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Development Sector
Study Groups**



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DELAYED CONTRIBUTION

Question 8/1: **Examination of strategies and methods of migration from analogue to digital terrestrial broadcasting and implementation of new services**

SOURCE: Thailand

TITLE: Digital Terrestrial Television in Thailand: Frequency planning and technical aspects

Action required: Participants are to consider this contribution for inclusion in the final report.

Keywords: *Digital Terrestrial Television, frequency planning, technical aspects, Thailand*

Abstract:

In Thailand, the National Broadcasting and Telecommunications Commission (NBTC) is playing an important role in promoting and implementing the transition from analogue to digital terrestrial television. In 2012, the transition roadmap was developed and DVB-T2 was selected as a national standard for digital terrestrial television (DTT). The technical specifications for DTT transmission, DTT receivers, as well as the first frequency plan were then developed. In 2013, NBTC and broadcasters conducted a field trial for DTT in Bangkok area to find tuning suitable parameter set - a key driver to the new frequency plan, aiming for a coverage target as stipulated in the roadmap. Since then, NBTC has been reviewing and updating relevant technical specifications and the frequency plan, as well as developing DTT technical guidelines.

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Introduction

In Thailand, the National Broadcasting and Telecommunications Commission (NBTC) is playing an important role in promoting and implementing the transition from analogue to digital terrestrial television. In 2012, the transition roadmap was developed and DVB-T2 was selected as a national standard for digital terrestrial television (DTT). The technical specifications for DTT transmission, DTT receivers, as well as the first frequency plan were then developed. In 2013, NBTC and broadcasters conducted a field trial for DTT in Bangkok area to find tuning suitable parameter set - a key driver to the new frequency plan, aiming for a coverage target as stipulated in the roadmap. Since then, NBTC has been reviewing and updating relevant technical specifications and the frequency plan, as well as developing DTT technical guidelines.

Key Technologies and Technical Parameters for DVB-T2

The following key technologies and requirements for digital terrestrial television are as follows;

Table 1: Key technologies and requirements for DTT in Thailand

Items	Specifications/Requirements
DTTB Transmission	DVB-T2
Resolution	SD and HD - SD – Standard Definition (576i) - HD – High Definition (1080i or 720p)
Video Compression	MPEG-4 AVC/H.264 (supports subtitling system)
Audio Compression	MPEG-4 HE AACv2 - Stereo is minimum requirement.
Conditional Access	No conditional access (free-to-air)
Number of Multiplexes	6
Number of Programs	48

In 2013, the field trial was conducted in Bangkok Metropolitan Area to determine a suitable parameter set. The parameter set was selected considering a trade-off between signal robustness and available bitrates.

- Robustness: able to plan a network to meet coverage requirement (95% household with fixed rooftop reception, plus portable indoor reception in major municipalities).
- Bitrates: able to deliver 48 digital TV programs (at least 10 HD programs and 38 SD programs) with 6 multiplexes.

Table 2 shows the DVB-T2 parameter set for Thailand. This parameter set is mandatory for network operators because these parameters provide certain characteristics, which are critical for the frequency planning.

Table 2: DVB-T2 parameter set for Thailand (Mandatory)

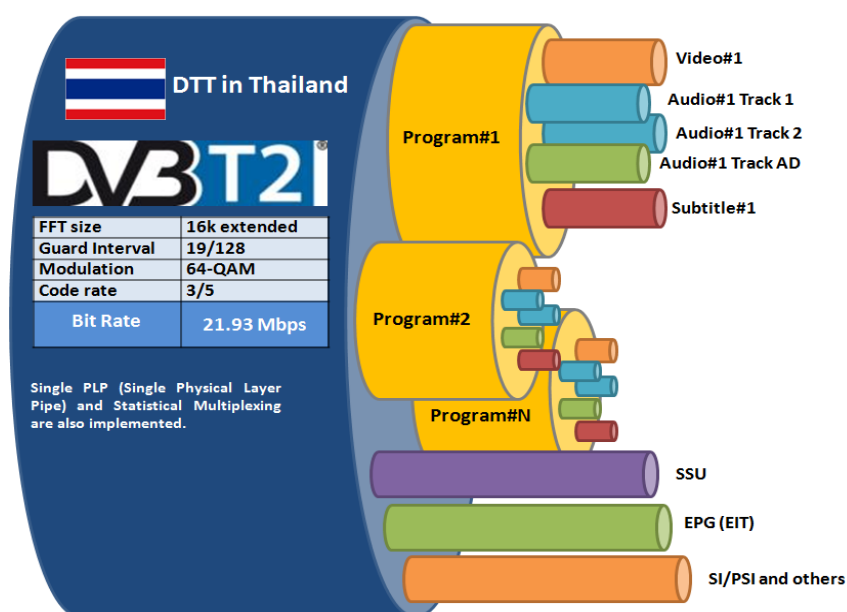
Parameters	Values
FFT size	16k extended
Guard Interval	19/128
Modulation	64-QAM
Code rate	3/5

The above parameter set can provide approximately 22 Mbps/multiplex, therefore, NBTC developed four possible options for multiplex composition:

- Option 1: 12 SD services (available for the multiplex for community services only)
- Option 2: 1 HD and 9 SD services
- Option 3: 2 HD and 6 SD services (being used in 4 multiplexes)
- Option 4: 3 HD and 3 SD services (being used in 1 multiplex)

Capacity Management

In 2014-2015, the NBTC has established a working group to develop technical guidelines for digital terrestrial television. In addition to the mandatory parameter set, these technical guidelines provide recommendations to network operators to use certain parameters and to manage the multiplex capacity in accordance with the chosen multiplex option as shown in Figure 1 and Table 3.



Source: Broadcasting Technology and Engineering Bureau (Office of the NBTC)

Figure 1: Example of Multiplex Composition with DVB-T2 Parameter being in Thailand

Table 3: Recommended Parameters and Multiplex Capacity Management

DVB-T2 Parameters: 16k ext., GI 19/128, PP2, 64-QAM, CR 3/5, L1Post:QPSK) Time Interleave Depth = 81.71 ms.	Total Bit Rate 21.930 Mbps			
ITEMS	Option 1	Option 2	Option 3	Option 4
Number of HD Channels	0	1	2	3
Number of SD Channels	12	9	6	3
TOTAL CHANNELS	12	10	8	6
BIT RATE	(kbps)			
Video Bit Rate (Pool Bit Rate with Statistical Multiplexing) - SD Bit Rate (min-max) = 0.75-2.5 Mbps - HD Bit Rate (min-max) = 2-7 Mbps	18400	18700	19000	19000
Audio Bit Rate (70 kbps per one stereo, 2 tracks per	1680	1400	1120	840

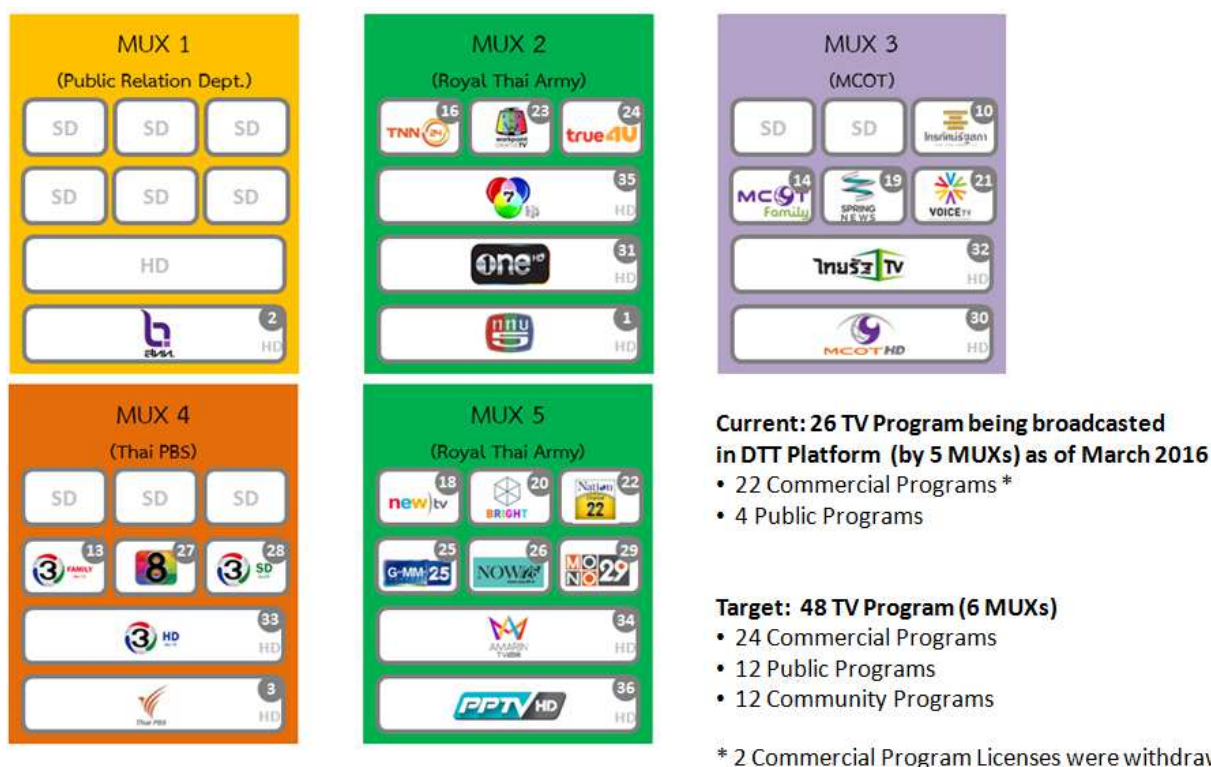
channel)				
Audio Description (35 kbps per one stereo, 1 track per channel)	420	350	280	210
Subtitles (100 kbps per channel)	1200	1000	800	600
SI (EIT) or EPG	300	300	300	300
SI (PMT) (25.75 kbps per channel)	309	257.5	206	154.5
SI (others) = 64 kbps	64	64	64	64
TOTAL PAYLOAD	22373	22071.5	21770	21168.5
Reserved for SSU and others	-443*	-141.5*	160	761.5

*The negative values imply that it is not feasible to provide all supplementary services (i.e. audio description, subtitle, SSU) at the same time.

Source: Broadcasting Technology and Engineering Bureau (Office of the NBTC)

Current TV Programs and Multiplex Loading

The auction for commercial TV programs took place in December 2013 and the licenses were given to 22 commercial TV programs (7 HD programs and 15 SD programs). In addition, 3 public TV programs were permitted to be broadcasted in HD format during the simulcast period. In 2015, NBTC granted one additional license to 1 public TV program (Parliament TV). Nowadays, Thailand has 26 digital TV programs (10 HD programs and 16 SD programs) transmitted by 5 multiplexes. The relationship between TV programs and current multiplex loading is shown in Figure 2.



Source: Broadcasting Technology and Engineering Bureau (Office of the NBTC)

Figure 2: Relationship between Digital TV Programs and Current Multiplex Loading (March 2016)

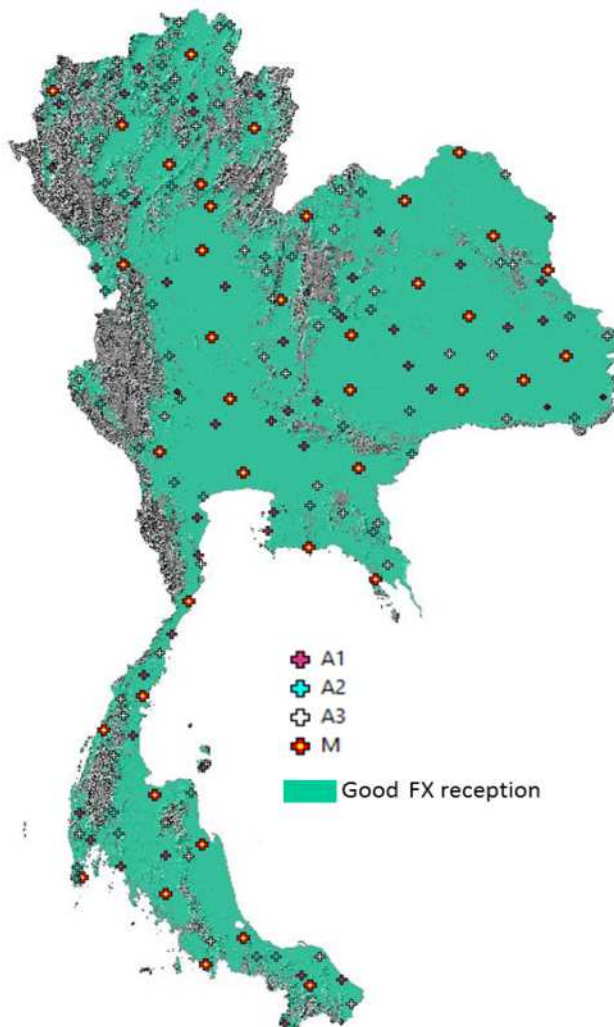
Frequency Planning

NBTC was in collaboration with International Telecommunications Union (ITU) to conduct a frequency planning for DTT. This project was completed the detailed planning for 39 main sites and 132 additional sites in February 2014 and February 2015, respectively. The 3rd edition of DTT frequency plan was officially published in August 2015. The summary of DTT frequency plan is shown in Table 4 below:

Table 4: Summary of DTT Frequency Plan for Thailand

No	Items	Description
1	Frequency range	510 – 790 MHz
2	Channel bandwidth	8 MHz (CH26-60)
3	Number of multiplexes	<ul style="list-style-type: none"> • 5 multiplexes before Analogue Switch-Off • 6 multiplexes after Analogue Switch-Off • 6th Multiplex is reserved for community TV
4	Number of service areas	39 service areas
5	Number of planned sites	39 main sites and 132 additional sites
6	Coverage target	95% household (fixed rooftop reception)

NBTC and ITU categorize the station type into 4 types (M, A1, A2, and A3). The description of each type and the coverage of DTT in Thailand are shown in Figure 3.



Type of Stations	Name	Number of Sites
M	Main sites (existing ATV sites)	39
A1	Additional existing sites (most ATV sites)	45
A2	Additional existing sites (most telecom sites)	33
A3	Additional non-existing sites	[49]

Figure 3: DTT Coverage in Thailand (after the completion of network rollout) and DTT Station Types

The frequency planning and re-planning had several stages and can be summarized below:

- 2012 : frequency planning was conducted by broadcasters and proposed to NBTC ;
- 2013 : the frequency plan of 2012 was verified and the frequency re-planning for 39 main sites was conducted jointly by NBTC and ITU ;
- 2014 : the frequency planning for additional sites was started by NBTC and ITU;
- 2015 : the frequency planning for additional sites (A1, A2 and A3) was completed ; and
- 2016 : the frequency re-planning for additional sites (A2 and A3) was conducted by NBTC to solve the problem on infrastructure and facilities e.g. limitation on space and capacity of the telecom sites.

Although, there were several stages of frequency planning, NBTC maintains the planning principles and parameters as shown in Table 5.

Table 5 : Planning Principles and Parameters

Parameters	Value/Criteria
System Variants	DVB-T2 with 16K ext, 64QAM, code rate 3/5, PP2, GI 266 μ s
Planning and Protection Criteria	Analogue TV: ITU-R BT.655 (protection ratio), ITU-R BT.417 (minimum field strength), ITU-R BT.419 (antenna discrimination) Digital TV: ITU-R BT.2033 (planning criteria incl. protection ratio for fixed reception mode), ITU-R BT.419 (antenna discrimination), Signal summation method : Log normal method Coverage Probability (Target) : 90%
Propagation model	CRC Predict Model - Wanted signal : 50% location, 50% time - Interfering signal : 50% location, 1% time
Terrain and Clutter data	100x100 m resolution or better resolution

The DTTB networks are deployed in four phases over a period of four years, providing fixed (FX) rooftop coverage for 95% of the Thai households. A major part of the first two phases have been reached. More additional sites are needed for the last two phases to reach the planning target.

Thai PBS operates a nationwide network of UHF transmitters and the applied antenna systems were technically assessed to provide enough capacity to accommodate also the DTTB frequencies. Hence the planning of the 39 main sites had to be based on reusing these UHF transmitter sites.

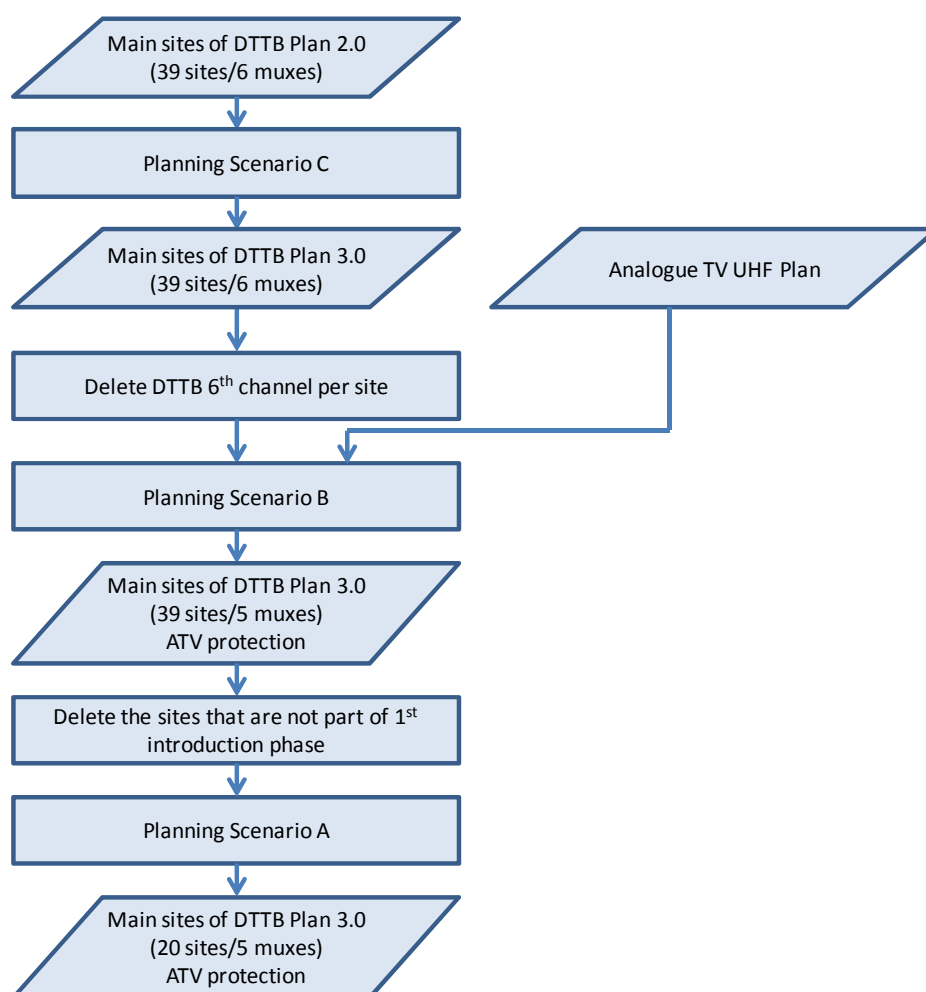
The following planning targets were defined:

- 1) FX rooftop coverage for 95% of the Thai households;
- 2) Regional FX rooftop coverage in 39 regions for providing Community services;
- 3) Portable Indoor (PI) coverage in target municipalities; and
- 4) Protection of operational ATV services in the UHF band.

Planning targets 1 to 3 are defined in the regulatory framework, i.e. NBTC Notifications. It should be noted however that the PI target was not clearly defined at the beginning of the planning process. Thus, the first step in the planning was to design the DTTB networks for FX rooftop reception and then calculate what the resulting PI coverage would be. At the time that the FX network would be deployed the policy makers would have reached a conclusion on the PI target and additional PI sites could be planned at a later stage. This approach would also allow the regulator to monitor the uptake of the DTTB services and how well the service providers would do in earning advertising income on the DTTB platform.

The operational ATV networks had to be protected from DTTB interfering these networks (and hence the ATV viewers) and reversely the DTTB network should be made compatible with these ATV networks. Also the network topology should be kept, as much as possible, the same when transitioning from the simulcast period (in which ATV service had to be protected) to the all digital situation (after television ASO in the UHF band).

The adopted planning approach to cater for this was to first plan for the all-digital situation. For the all-digital situation the network would be optimize to reach the planning targets and to minimize spectrum usage. This planning scenario was labeled scenario C. For protecting ATV services either some interference on the ATV networks had to be accepted (i.e. acceptable interference) or temporarily frequency had to be applied. The number of frequency changes should be kept to a minimum as this would increase network costs as well as complicate the network deployment. An overview of this planning approach is provided in Figure 4.



Source: Collaboration Project between NBTC and ITU

Figure 4 : Applied Planning Approach

Network Rollout

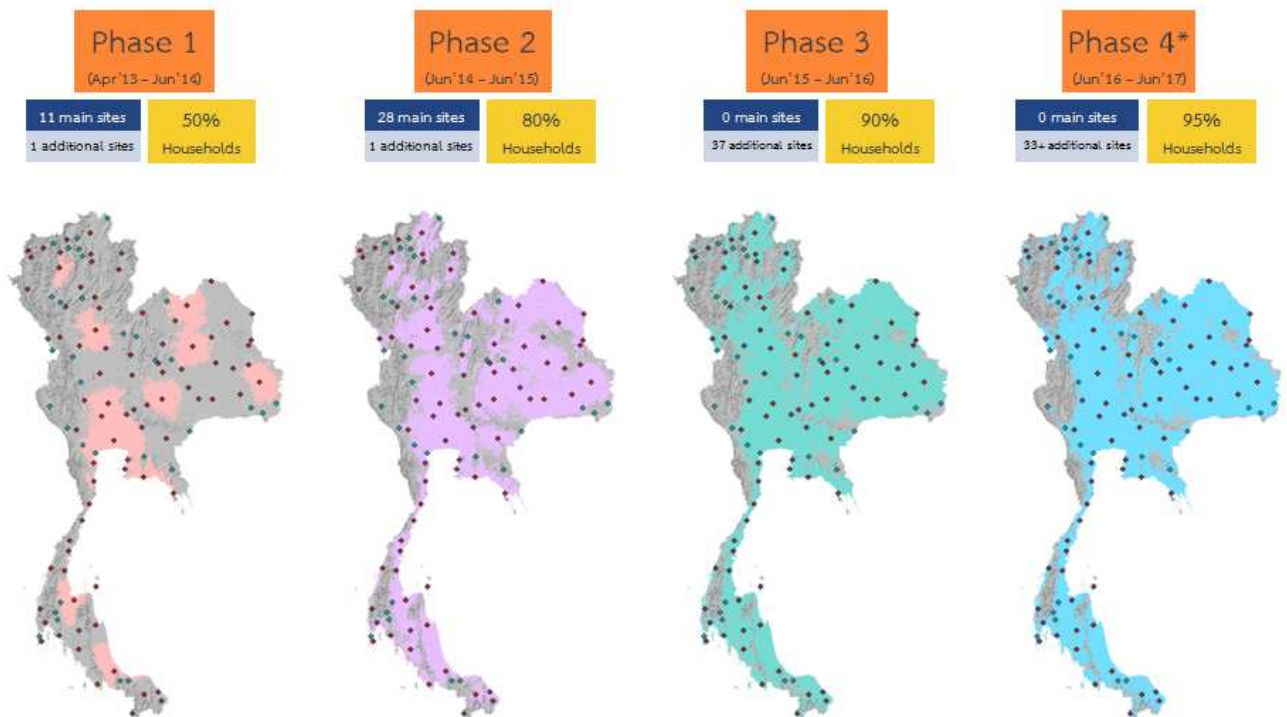
According to license conditions, the network operators shall implement their networks to reach 95% households within 4 years. The network deployment schedule was jointly developed by NBTC and network operators. The deployment schedule is shown in Table 6.

Table 6: DTT Network Deployment Schedule and Current Status

Phase	Duration	Rollout Obligation	Rollout Plan	Status**
1	April 2014 – June 2014	50% Households	11 M sites and 1 A1 site	Completed
2	June 2014 – June 2015	80% Households	+ 28 M sites and 7 A1 sites	Completed
3	June 2015 – June 2016	90% Households	+ 37 A1 sites	Ongoing
4	June 2016 – June 2017	95% Households	+ 33 A2 sites + A3 sites	Planned Reviewing

**As of March 2016.

The deployment phase and the coverage are shown in Figure 5 below:



* Phase 4 does not include the A3 sites which are under reviewing

Source: Broadcasting Technology and Engineering Bureau (Office of the NBTC)

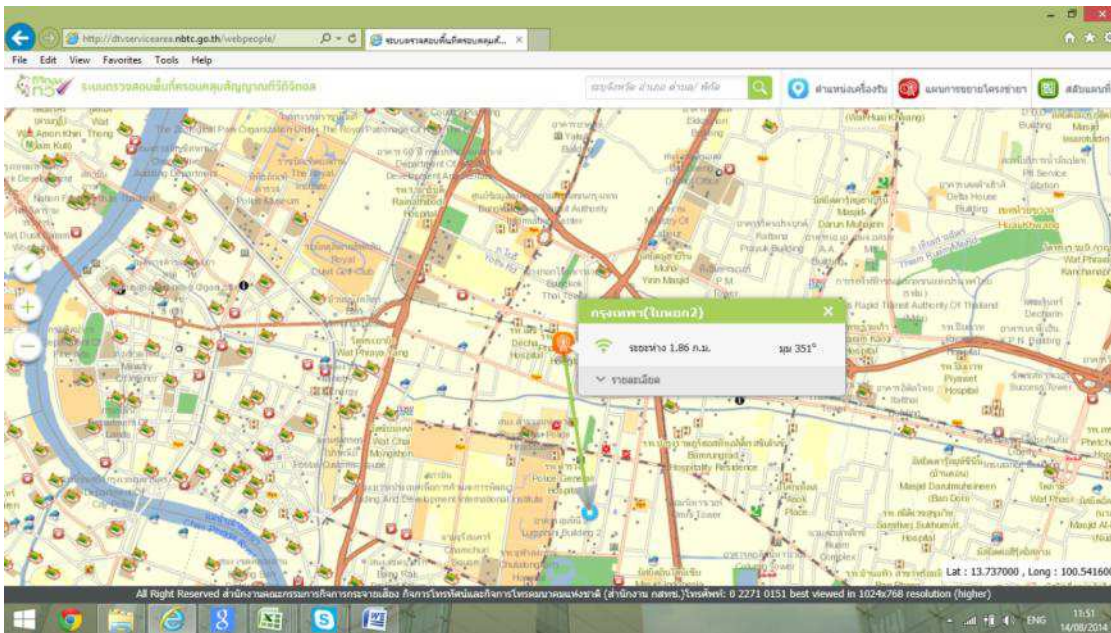
Figure 6: DTT Deployment Phase and Target Coverage

Coverage Checking Application

Based on the frequency planning and simulation results, the NBTC launched the digital terrestrial television coverage checking application. Figure 8 shows the graphical user interface of one of the web pages of NBTC’s coverage checker. The application was made available for PC, tablet, smartphone in 3 platforms: (1) Web browser, (2) Android OS, (3) iOS. It shows the common information found on any other typical coverage checker websites, including:

- 1) A text box to enter the position of the reception location;

- 2) The location of the nearest or best transmitter site (indicated on the map with a tower symbol);
- 3) An indication of the signal strength and quality (indicated with a signal strength symbol, typically found on mobile telephone hand-sets);
- 4) The number of multiplexes available on this transmitter site (and click through pages to the available services on each multiplex);
- 5) Indication of the antenna direction angle (azimuth angle) towards the nearest or best transmitter site (indicated on the map with a green line).

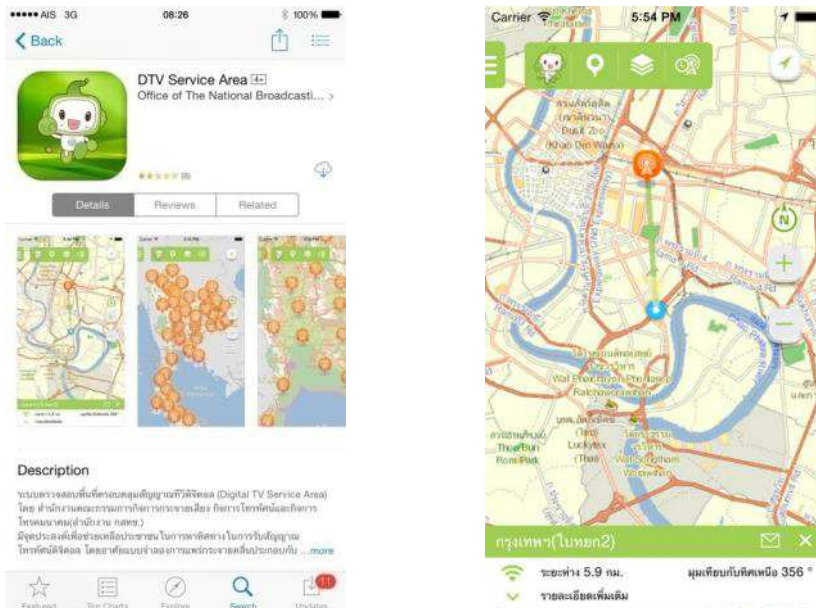


Source: NBTC

Figure 7: Graphical user interface of coverage checker

Modern smartphones have GPS, Wi-Fi and compass functionality and these technologies are used to locate the exact position of the smartphone. Location based services, like Google Maps, use this positioning information. Similarly the coverage checker on the smartphone can be designed as a location based service.

A smartphone at any reception location can automatically use the positioning information to let the coverage checker software know where the reception location is. In addition, using the compass functionality the smartphone can be directed to the best server transmission site. This is particularly helpful for people having difficulties in reading maps and figuring out the azimuth angle (for directing their receiving antenna). Figure 9 shows the smartphone user interface for this functionality.



Source: NBTC

Figure 8: Smartphone user interface

Conclusion

NBTC has completed several technical regulations and recommendations to ensure the reliability and the performance of the DTT network. Currently, the DTT coverage is able to reach approximately 80% of households delivering 26 digital TV programs. In 2017, NBTC expects to have DTT network covering up to 95% households and delivering 48 digital TV programs.

In addition to the technical parameters and capacity/frequency planning, NBTC has recently launched the DTT coverage checking application, based on the result of frequency planning, in 3 platforms: Android OS, iOS, and web-based (please visit: <http://dvtvservicearea.nbtc.go.th>). NBTC also developed EPG server to facilitate both service providers and network operators in order to prepare centralized EPG information, which can be used for cross-carried EPG. Progress and development are ongoing with the hope that this will improve technical regulations and guidelines for the industry and for the benefits of Thai viewers.