	6B	6D	9A	9C	12A
	R09-2	7A	7B	7D	9B	9D	12B
R10	R10-1	6A	6B	6D	9A	9B	9D

Figure 1: *: The frequency allotment plan for DAB+ in Thailand (Map)*



Since this is the frequency allotment plan, it is essential to establish the criteria for the frequency assignment process, which occurs after the network license is granted and the technical characteristics of the transmitter site are known. The criteria for coverage prediction and interference assessment are outlined in ***Table 2***.

An example of interference assessment for 10D block in allotment area R02-2 is shown in ***Figure 2*** and is further detailed in all the cases shown in ***Table 3***.

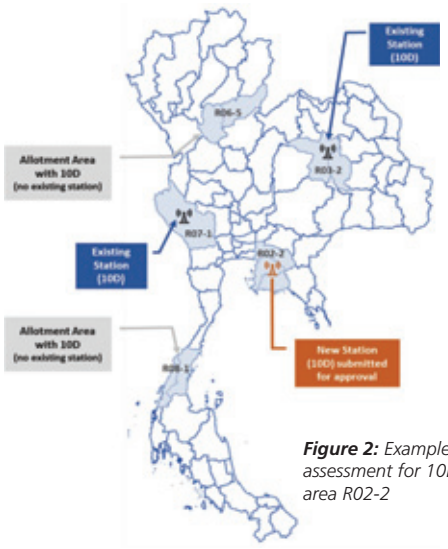


Figure 2: *Example of interference assessment for 10D block in allotment area R02-2*

Table 2: *The criteria for coverage prediction and interference assessment*

Coverage Prediction	Interference Assessment
• The minimum field strength for mobile reception is 42.84 dBµV/m at 200 MHz and 1.5 meters above ground level. • The reference propagation model is Recommendation ITU-R P.1546, CRC Predict, or an equivalent terrain-based model. • For SFN, the reference coverage area is derived from 99% of locations and 95% of the time. • For other cases, the reference coverage area is derived from 99% of locations and 99% of the time.	• The reference coverage area may be larger than the service area; however, it shall not cause interference to other service areas. If any possible interference, it will be permitted only if accepted by the affected network operators. • To prevent interference to future stations, the maximum permissible field strength at the border of another allotment area using the same frequency block is 26 dBµV/m. In SFN, the cumulative field strength will be used for the assessment. • In case of potential interference, the network operator shall revise the technical characteristics of the stations and resubmit for approval. • The field strength of wanted station is calculated from 50% of the time and 50% of the location, and the field strength of unwanted station is calculated from 1% of the time and 50% of the location.

Note: 1. "Reference coverage area" is based on calculation and "service area" is based on allotment area indicated in license condition.
2. Technical basis for planning, protection criteria and out-of-band emissions refers to Recommendation ITU-R BS.1660-9.

Table 3: Details of all the cases for interference assessment

Cases	Criteria
(1) New station and existing stations using the same frequency block	New station shall not cause interference to existing stations, particularly within the service areas of those stations.
(2) New station and another allotment areas with the same frequency block (no existing station)	Field strength of new station shall not exceed 26 dBµV/m at the border of another allotment areas.
(3) New station and adjacent service areas	If the reference coverage area of a new station located within a specific service area overlaps with adjacent service areas, coordination will be required.

CAPACITY PLANNING

The net bit rate of DAB+ ensemble is 1152 kbps, and a study on capacity planning for the DAB+ network in Thailand recommends 64 kbps per DAB+ channel. Based on this, one ensemble can accommodate 18 channels. However, the bit rate per channel is not specified in the NBTC Notification and remains flexible for future licensing processes. For instance, some broadcasters may require a higher bit rate, such as 128 kbps, for high-quality audio, while some others may opt for a lower bit rate, such as 48 kbps or 32 kbps.

CONCLUSIONS

According to the law, radio services in Thailand are categorized into three levels: national, regional, and local. This frequency allotment plan has been prepared for all three levels of radio services, but the bit rate per audio channel is not specified in the technical regulations. This allows for flexibility to accommodate future licensing schemes, which will be determined later this year. Although there is flexibility, it still take into account the quality of signal, coverage area and interference prevention.

In addition to the frequency allotment plan for DAB+, the NBTC Notifications on the technical standards for DAB+ transmitters and receivers have been published in the Government Gazette. All relevant NBTC Notifications (in Thai) can be downloaded from the website (https://broadcast.nbtc.go.th). The next step for NBTC is the licensing process, which is expected to begin at the end of 2025 or in 2026.

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Mr Supatrasit has experience in both telecommunications and broadcasting sectors. He has been involved in broadcasting industry since 2011, which was the beginning of transition to digital television in Thailand. He is responsible for developing technical regulations (technical specification and frequency planning) and technical policy of digital terrestrial television. He worked in the 700 MHz re-stacking project during 2019-2021. In 2020-2022, he conducted the feasibility study on 4K technology in Thailand. Recently, in 2023-2024, he collaborated with consultants from Thammasat University and overseas partners to conduct the network design and frequency planning for DAB+ network in Thailand. He also developed the NBTC Notification on DAB+ Frequency Plan, published in October 2024. ■