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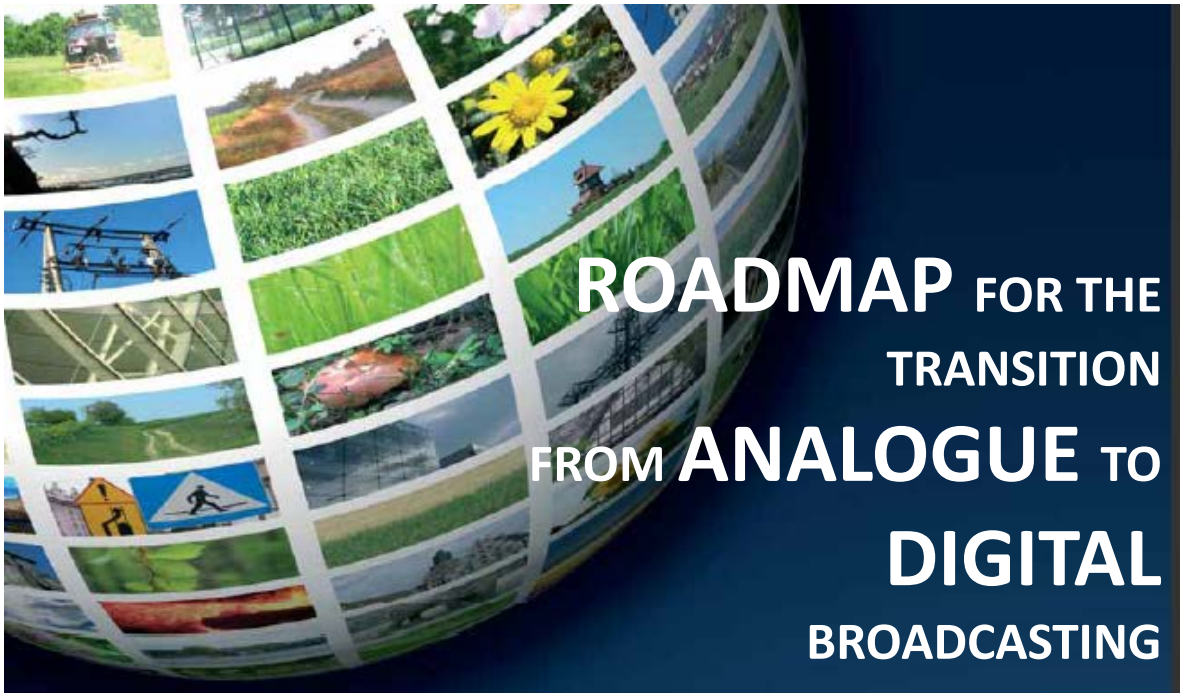

Detailed planning of the 39 DTTB main sites in Thailand

International Telecommunication Union

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Detailed planning of the 39 DTTB main sites

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1. Introduction

The DTTB plan in Thailand was published on 18 December 2012. Although published recently, this plan was developed some time ago. In the meantime conditions and requirements changed and NBTC was faced with the challenge to amend the plan to fulfil the new requirements, including:

- Six multiplexes with a population coverage of at least 95% after analogue TV switch-off;
- Five multiplexes before analogue TV switch-off;
- Use of DVB-T2 system variant 64 QAM, code rate 3/5, Pilot Pattern 2, Guard interval 226 µs.

The starting point for developing the amended plan was the analysis of DTTB plan of 18 December 2012 by ITU experts[1]. The main conclusions of the DTTB Plan analysis were:

a) In addition to the 39 main sites, it is expected that about 120 additional sites will be needed to reach the required 95% population coverage (a number of these additional site were already included in the DTTB plan of 18 December 2012);
b) In general power reductions are needed to
    - Reduce interference;
    - Avoid unstable reception at the edge of the coverage area;
    - Improve efficient spectrum usage; thus facilitating planning of the additional sites;
    - Reduce operational and investments costs;
c) The available spectrum (channel 26 to 60) is not fully used;
d) The coverage of a considerable number of the main sites suffers from severe interference caused by other DTTB sites (main sites and additional sites) and coverage of the multiplexes per sites differs considerably. Channel changes should be considered to resolve these interference cases;
e) A number of the main sites cause severe interference to analogue TV services during the transition period. The Interference to analogue TV has to be reduced to acceptable levels.

The ITU experts were asked to develop the plan further with regard to the 39 main sites, with the aim to improve compatibility and to achieve more or less equal coverage of the multiplexes per site by means of power reductions and frequency changes.

At a later stage the additional sites need to be planned in such a way that the coverage target is reached and no unacceptable interference is caused to the coverage of the main sites.

The following conventions are used regarding the version of the DTTB plan:

Version	DTTB Plan
DTTB Plan 1.0	DTTB Plan as published on 18 December 2012.
DTTB Plan 1.1	DTTB Plan 1.0 including more detailed characteristics and corrections concerning the 39 main stations as agreed between NBTC and ITU.
DTTB Plan 2.0	DTTB Plan 1.1 including provisional modifications and additions proposed by ITU

[1] See report Analysis of the DTTB plan v1.1, 2 July 2013.

DTTB Plan 3.0	DTTB Plan 2.0 including modifications resulting from the recommendations mentioned in the Plan analysis report.

Table 1.1: Conventions on the version of the DTTB plan

DTTB Plan 3.0 regarding the 39 main sites was developed for three scenarios:

1. Planning scenario C: Six multiplexes after analogue switch-off;
2. Planning scenario B: Five multiplexes before analogue switch-off;
3. Planning scenario A: Five multiplexes at the sites in the first introduction stage.

The multiplexes have been assigned to the following network operators.

Multiplex	Network operator
1	NBT
2	Army TV
3	MCOT
4	TPBS
5	Army TV
6	To be decided

Table 1.2 Network operators

In this report the five multiplexes are referred to as network 1 to 5, as Mux 1 to 5, or by the network operator. The operator of the 6th multiplex is not known yet. This multiplex is also referred to as Mux 6.

This report describes first the planning principles, planning method, planning data and planning process, followed by results of planning scenario C, B and A. Finally considerations regarding the plan implementation are given.

A summary of the Plan 3.0 regarding the main sites in the scenarios A, B and C is shown in Annex 6. Annex 7 gives a summary of the UHF analogue TV stations that were taken into account in scenarios A and B. An overview of the planning results that were handed over to NBTC is shown in Annex 8.

2. Planning process

This section gives an overview of the planning principles, the planning method and the planning data used in the development of DTTB Plan 3.0 with regard to the 39 main sites. A detailed description of the planning principles and planning method is given in Annex 1 and Annex 2 respectively.

2.1 Planning principles

The planning principles are summarised in the table below. More detailed information is given in Annex 1, Table A1.3, Table A1.4 and Table A1.5.

Planning element	Used in the development of DTTB Plan 3.0 regarding the 39 main sites
Frequency range for DTTB planning	1. 510 -790 MHz (channels 26 to 60); 2. In border area with Malaysia: o According to coordination agreement: even numbered channels; o At request NBTC: no channels above 48.
Technical parameters	1. DVB-T2 system variant 64QAM, code rate 3/5, Pilot Pattern 2, Guard interval 226 µs; 2. Planning criteria as specified in latest ITU-R recommendations; o Building penetration loss: mean value 11 dB , standard deviation 6 dB; 3. Propagation model CRC-predict as implemented in the Progira planning software.
Coverage target	1. Optimum population coverage with fixed reception; 2. Similar coverage of the six multiplexes per site.

Table 2.1: Overview of planning parameters

It should be noted that a number of planning elements were not been taken into account. These elements are summarised in the table below.

Planning elements not taken into account	Impact on Plan 3.0 regarding the 39 main sites
Additional sites • **To increase coverage of the 39 main sites to the required 95% population coverage** • **To improve portable indoor reception**	None, to be planned subsequently to the 39 main sites, in such a way that: • The coverage target is reached; • No unacceptable interference is caused to the coverage of the main sites.
Foreign DTTB and analogue TV sites, other than • **The coordination agreement with Malaysia** • **Avoidance of channel 37 at site 12 in relation to Laos**	Review of plan after international coordination and availability of accurate data may be needed.
Mobile services below 510 MHz (<channel 26)	The mobile service below 510 MHz is considered compatible[2].

[2] See report Analysis of the DTTB plan v1.1, 2 July 2013, Section 5.3

Mobile services (IMT) above 790 MHz (> channel 60)	When accurate deployment data are available and compatibility can be assessed, review of assignments with channel 60 may be needed.
Mobile services (IMT) in 700 MHz band (channels 49 to 60)	When the allocation of the 700 MHz to IMT is decided, a review of service requirements and re-planning of all DTTB sites will be needed.
Transmitting antenna limitations	No impact on plan, but network operators should check power and voltage limitations of antennas when DTTB or DTTB and ATV are combined into one antenna. Replacement of combiners and antennas may be needed.
Other types of transmitting antenna polarisation	In Plan 3.0, transmitting antennas are horizontally polarised. Network operators may use other types of polarisation subject to approval by NBTC and not causing more interference and not providing less coverage than the related plan entries.
Other locations of main sites	Network operators may use other sites than indicated in Plan 3.0 subject to approval by NBTC and not causing more interference and not providing less coverage than the related plan entries.

Table 2.2: Elements not taken into account in planning the 39 DTTB main sites

2.2 Planning method

In developing DTTB Plan 3.0 with regard to the 39 main sites, the following assignment principles were adopted.

1) Optimisation of population coverage with fixed reception after analogue switch-off and temporarily power reductions and frequency assignments during the transition period to protect analogue TV at acceptable levels;
2) Use of Plan 2.0 as a basis, but with power reductions and channel changes to improve compatibility;
3) Application of regular channel groups to achieve more or less equal coverage of the multiplexes per site and a channel separation at a site of at least two channels, as far as possible in planning. One channel difference is technically feasible but requires more complex (hence more expensive) filtering and may be unavoidable in some cases;
4) Use of MFNs for the main sites, but if needed for planning reasons use of SFNs where possible for national services;
5) Avoiding unstable reception at the edge of the coverage areas due to time variations of the wanted signal;
6) Efficient spectrum usage by assigning channels in such way that temporarily channels are available during the transition period to protect analogue TV and that the coverage target of 95% coverage can most likely be reached by planning additional sites at a later stage.

The planning method is based on the above mentioned assignment principles and is summarised in the table below.

Planning element	Applied in the development of DTTB Plan 3.0 regarding the 39 main sites
Amended channel groups (see Annex 2, Section1)	1. Regular channel distribution, as far as possible, to obtain similar coverage per multiplex per site; 2. Six channels per site providing six multiplexes after analogue TV switch-off; 3. Six channel groups to provide sufficient planning flexibility to reduce critical interference cases.
ERP adjustments (see Annex 2, Section 2)	1. Optimization of ERP per site to: a. Reduce interference; b. Improve spectrum efficiency; c. Reduce operational and investments costs; 2. Maximum ERP of 50 kW to avoid unstable reception near the edge of coverage.
SFN/MFN (see Annex 2, Section 3)	1. SFN if separation between the sites is less than 80 km (the distance corresponding to the duration of the guard interval); 2. Mux 6 is intended for community services in 39 main service areas corresponding to the coverage areas of each of the 39 main sites and should operate as MFN.
Planning scenarios (see Annex 2, Section 4)	Three planning scenarios representative for: A. The situation by mid-2014 when the first group of main sites will be in operation with five DTTB multiplexes and all analogue TV in operation; B. The situation that all 39 main sites will be in operation with five DTTB multiplexes and all analogue TV in operation; C. The all-digital situation when 39 main sites will be in operation with six multiplexes and all analogue TV has been switched off.

Table 2.3: Overview of planning method

2.3 Planning data

The data used in the planning process is summarised in Table 2.4. More detailed information is given in Annex 1, Table A1.1 and Table A1.2.

Planning data	Used in the development of DTTB Plan 3.0 regarding the main sites
DTTB and analogue TV data	• Location and antenna height of the 39 main sites as from Plan 2.0 with more detailed antenna data (see note below), provided by NBTC; • Analogue TV transmitter data as used in DTTB Plan verification, with more detailed antenna data, provided by NBTC (see Annex 7).
Population data base	• Corrected population numbers provided by NBTC with a total population of o 64,505,166 people; o 22,865,383 households; • 185 municipalities which are of particular interest for portable indoor reception, provided by NBTC.

Terrain data base	• Terrain and clutter data, provided by NBTC: o Terrain and clutter data resolution: 100 m by 100 m; o Clutter data resolution in Bangkok area: 20 m by 20 m with corrected building heights for some clutter codes.

Table 2.4: Planning data

Note

In most cases the differences between the detailed antenna data and the antenna patterns in DTTB Plan 2.0 were minimal. However, at one site (Sakaeo) the direction of the main reduction in the pattern was at 145 degrees, while in DTTB Plan 2.0 it was 45 degrees.

3. Results of planning scenario C

Scenario C reflects the situation that 39 main sites with six multiplexes each are in operation and analogue TV has been switched-off.

This section describes the initial results of planning scenario C, followed by a presentation of agreed results of planning scenario C consisting of:

- Transmitter list of the 39 main sites;
- Fixed reception coverage;
- Portable indoor coverage.

A description of the scenario C planning process is given in Annex 3.

3.1 Initial results

During a mission in Bangkok from 10 to 20 November 2013, the initial results of planning scenario C and a number of alternative solutions (see Annex 3) were discussed with NBTC and presented at a workshop with the network operators.

The following comments on the initial results were received during the mission.

#	Item	Comment	Conclusion
1	**Number of main service areas**	39 main service areas is a must.	SFNs between main sites are only allowed for multiplex 1 to 5. In Mux 6 (community services), the channels should be different.
2	**Future 7th mux**	There may be a need in future for a 7th multiplex.	No planning of the 7th multiplex now. If so required in future the channels 21 to 25 (currently allocated to mobile) will be considered.
3	**Use of channels above 51**	Network operators do not prefer these channels because of current combiners and antennas.	Use of channels above 51 is needed to develop Plan 3.0 with 95% population coverage. Furthermore: • Current transmission equipment is more than 10 years old and needs to be replaced during the DTTB license period of 15 years; • Plan 1.0 also uses channels above 51 (6%), while in Plan 3.0 11% of the channels is above 51.
4	**Use of channels above 38**	Network operators do not prefer these channels because current receiving antennas are suitable for Band IV only.	Use of channels above 38 is needed to develop Plan 3.0 with 95% population coverage. Furthermore: • It was stated that also Band IV/V receiving antennas are in use; • Plan 1.0 also uses channels above 38 (53%), while in Plan 3.0 50% of the channels is above 38.
5	**700 MHz**	Network operators prefer to use channels below 49 in main cities	Use of channels above 48 is needed to develop Plan 3.0 with 95% population coverage. Furthermore: • Plan 1.0 also uses channels above 48 (13%), while in Plan

		to be resilient to IMT in 700 MHz band.	3.0 21% of the channels is above 48; • If IMT in 700 MHz is allocated, complete re-planning of DTTB is needed and a choice should be made between 4 multiplexes with about 95% population coverage, or 6 multiplexes with about 70% population coverage. If channels below 26 become available, 5 multiplexes may be possible.
6	**Use of Plan 1.0**	Network operators prefer to use Plan 1.0 for reasons given in comments of items 2 to 5 and because it is better compatible with ATV.	With Plan 1.0 population coverage of 95% is unachievable and coverage difference of multiplexes per site is very large in many cases. Furthermore: • In Plan 1.0 compatibility with distant ATV sites is not achieved; • Plan 3.0 is optimised for the situation after ASO and temporarily frequencies will be assigned to protect ATV (scenario B).
7	**Site sharing**	Some network operators wish to use their own sites instead of the shared sites given in Plan 1.0 and 3.0	Plan 3.0, with shared sites for all six multiplexes, is the basis. Network operators may propose a different site if the distance from the reference site mentioned in Plan 3.0 is less than 2 km and subject to approval by NBTC.
8	**Assigned channel groups**	Network operators are concerned about the channel groups at sites 4, 11, 12, 15, 24, 25, 26, 27, 33, 34 because of interference in practice and comment given in item 3.	Channel group changes at sites 11, 12, 26, 33, 34, 35, 36 results in population coverage increase and have been incorporated in final Plan 3.0 for the all-digital situation. These changes include also further improvements resulting from discussions between NBTC and the ITU experts. To obtain an optimal coverage in the southern part (sites 36 to 39) NBTC accepted a relaxation of the planning principles by allowing a few channels above 48 in that area.
9	**Assigned power**	Network operators are concerned about the ERP at site 12.	ERP increase at site 12 from 40 to 50 kW.
10	**SFN of site 25/26**	Network operators prefer SFN of sites 26/27 instead of 25/26, because of local culture.	SFN of sites 26/27 instead of 25/26. However, the SFN is for the national multiplexes only (1 to 5). The community services in Mux 6 are not in SFN (see conclusion item 1).

Table 3.1: Comments received on the initial plan

The DTTB Plan 3.0 regarding the 39 main sites and including the conclusions mentioned above was agreed by NBTC on the 19th of November 2013 and endorsed by the network operators.

In planning scenario B, at a number of sites the channels were rearranged across the multiplexes (see Annex 4). Furthermore, after the above mentioned plan was agreed, NBTC requested to avoid channel 37 at site 12, to reflect the outcome of a coordination meeting with Laos. This could be resolved by a rearrangement of the channels at site 11 and 12 and was taken into account in the planning of scenario B (see Annex 4, Section 3, item a). These rearrangements are an amendment to the scenario C plan.

3.2 Transmitter list

The agreed transmitter list of the 39 main sites in scenario C, including a number of channel rearrangements per site carried out in planning scenario B, is shown is Table 3.2.

A	B	C	D	E	F	G	H	I	J	K	L
Site N°	Site name	Longitude	Latitude	ERP (kW)	CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6
1.0	**Bangkok_DTT**	100.540000	13.754444	50	Db	26	36	40	44	32	29
2.0	**Kanchana Buri_DTT**	99.420556	14.074444	25	Dc	49	37	41	30	27	33
3.0	**Singburi_DTT**	100.377004	14.836115	15	Da	35	51	47	39	31	28
4.0	**Rayong_DTT**	101.412906	12.676200	50	De	45	59	53	56	43	48
5.0	**Sakaeo_DTT**	102.104231	13.804003	50	Dd	54	50	46	38	57	34
6.0	**Trat_DTT**	102.298661	12.195907	50	Dc	33	37	41	49	30	27
7.0	**Prachaub Khiri Khun_DTT**	99.801282	11.905902	20	Dd	46	50	54	57	38	34
8.0	**Nakhon Ratchasima_DTT**	101.995556	14.946389	50	Dc	41	49	30	33	37	27
9.0	**Chaiyaphum_DTT**	102.030000	15.759167	15	Da	31	47	39	35	51	28
10.0	**Surin_DTT**	103.512500	14.918611	50	Db	26	32	40	36	44	29
11.0	**Sisaket_DTT**	104.348333	15.039167	20	Dc/f	41	30	33	27	49	37
12.0	**Ubon Ratchathani_DTT**	104.923611	15.381667	50	Dc	41	30	33	27	49	52
13.0	**Mukdahan_DTT**	104.723333	16.608333	20	Da	47	39	35	28	51	31
14.0	**Roi ET_DTT**	103.584167	15.936111	50	Dd	57	50	46	54	34	38
15.0	**Khon Kaen_DTT**	102.946425	16.463758	50	De	59	45	53	56	48	43
16.0	**Loie_DTT**	101.444519	17.470655	20	Dd	46	50	57	54	38	34
17.0	**Udonthani_DTT**	102.794088	17.664041	50	Da	47	35	31	39	51	28
18.0	**Buengkan_DTT**	103.559444	18.351667	10	Db	44	32	36	40	26	29
19.0	**Sakhon Nakhon_DTT**	103.987778	17.137778	50	Dc	30	49	41	33	37	27
20.0	**Chiang Mai_DTT**	98.917500	18.809722	50	Dd	46	50	54	57	38	34
21.0	**Mae Hong Son Doi kong mu_DTT**	97.957985	19.297351	1	Dc	37	41	49	30	33	27
22.0	**Lampang_DTT**	99.563029	18.243457	50	Db	26	44	32	36	40	29
23.0	**Chiang Rai_DTT**	99.867041	19.813755	50	Dc	49	30	33	37	41	27
24.0	**Nan_DTT**	100.741214	18.742635	50	Da	28	31	35	39	51	47
25.0	**Phrae_DTT**	100.000833	17.933333	30	De	45	48	59	56	43	53
26.0	**Utaradit_DTT**	100.125278	17.619722	2	Dc/f	41	30	33	37	49	**52**
27.0	**Sukhothai_DTT**	100.010563	16.984763	50	Dc	41	30	33	37	49	**27**
28.0	**Tak_DTT**	98.927687	16.778691	50	Da	31	35	39	51	47	28
29.0	**Nakhon Sawan_DTT**	100.133636	15.715740	50	Dd	57	46	50	54	38	34
30.0	**Phetchaboon_DTT**	101.071373	16.251014	10	Db	40	44	29	32	36	26

A	B	C	D	E	F	G	H	I	J	K	L
Site N°	Site name	Longitude	Latitude	ERP (kW)	CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6
31.0	**Chumphon_DTT**	99.126420	10.574229	50	Da	51	47	31	35	39	28
32.0	**Ranong_DTT**	98.673889	10.026111	15	Dc	49	30	37	41	33	27
33.0	**Surat Thani_DTT**	99.348510	9.091700	50	Db	26	36	40	44	32	29
34.0	**Phuket_DTT**	98.395395	7.898698	25	Da	35	39	51	47	31	28
35.0	**Nakhon Sri Thumarat_DTT**	99.984722	8.354167	30	Dc	30	33	37	41	49	27
36.0	**Trang_DTT**	99.486511	7.656956	40	De	43	59	48	53	56	45
37.0	**Song Khla_DTT**	100.520195	7.015850	50	TDa'	50	42	46	38	26	34
38.0	**Satun_DTT**	100.025305	6.635252	30	TDa'/f	50	42	46	38	26	52
39.0	**Yala_DTT**	101.390278	6.3336111	30	TDb	32	48	36	44	28	40

Table 3.2: Transmitter list of the 39 main sites after analogue switch-off

Columns C and D show the geographical coordinates in degrees and decimals of degrees. Column E shows the maximum effective radiated power (ERP) and the channel group (CG) per site is indicated in column F. Columns G to L show the channel number per multiplex. At sites 12 and 13, 26 and 27 as well as 37 and 38, the transmitters operate as SFN in networks 1 to 5. The 6th network, intended for community services, operates as MFN. For that reason, the channel in the 6th network at one of the sites in each SFN have been replaced by channel 52 from group Df, hence the indication Dc/f and TDa'/f.

In the adopted channel scheme (see Annex 2, Figure A2.1) the groups TDa and TDb, do not contain channels above 48. As no satisfactory coverage could be achieved within that limitation, NBTC allowed using channel 50 in channel group TDa. Because the composition of the group deviates now from the adopted group TDa (see Annex 2, Figure A2.1), at sites 37 and 38 the group has been nominated as TDa'.

Column C shows the maximum effective radiated power (ERP) of each of the transmitters per site. The network operators have to determine the transmitter power per channel (multiplex) taking into account the antenna gain per channel and the losses in combiner and antenna cable per channel.

A summary of DTTB Plan 3.0 regarding the 39 main sites, including the temporarily assignments in the transition period, is given in Annex 6.

3.3 Fixed reception coverage

In this section the population, household and area coverage with fixed reception in scenario C are presented.

3.3.1 Population coverage with fixed reception

The population coverage with fixed reception in scenario C is shown in Figure 3.1.a and the household coverage in Figure 3.1.b.

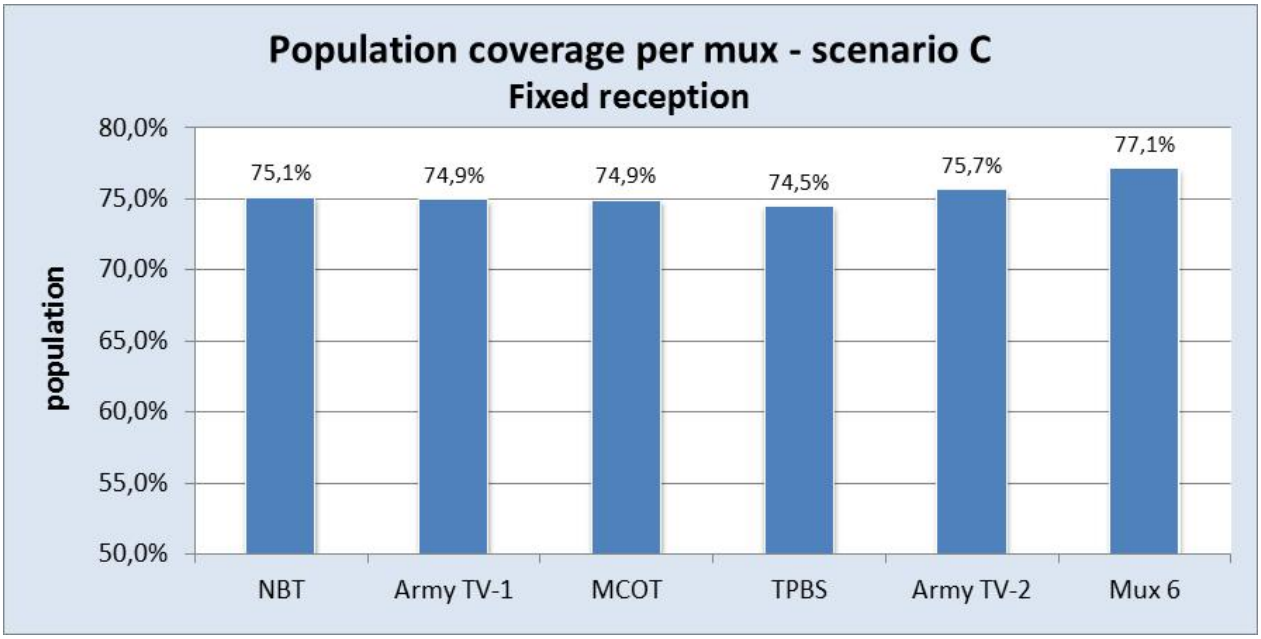

Figure 3.1.a: Population coverage in scenario C

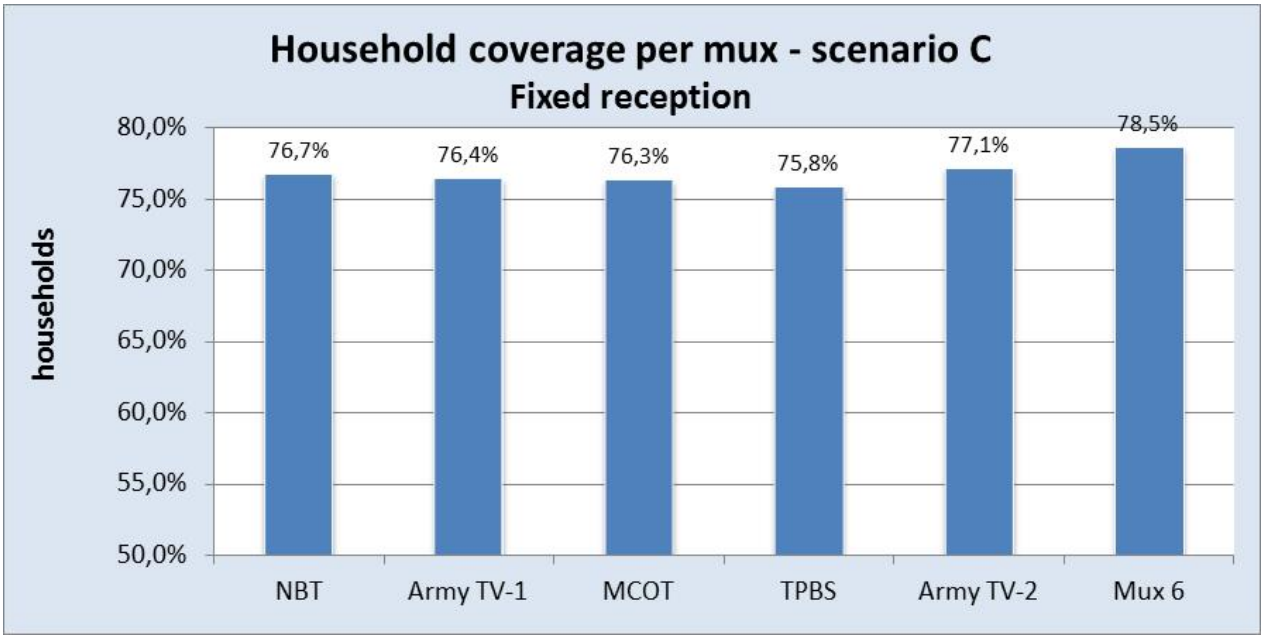

Figure 3.1.b: Household coverage in scenario C

The household coverage ranges from about 76% to 78%. The differences in coverage per multiplex are mainly caused by propagation differences between lower and higher channels. In multiplexes 1 to 5 the channels per site were arranged to obtain more or less equal coverage per multiplex. Multiplex 6 contains many channels in the lower part of the band, but was excluded from this arrangement, because most channels in multiplex 6 are in operation by TPBS analogue TV in scenario A and B (see Annex 4, Section 3).

The interference limited coverage figures are about 1% below the noise limited coverage figures. This is considered as a good balance in the trade-off between the power of the sites and the coverage that can be achieved in the available spectrum.

3.3.2 Area coverage with fixed reception

Figures 3.2 to 3.7 show the composite interference limited coverage per multiplex in scenario C. Orange coloured areas have ≥95% reception probability, which is considered as good reception. For information also areas with a reception probability of 90% to 95% (yellow coloured) and 70% to 90% (green coloured) are indicated.

Figure 3.2: Coverage of the 39 main sites of NBT after analogue TV switch-off

Figure 3.3: Coverage of the 39 main of Army TV-1 after analogue TV switch-off

Figure 3.4: Coverage of the 39 main sites of MCOT after analogue TV switch-off

Figure 3.5: Coverage of the 39 main sites of TPBS after analogue TV switch-off

Figure 3.6: Coverage of the 39 main sites of Army TV-2 after analogue TV switch-off

Figure 3.7: Coverage of the 39 main sites of Mux 6 after analogue TV switch-off

3.4 Portable indoor coverage

In this section the population and area coverage with portable indoor reception in scenario C are presented.

3.4.1 Population coverage with portable indoor reception

The population coverage with portable indoor reception in scenario C is shown in Figure 3.8.a and the household coverage in Figure 3.8.b. The household coverage with portable indoor reception ranges from about 24% to 25% of the households.

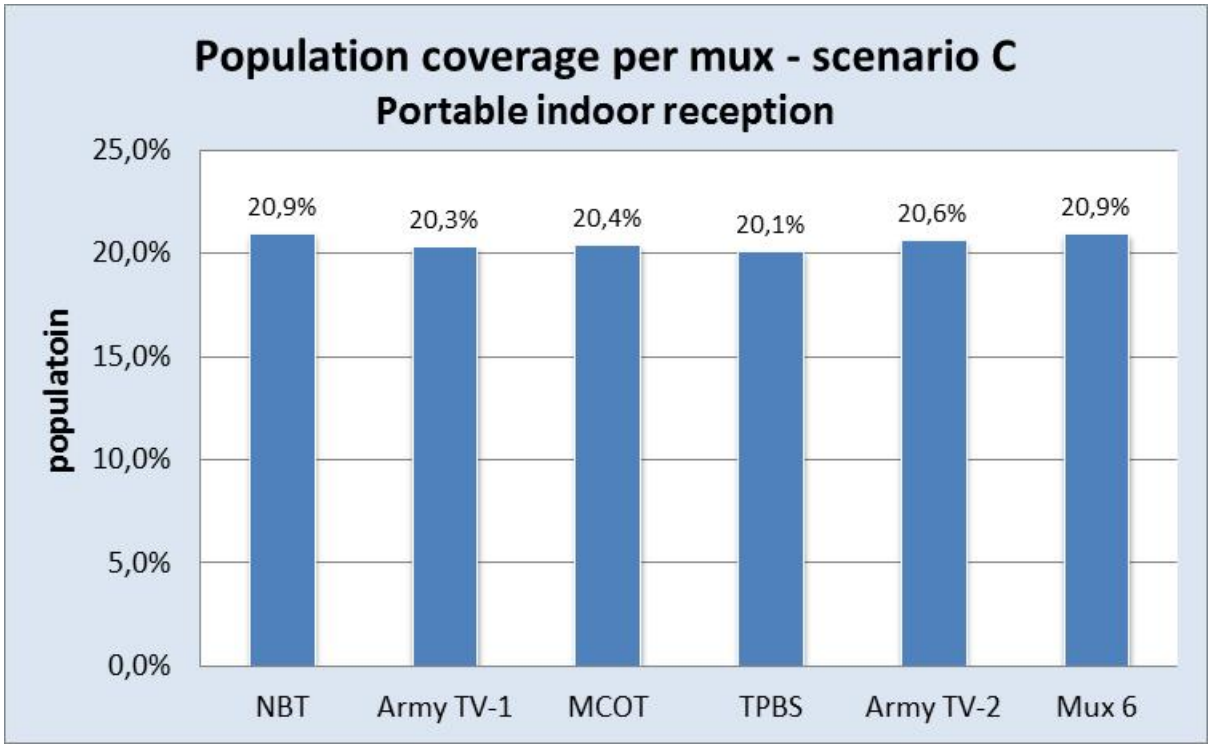

Figure 3.8.a: Population coverage in scenario C with portable indoor reception

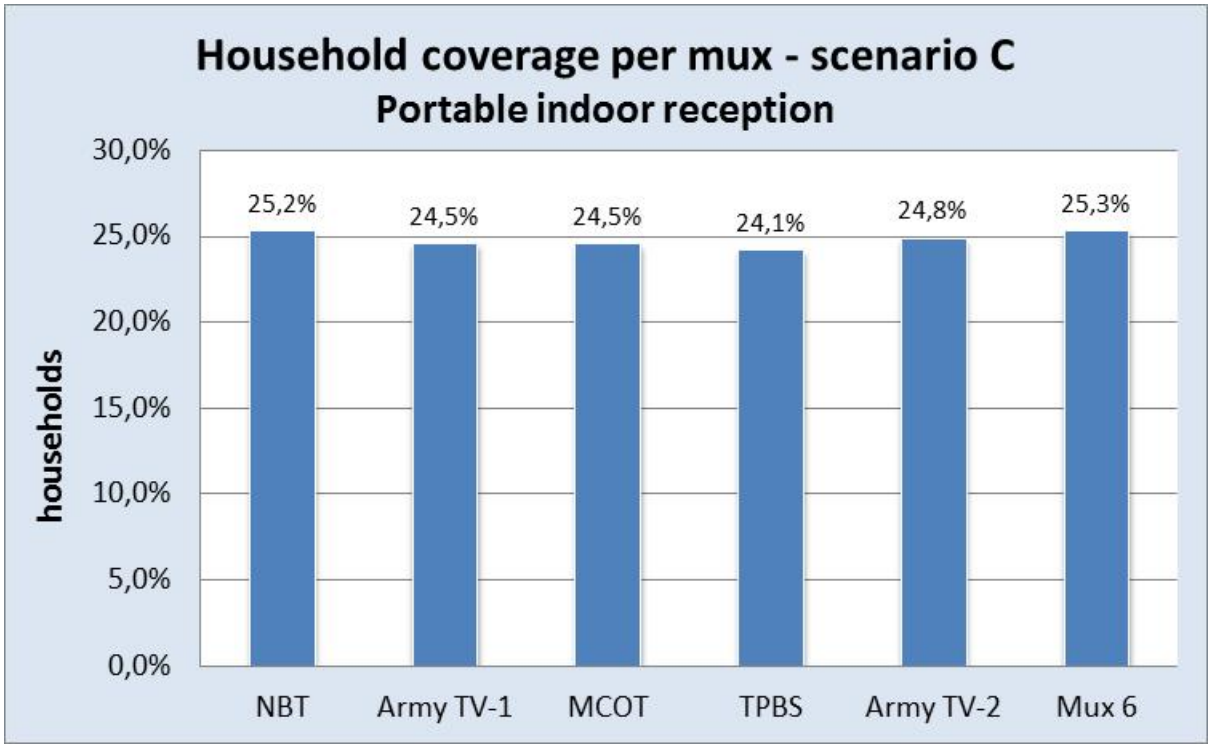

Figure 3.8.b: Household coverage in scenario C with portable indoor reception

Portable indoor coverage is noise limited, because of the high minimum field strength value for portable indoor reception and the relative low interference levels that were needed to achieve compatibility with fixed reception.

The population coverage with portable indoor reception in scenario C in the 185 target municipalities in which indoor reception is of particular interest is shown in Table 3.3 and Figure 3.9.

PI Coverage	0 %	≥ 50 %	≥ 70 %	≥ 90 %	≥ 95 %	100 %
NBT	109	48	40	29	23	8
Army TV-1	108	48	40	30	25	7
MCOT	109	47	40	29	25	6
TPBS	109	47	39	29	24	4
Army TV-2	109	48	39	27	25	8
Mux 6	109	51	42	29	26	9

Table 3.3 Indoor coverage in scenario C in the 185 target municipalities

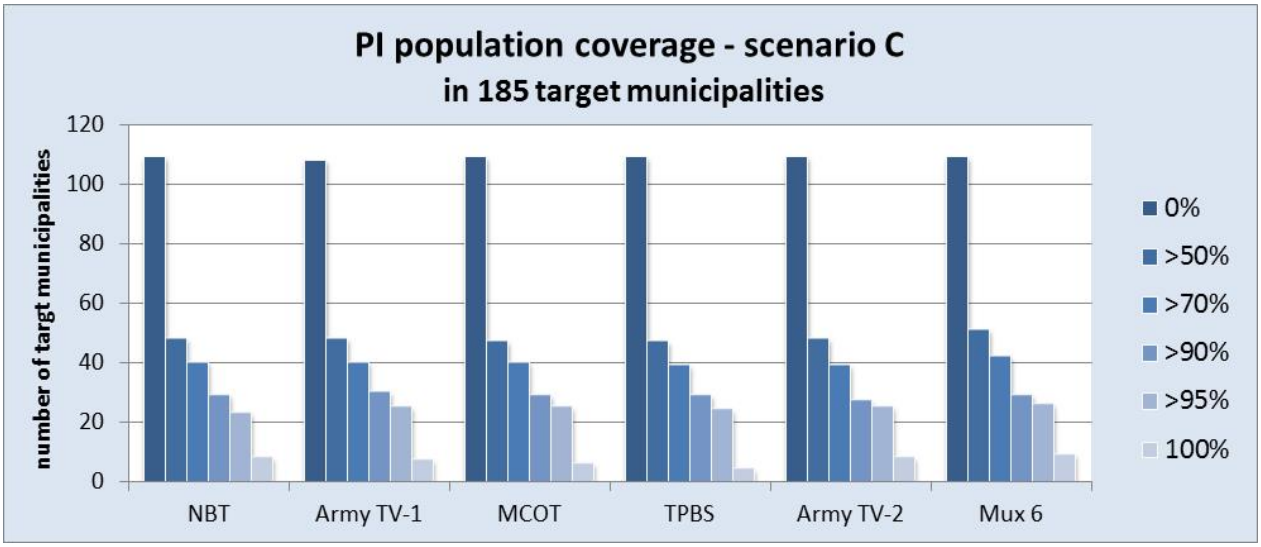

Figure 3.9: Indoor coverage in scenario C in the 185 target municipalities

The results show that in 27 target municipalities more than 90% of the population has good indoor reception of all six multiplexes and in 47 target municipalities 50% of the population has good indoor reception of all six multiplexes. It should be noted that the additional sites needed to reach 95% population coverage with rooftop reception will also increase the number of target municipalities with indoor reception.

The indoor reception results should be interpreted with caution, because in practice the indoor reception conditions may deviate from those defined in the planning principles. In the planning principles a simple receiving antenna is assumed at a height of 1.5 m at the ground floor in a room with a window. The receiving situation in practise may deviate depending on:

- The actual location of the indoor receiving antenna and the quality of the antenna.
  Location near a window an use of so-called active indoor antennas gives better reception;
- The floor where reception takes place.
  At higher floors the field strength is higher hence better reception than at ground floor;
- The actual building penetration loss.
  Depending on the type of building and window screening the field strength inside the building may be higher or lower than assumed in the calculations;
- The population distribution in a sub-district.
  A sub-district is the unit for which population figures are available. If a sub-district is partly covered, it is assumed that in the target municipality a proportional number of people has good reception. However, in practise a municipality may be situated in the part of the sub-district with good coverage or contrary in the part with no coverage.

3.4.2 Area coverage with portable indoor reception

Figures 3.10 to 3.15 show the portable indoor (PI) coverage per multiplex in scenario C.

Figure 3.10: PI coverage 39 main sites of NBT in scenario C

Figure 3.11: PI coverage 39 main sites of Army TV-1 in scenario C

Figure 3.12: PI coverage 39 main sites of MCOT in scenario C

Figure 3.13: PI coverage 39 main sites of TPBS in scenario C

Figure 3.14: PI coverage 39 main sites of Army TV-2 in scenario C

Figure 3.15: PI coverage 39 main sites of Mux 6 in scenario C

As the Bangkok area is of particular interest, the portable indoor coverage in Bangkok at channel 26 is shown at a larger scale in Figure 3.16. For reference, circles are indicated giving the radius from the transmitter at 10 km, 20 km and 35 km.

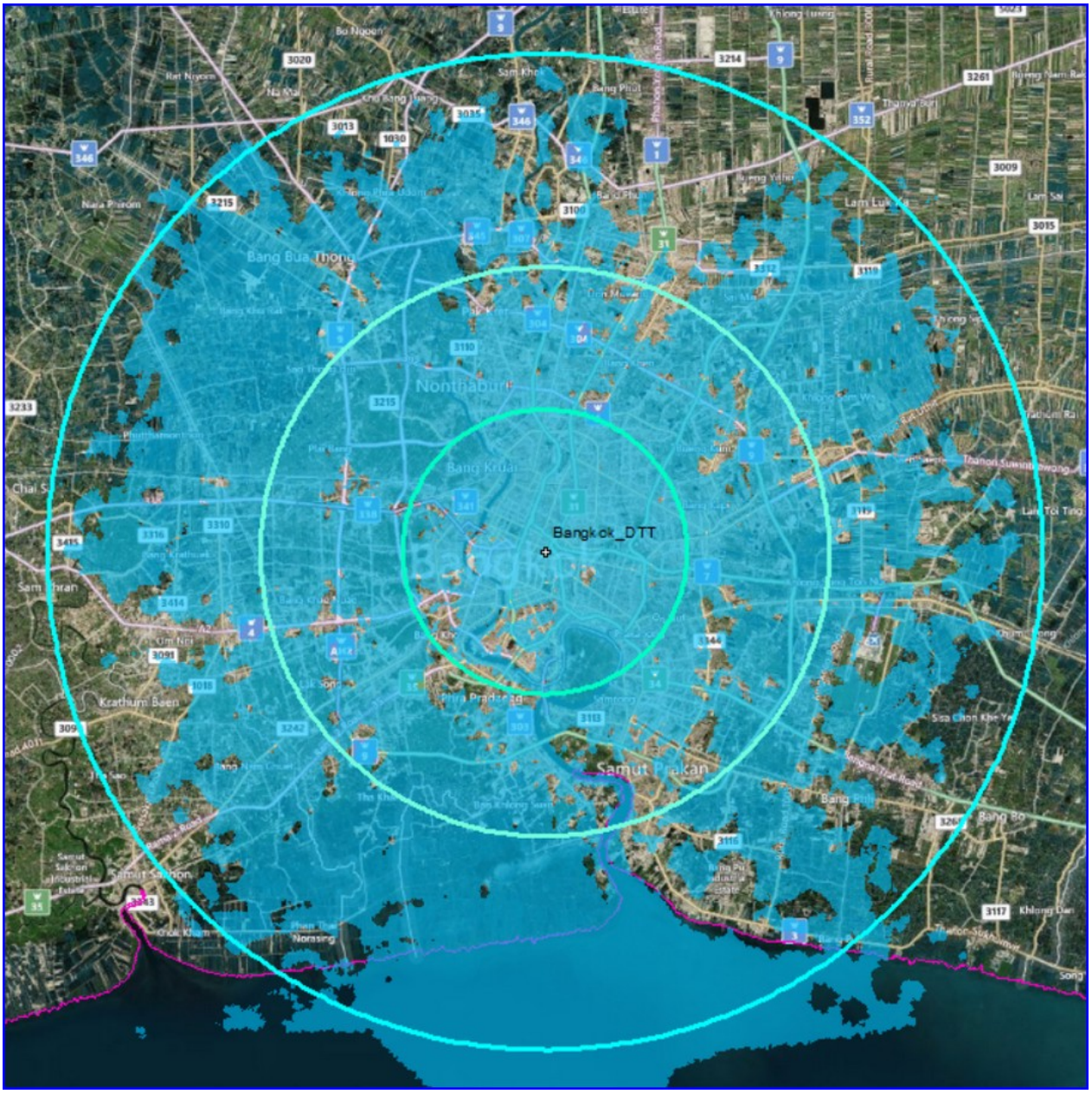

Figure 3.16: Portable indoor coverage of the Bangkok transmitter at channel 26

4. Results of planning scenario B

Scenario B reflects the situation that 39 DTTB main sites with five multiplexes each are in operation and analogue TV stations shown in Annex 7 are in operation.

This section describes the results of planning scenario B and contains a presentation of:

- The transmitter list of the 39 main sites;
- Fixed reception DTTB coverage;
- Portable indoor DTTB coverage;
- Analogue TV coverage.

A description of the scenario B planning process is given in Annex 4.

During a mission in Bangkok from 13 to 24 January 2014, the draft results of planning scenario B were discussed with NBTC. After having made a few amendments in the arrangements of the channels per site, the plan was agreed by NBTC and endorsed by the network operators. With the draft plan a number of optional measures were suggested to improve compatibility (see Annex 4). The measures were:

- ERP reduction of four DTTB stations to reduce interference to analogue TV station Roi ET Ch5;
- Temporarily channels assignments at two DTTB stations to avoid interference from analogue TV stations Roi Et TPBS and Toen Ch11 respectively.

The network operators concerned did not consider it necessary to apply these measures.

4.1 Transmitter list

The agreed transmitter list of the 39 main sites in scenario B is shown is Table 4.1. Columns C and D show the geographical coordinates in degrees and decimals of degrees. Column E shows the maximum effective radiated power (ERP) and the channel group (CG) in scenario C per site is indicated in column F. Columns G to K show the channel number per multiplex. In total 26 temporarily channels were assigned to avoid interference to analogue TV. The temporarily channels are printed red in the grey shaded fields.

A	B	C	D	E	F	G	H	I	J	K
Site N°	Site name	Longitude	Latitude	ERP (kW)	Sc C CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2
1.0	**Bangkok_DTT**	100.540000	13.754444	50	Db	26	36	40	44	52
2.0	**Kanchana Buri_DTT**	99.420556	14.074444	25	Dc	49	37	41	30	27
3.0	**Singburi_DTT**	100.377004	14.836115	15	Da	35	51	47	39	55
4.0	**Rayong_DTT**	101.412906	12.676200	50	De	45	59	53	56	43
5.0	**Sakaeo_DTT**	102.104231	13.804003	50	Dd	54	42	46	38	57
6.0	**Trat_DTT**	102.298661	12.195907	50	Dc	33	37	41	49	30
7.0	**Prachaub Khiri Khun_DTT**	99.801282	11.905902	20	Dd	46	50	54	57	38
8.0	**Nakhon Ratchasima_DTT**	101.995556	14.946389	50	Dc	58	52	30	33	37

A	B	C	D	E	F	G	H	I	J	K
Site N°	Site name	Longitude	Latitude	ERP (kW)	Sc C CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2
9.0	**Chaiyaphum_DTT**	102.030000	15.759167	15	Da	55	47	39	35	51
10.0	**Surin_DTT**	103.512500	14.918611	50	Db	42	32	40	36	44
11.0	**Sisaket_DTT**	104.348333	15.039167	20	Dc/f	41	52	58	37	49
12.0	**Ubon Ratchathani_DTT**	104.923611	15.381667	50	Dc	41	52	58	26	49
13.0	**Mukdahan_DTT**	104.723333	16.608333	20	Da	47	39	35	28	51
14.0	**Roi ET_DTT**	103.584167	15.936111	50	Dd	57	50	46	60	55
15.0	**Khon Kaen_DTT**	102.946425	16.463758	50	De	59	45	52	56	48
16.0	**Loie_DTT**	101.444519	17.470655	20	Dd	46	42	57	54	38
17.0	**Udonthani_DTT**	102.794088	17.664041	50	Da	47	35	55	39	51
18.0	**Buengkan_DTT**	103.559444	18.351667	10	Db	44	32	36	40	52
19.0	**Sakhon Nakhon_DTT**	103.987778	17.137778	50	Dc	30	49	41	33	58
20.0	**Chiang Mai_DTT**	98.917500	18.809722	50	Dd	60	50	54	57	38
21.0	**Mae Hong Son Doi kong mu_DTT**	97.957985	19.297351	1	Dc	37	41	49	30	33
22.0	**Lampang_DTT**	99.563029	18.243457	50	Db	26	44	32	36	40
23.0	**Chiang Rai_DTT**	99.867041	19.813755	50	Dc	49	30	33	37	41
24.0	**Nan_DTT**	100.741214	18.742635	50	Da	28	31	35	39	51
25.0	**Phrae_DTT**	100.000833	17.933333	30	De	45	48	59	56	43
26.0	**Utaradit_DTT**	100.125278	17.619722	2	Dc/f	41	30	**33**	52	49
27.0	**Sukhothai_DTT**	100.010563	16.984763	50	Dc	41	30	33	52	49
28.0	**Tak_DTT**	98.927687	16.778691	50	Da	**31**	**35**	39	51	47
29.0	**Nakhon Sawan_DTT**	100.133636	15.715740	50	Dd	57	46	50	54	38
30.0	**Phetchaboon_DTT**	101.071373	16.251014	10	Db	40	44	29	32	36
31.0	**Chumphon_DTT**	99.126420	10.574229	50	Da	51	47	31	35	39
32.0	**Ranong_DTT**	98.673889	10.026111	15	Dc	49	30	37	41	33
33.0	**Surat Thani_DTT**	99.348510	9.091700	50	Db	26	36	40	44	32
34.0	**Phuket_DTT**	98.395395	7.898698	25	Da	**35**	39	51	47	31
35.0	**Nakhon Sri Thumarat_DTT**	99.984722	8.354167	30	Dc	30	33	37	41	49
36.0	**Trang_DTT**	99.486511	7.656956	40	De	43	59	48	53	56
37.0	**Song Khla_DTT**	100.520195	7.015850	50	TDa’	50	42	46	54	26
38.0	**Satun_DTT**	100.025305	6.635252	30	TDa’/f	52	42	60	38	26
39.0	**Yala_DTT**	101.390278	6.3336111	30	TDb	32	48	36	44	28

Table 4.1: Transmitter list in scenario B

Annex 6 shows a summary of DTTB Plan 3.0 regarding the 39 main sites, including the assignments in scenario C and B. Also are indicated:

- The analogue TV stations that need to be switched off before the temporarily channels in scenario B can be changed to the channels of the scenario C plan;
- The analogue TV stations where DTTB interference in the coverage area was accepted.

4.2 Fixed reception coverage

In this section the population, household and area coverage with fixed reception in scenario B is presented.

4.2.1 Population coverage with fixed reception

The population coverage with fixed reception in scenario B in comparison with the situation in scenario A and C is shown in Figure 4.1.a. The household coverage in scenario B is shown in Figure 4.1.b.

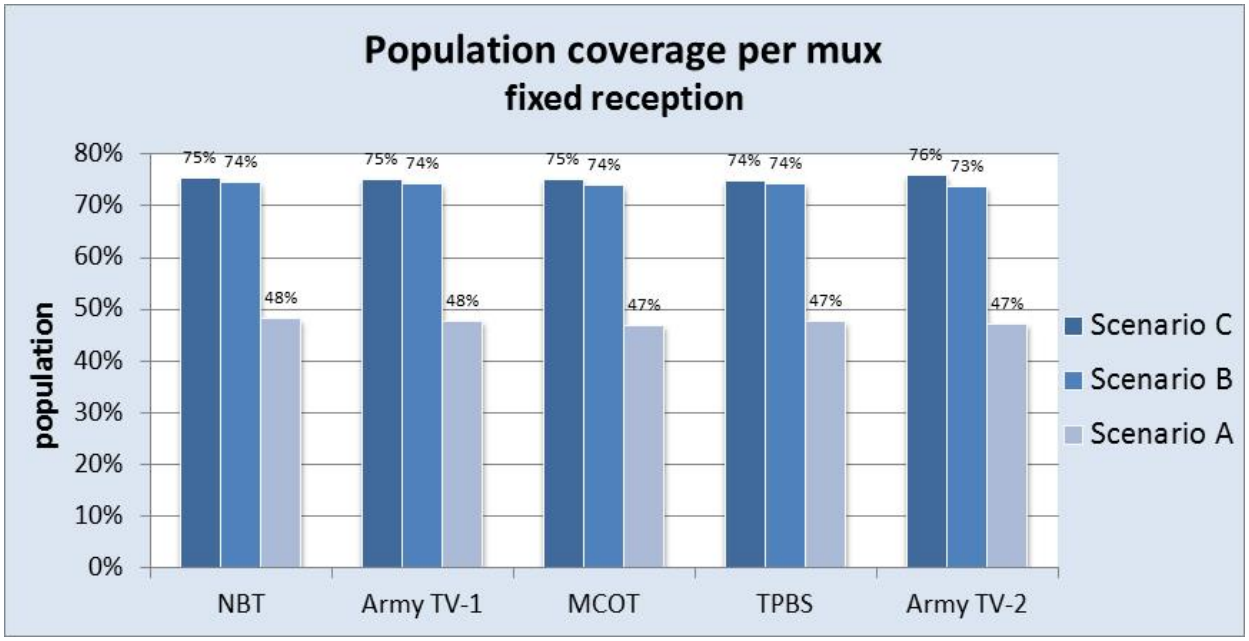

Figure 4.1.a: Population coverage in scenario C, B and A

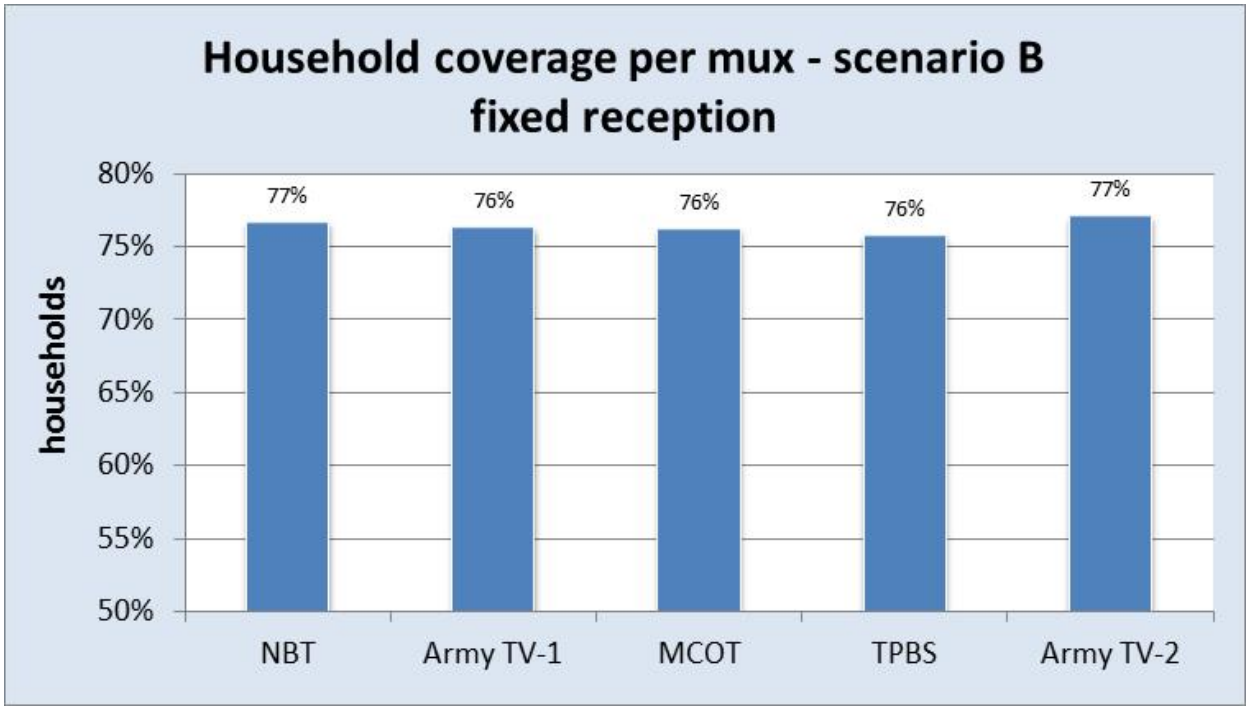

Figure 4.1.b: Household coverage in scenario B

The differences between scenario C and B range from 0.6% to 2.9%. The reasons for the differences are interference from analogue TV and at a number of sites also interference from temporarily DTTB channels. In addition the difference can be attributed to propagation differences as the temporarily channels in the transition period are in general higher than the channels to be used after analogue TV switch-off.

4.2.2 Area coverage with fixed reception

Figures 4.2 to 4.6 show the composite interference limited coverage per multiplex in scenario B. Orange coloured areas have ≥95% reception probability, which is considered as good reception. For information also areas with a reception probability of 90% to 95% (yellow coloured) and 70% to 90% (green coloured) are indicated.

Figure 4.2: Coverage of the 39 main sites of NBT in scenario B

Figure 4.3: Coverage of the 39 main of Army TV-1 in scenario B

Figure 4.4: Coverage of the 39 main sites of MCOT in scenario B

Figure 4.5: Coverage of the 39 main sites of TPBS in scenario B

Figure 4.6: Coverage of the 39 main sites of Army TV-2 in scenario B

4.3 Portable indoor reception coverage

In this section population, household and area coverage with portable indoor reception in scenario B, are presented.

4.3.1 Population coverage with portable indoor reception

The population coverage with indoor reception in scenario B compared to scenario C and A is shown in Figure 4.7.a. The household coverage in scenario B is shown in Figure 4.7.b.

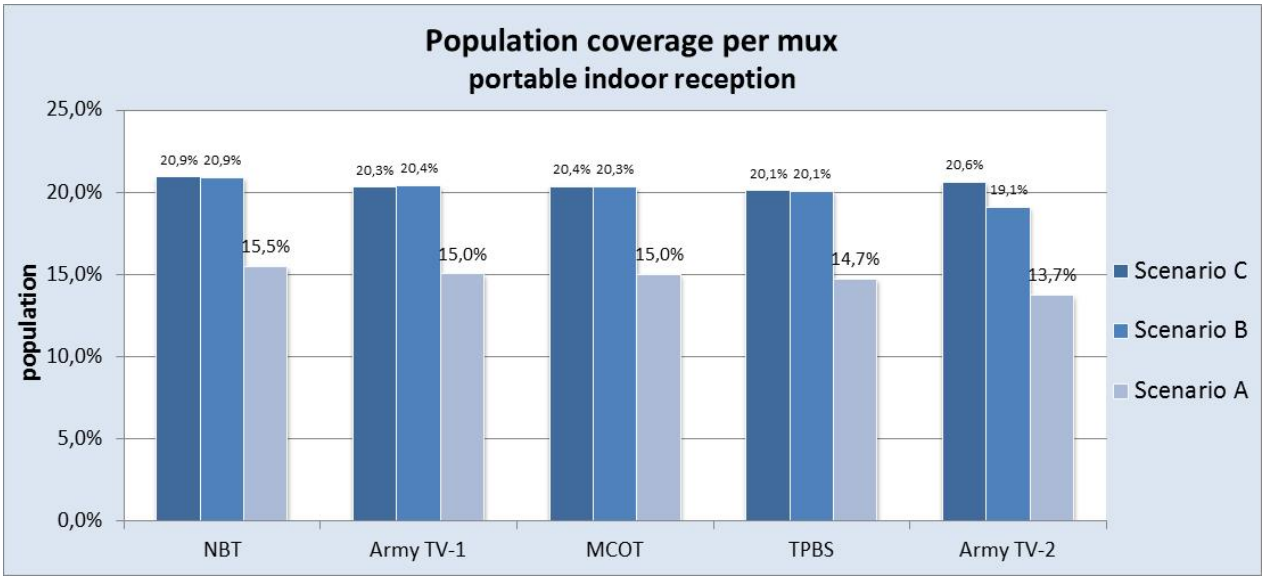

Figure 4.7.a: Population coverage in scenario C, B and A with portable indoor reception

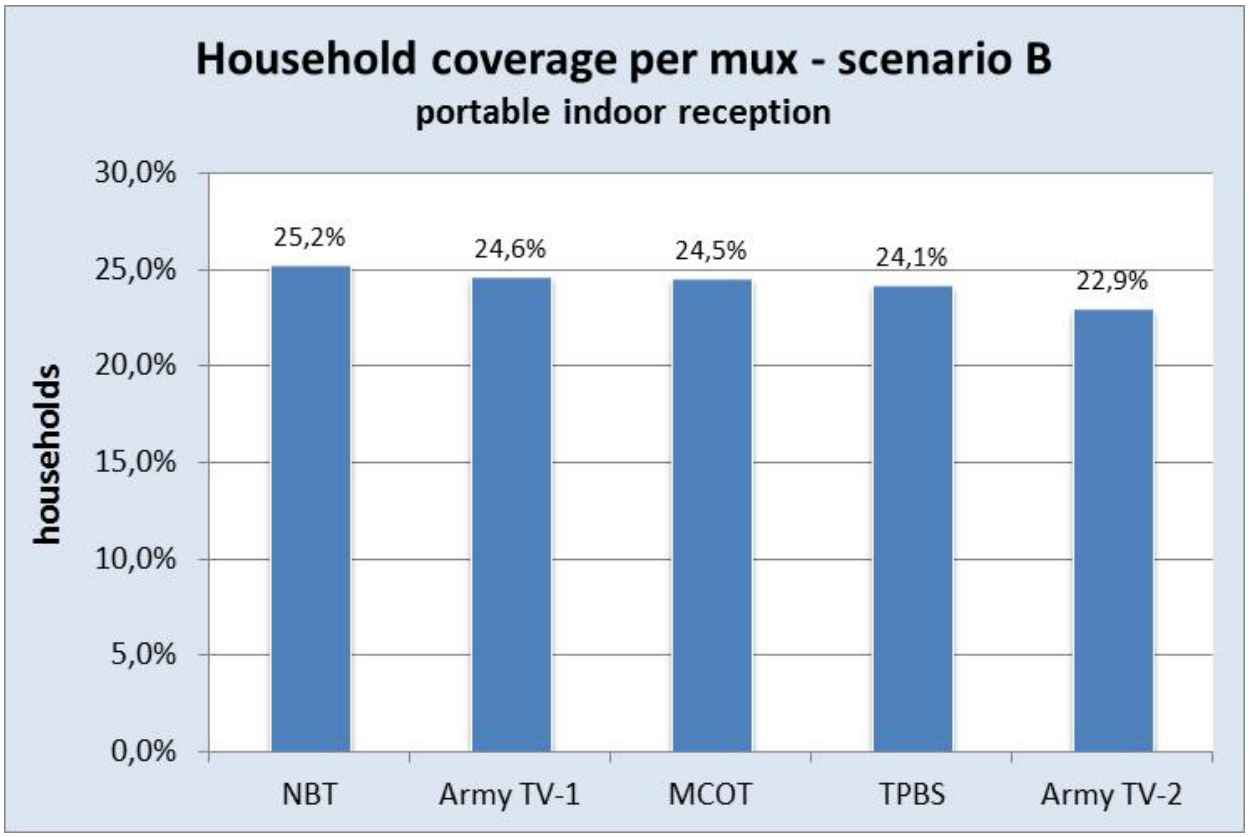

Figure 4.7.b: Household coverage in scenario B with portable indoor reception

The difference between coverage before and after analogue TV switch-off is mainly because propagation differences as the temporarily channels in the transition period are in general higher than the channels to be used after analogue TV switch-off.

The population coverage with portable indoor reception in scenario B in the 185 target municipalities in which indoor reception is of particular interest is shown in Table 4.2 and Figure 4.8.

PI Coverage	0 %	≥ 50 %	≥ 70 %	≥ 90 %	≥ 95 %	100 %
NBT	109	47	40	29	23	7
Army TV-1	109	48	40	30	25	7
MCOT	109	47	40	29	25	6
TPBS	109	47	38	28	23	4
Army TV-2	109	47	36	26	22	7

Table 4.2 Indoor coverage in scenario B in the 185 target municipalities

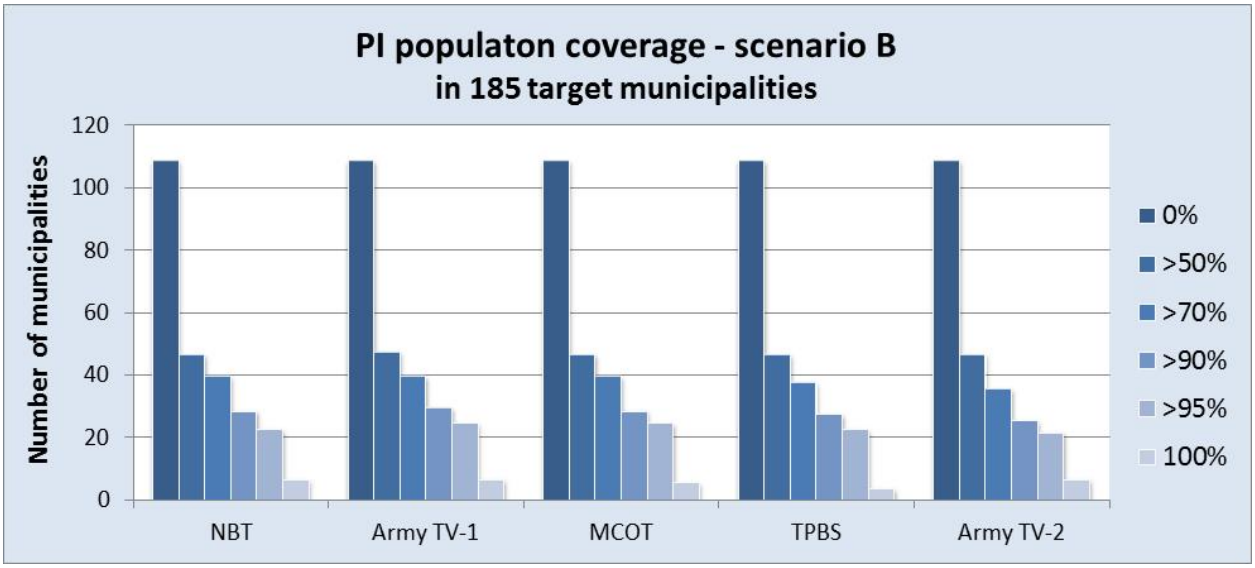

Figure 4.8: Indoor coverage in scenario B in the 185 target municipalities

The results show that in 26 target municipalities more than 90% of the population has good indoor reception of the five multiplexes and in 47 target municipalities 50% of the population has good indoor reception of the five multiplexes.

4.3.2 Area coverage with portable indoor reception

The area coverage with portable indoor reception before and after analogue switch-off is very similar. The differences cannot be distinguished on coverage plots with scales used in this report. Therefore reference is made to Figures 3.10 to 3.14.

4.4 Analogue TV coverage

In the scenario B planning process interference from DTTB stations to UHF analogue TV was accepted in a number of cases (see Annex 4). Consequently the UHF analogue TV coverage reduces during the transition period. Figure 4.9.a shows the population coverage in scenario B in comparison with the situation before DTTB launch and in scenario A. Figure 4.9.b shows the household coverage in scenario B.

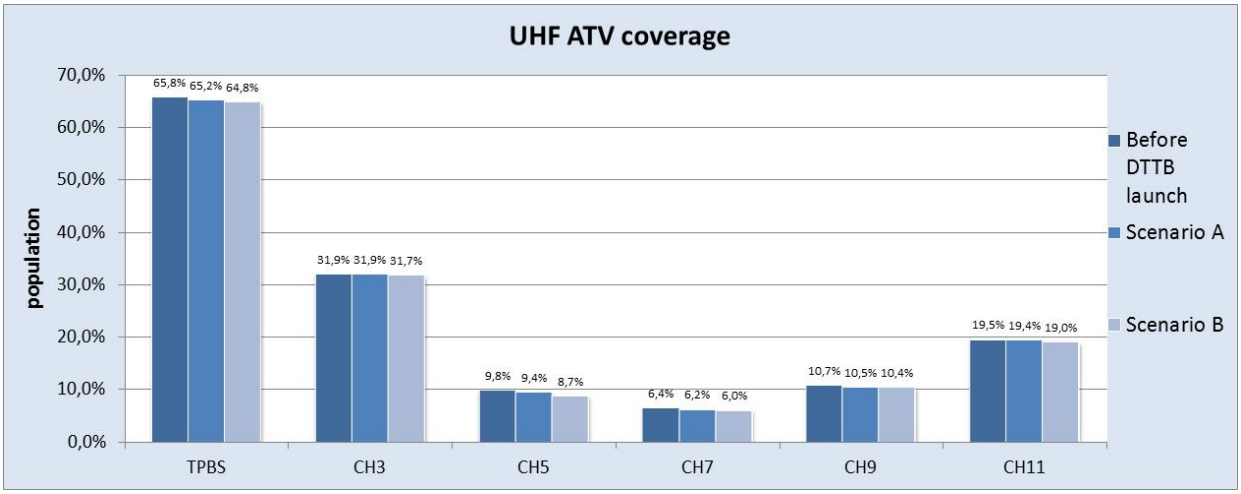

Figure 4.9.a: UHF analogue TV population coverage before DTTB launch and during scenario A and B

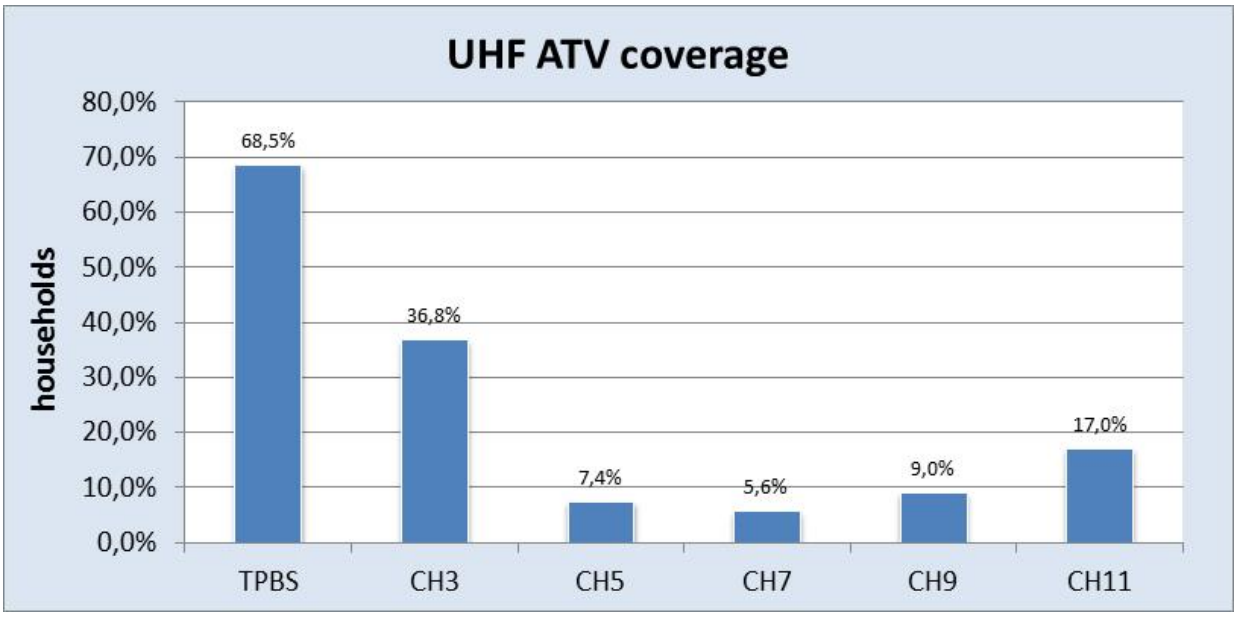

Figure 4.9.b: UHF analogue TV household coverage in scenario B

The potentially affected UHF TV viewers due to DTTB transmissions in scenario B, compared to the situation before DTTB launch are indicated in Table 4.3.

Potentially affected	TPBS	CH3	CH5	CH7	CH9	CH11
Population	1.4%	0.6%	11.0%	6.2%	2.9%	2.4%
Households	1.2%	0.5%	11.2%	6.9%	3.2%	2.2%

Table 4.3: Potentially affected UHF ATV viewers

It should be noted that the analogue TV stations of TPBS transmit in UHF only. The analogue TV stations of the other broadcasters transmit partly in UHF and partly in VHF. The potentially affected viewers

indicated in Table 4.3 refer to UHF transmissions. In the mixed VHF/UHF networks the potentially affected viewers relative to the total number of viewers is therefore much lower.

Figures 4.10 to 4.14 show the UHF analogue TV area coverage per network in scenario B. The green coloured areas show locations with good analogue TV reception. In the red coloured areas reception is interfered by other analogue TV transmitters. The blue coloured areas indicate locations where good analogue TV reception, without interference by other analogue TV transmitters, is affected by interference from DTTB stations in scenario B.

Figure 4.10: UHF ATV coverage of CH3 in scenario B

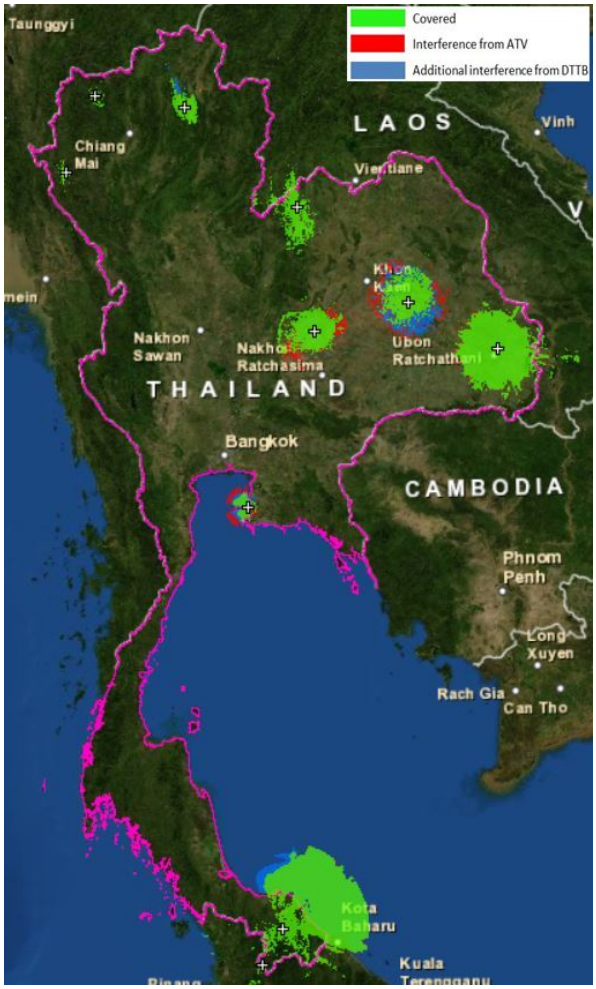

Figure 4.11: UHF ATV coverage of CH5 in scenario B

Figure 4.12: UHF ATV coverage of CH7 in scenario B

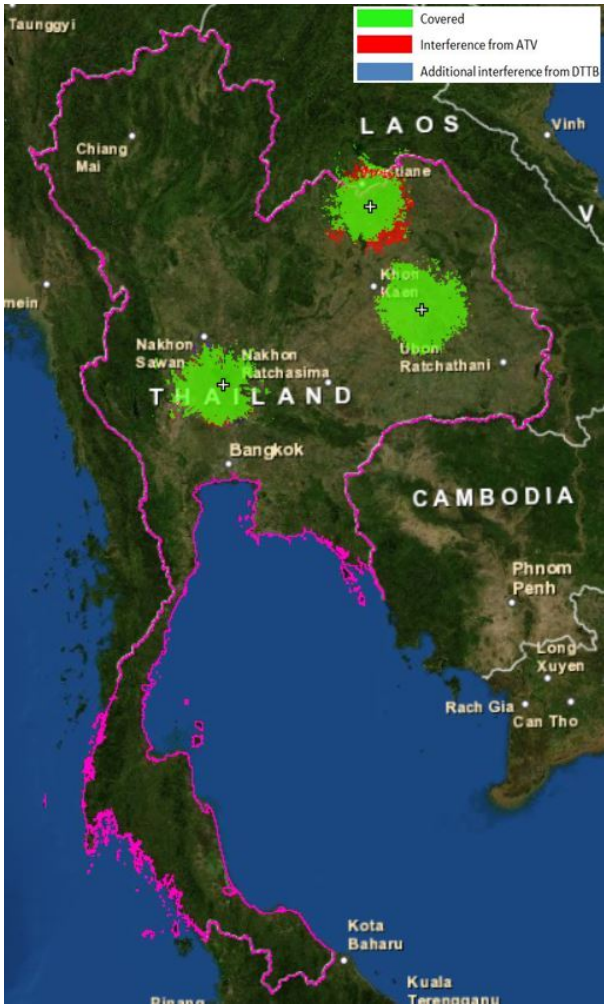

Figure 4.13: UHF ATV coverage of CH9 in scenario B

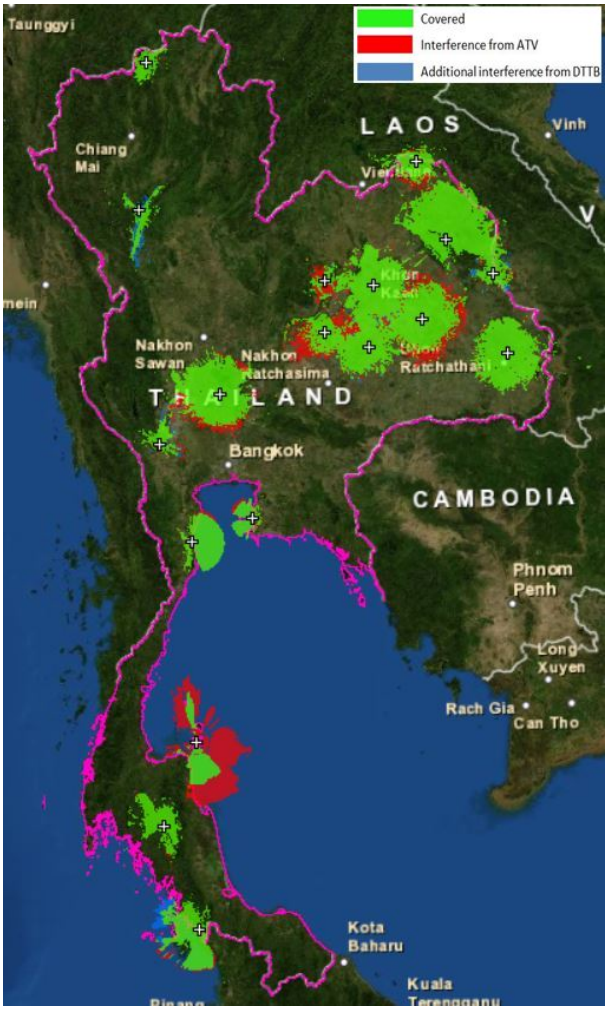

Figure 4.14: UHF ATV coverage of CH11 in scenario B

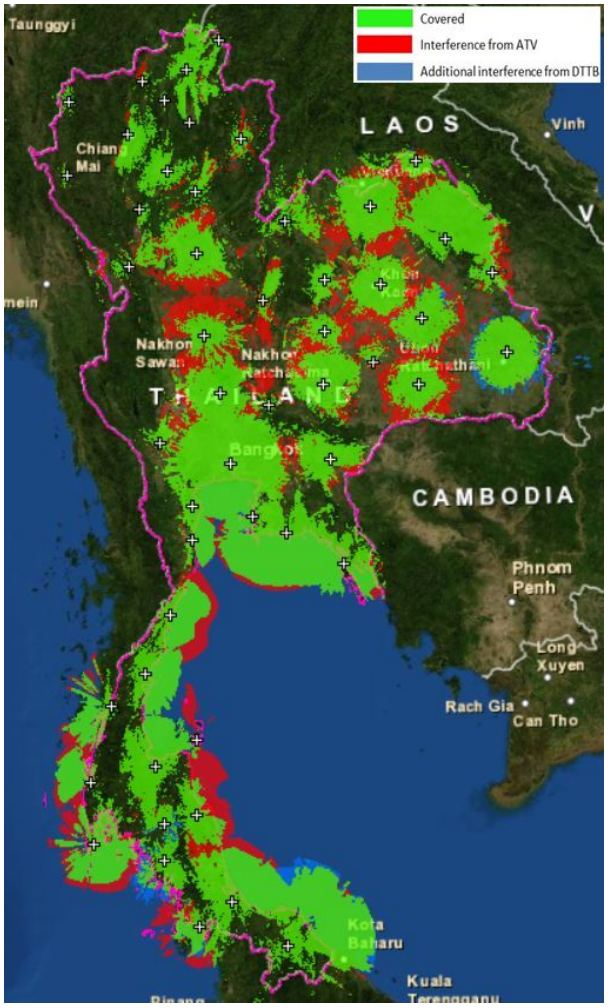

Figure 4.15: UHF ATV coverage of TPBS in scenario B

5. Results of planning scenario A

Scenario A reflects the situation that the eleven DTTB main sites of the first deployment phase with five multiplexes each are in operation and analogue TV stations (see Annex 7) are in operation.

This section describes the results of planning scenario A and contains a presentation of:

- Transmitter list of the 11 main sites;
- Fixed reception coverage;
- Portable indoor coverage;
- Analogue TV coverage.

A description of the scenario A planning process is given in Annex 5.

During a mission in Bangkok from 13 to 24 January 2014, the results of planning scenario A were agreed by NBTC and endorsed by the network operators.

5.1 Transmitter list

The agreed transmitter list of the 11 main sites of the first deployment phase is shown in Table 5.1. Columns C and D show the geographical coordinates in degrees and decimals of degrees. Column E shows the maximum effective radiated power (ERP) and the channel group (CG) in scenario C per site is indicated in column F. Columns G to K show the channel number per multiplex. The temporarily channels are printed red in the grey shaded fields.

A	B	C	D	E	F	G	H	I	J	K
Site N°	Site name	Longitude	Latitude	ERP (kW)	Sc C CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2
1.0	**Bangkok_DTT**	100.540000	13.754444	50	Db	26	36	40	44	52
3.0	**Singburi_DTT**	100.377004	14.836115	15	Da	35	51	47	39	55
4.0	**Rayong_DTT**	101.412906	12.676200	50	De	45	59	53	56	43
8.0	**Nakhon Ratchasima_DTT**	101.995556	14.946389	50	Dc	58	52	30	33	37
12.0	**Ubon Ratchathani_DTT SFN**	104.923611	15.381667	50	Dc	41	52	58	26	49
15.0	**Khon Kaen_DTT**	102.946425	16.463758	50	De	59	45	52	56	48
17.0	**Udonthani_DTT**	102.794088	17.664041	50	Da	47	35	55	39	51
20.0	**Chiang Mai_DTT**	98.917500	18.809722	50	Dd	60	50	54	57	38
27.0	**Sukhothai_DTT SFN**	100.010563	16.984763	50	Dc	41	30	33	52	49
33.0	**Surat Thani_DTT**	99.348510	9.091700	50	Db	26	36	40	44	32
37.0	**Song Khla_DTT SFN**	100.520195	7.015850	50	TDa'	50	42	46	54	26

Table 5.1: Transmitter list of the 11 main sites in the first deployment phase

Annex 6 shows a summary of DTTB Plan 3.0 regarding the 39 main sites, with the assignments of the first deployment phase indicated in colour shaded fields.

5.2 Fixed reception coverage

In this section the population, household and area coverage with fixed reception of the eleven main sites of the first deployment phase (scenario A) are presented.

5.2.1 Population coverage with fixed reception

The population coverage with fixed reception in scenario A is shown in Figure 5.1.a. The household coverage in scenario A is shown in Figure 5.1.b. A comparison of the population coverage in scenario A, B and C is shown in Section 4.2.1 Figure 4.1.a.

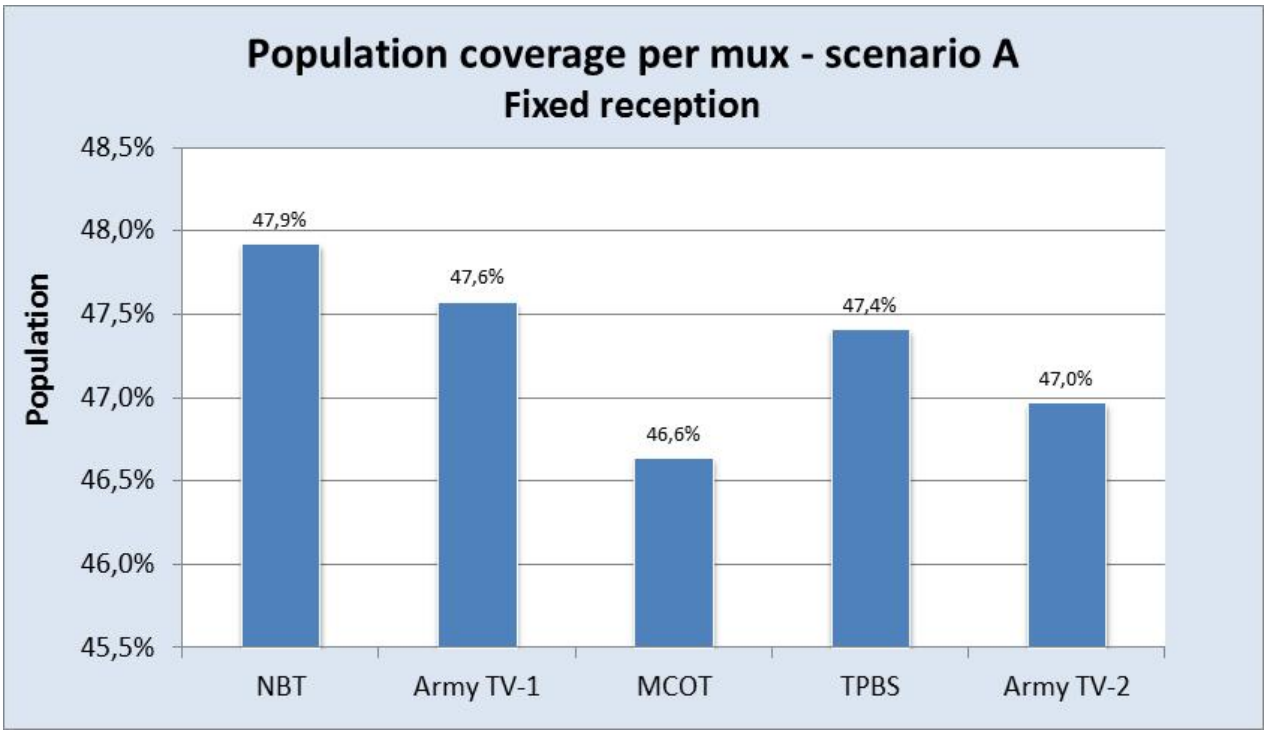

Figure 5.1.a: Population coverage with fixed reception in scenario A

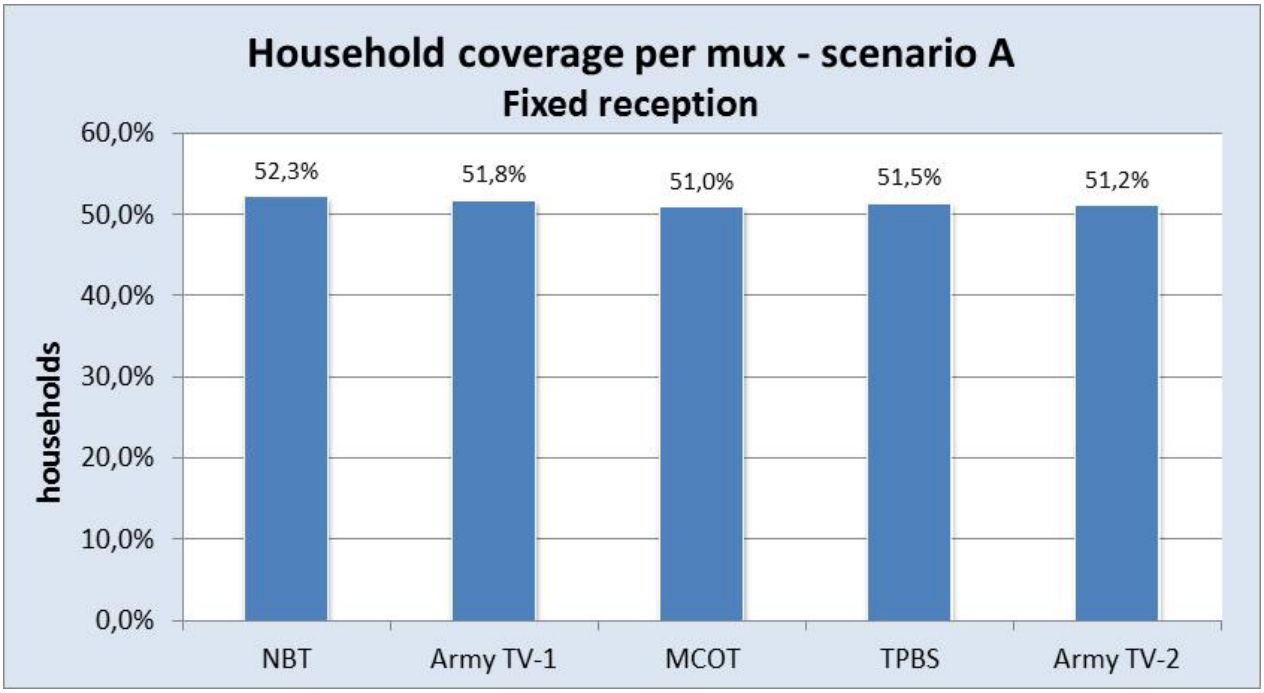

Figure 5.1.b: Household coverage with fixed reception in scenario A

The differences between scenario A and B are because in scenario A eleven sites are in operation, while in scenario B 39 sites are in operation. Furthermore because of the lower number of DTTB sites in scenario A the interference from DTTB sites is less compared to scenario B.

The household coverage of the first eleven main sites exceeds the required minimum coverage of 50%.

5.2.2 Area coverage with fixed reception

Figures 5.2 to 5.6 show the composite interference limited coverage per network by the eleven main sites in the first deployment phase (scenario A). Orange coloured areas have ≥95% reception probability, which is considered as good reception. For information also areas with a reception probability of 90% to 95% (yellow coloured) and 70% to 90% (green coloured) are indicated.

Figure 5.2: Coverage of the 11 main sites of NBT in scenario A

Figure 5.3: Coverage of the 11 main of Army TV-1 in scenario A

Figure 5.4: Coverage of the 11 main sites of MCOT in scenario A

Figure 5.5: Coverage of the 11 main sites of TPBS in scenario A

Figure 5.6: Coverage of the 11 main sites of Army TV-2 in scenario A

5.3 Portable indoor reception coverage

In this section population, household and area coverage with portable indoor reception in scenario A, are presented.

5.3.1 Population coverage with portable indoor reception

The population coverage with indoor reception of the eleven main sites in scenario A is shown in Figure 5.7.1.a. The household coverage in scenario A is shown in Figure 5.7.b. A comparison of the population coverage in scenario A, B and C is shown in Section 4.3.1 Figure 4.7.a.

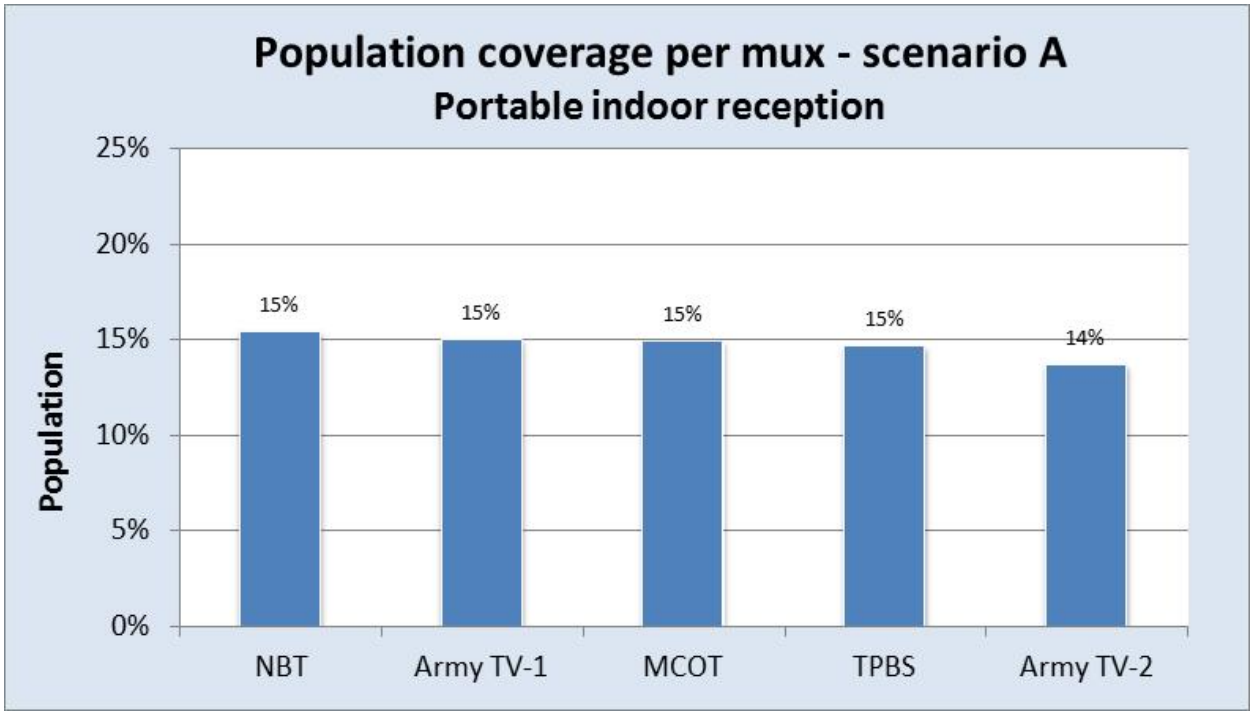

Figure 5.7.a: Population coverage with portable indoor reception in scenario A

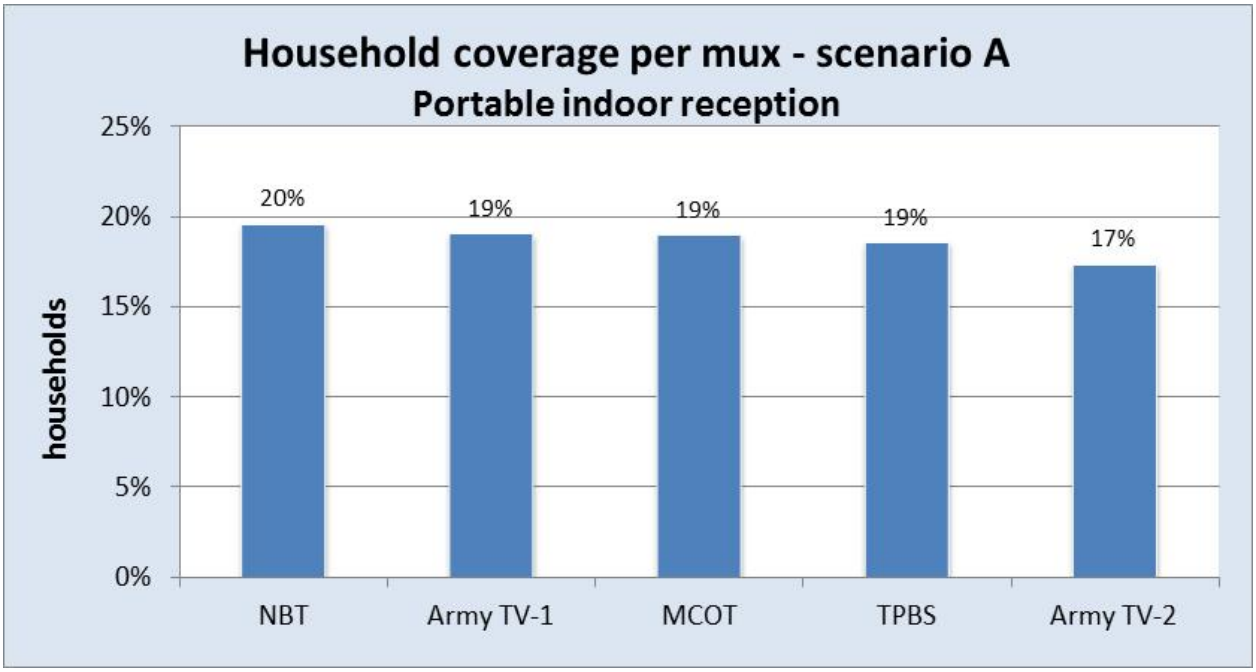

Figure 5.7.b: Household coverage with portable indoor reception in scenario A

The population coverage with portable indoor reception in scenario A in the 185 target municipalities in which indoor reception is of particular interest is shown in Table 5.2 and Figure 5.8.

PI Coverage	0 %	≥ 50 %	≥ 70 %	≥ 90 %	≥ 95 %	100 %
NBT	136	26	21	14	12	4
Army TV-1	136	27	22	15	13	4
MCOT	136	27	21	15	13	4
TPBS	136	27	19	14	11	2
Army TV-2	136	26	18	13	10	5

Table 5.2 Indoor coverage in scenario A in the 185 target municipalities

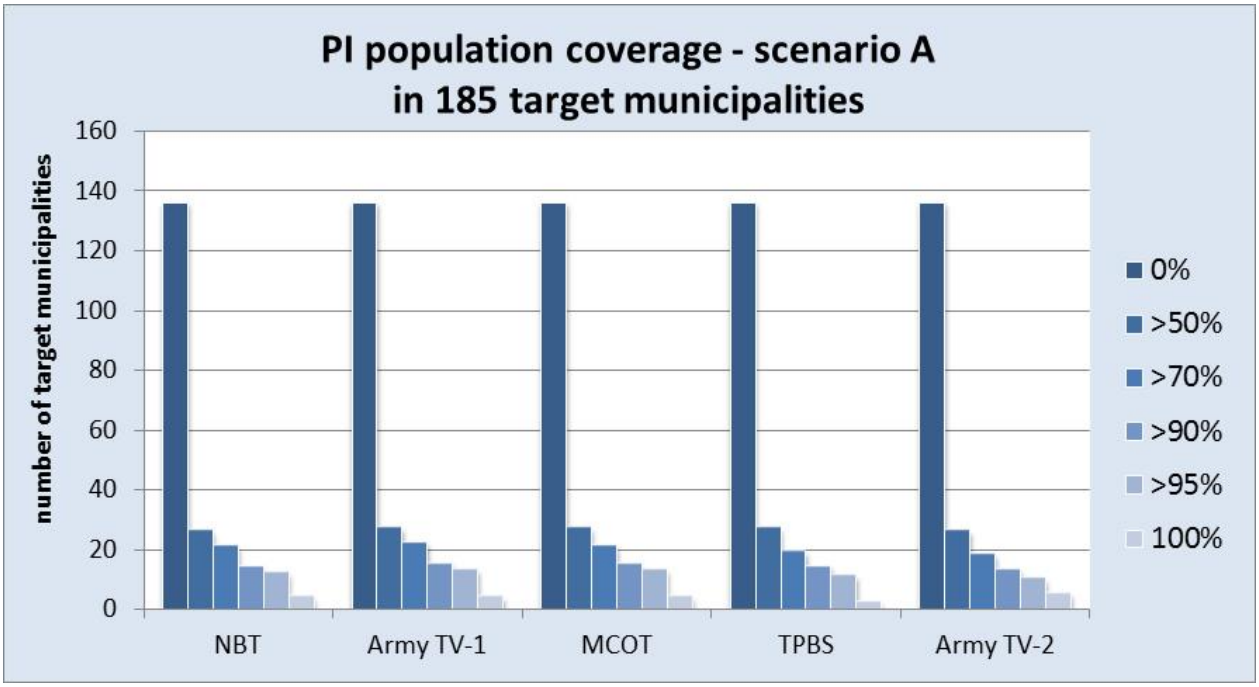

Figure 5.8: Indoor coverage in scenario A in the 185 target municipalities

The results show that in 13 target municipalities more than 90% of the population has good indoor reception of the five multiplexes and in 26 target municipalities 50% of the population has good indoor reception of the five multiplexes.

5.3.2 Area coverage with portable indoor reception

The area coverage with portable indoor reception per multiplex in scenario A is shown in Figures 5.9 to 5.13.

Figure 5.9: Coverage of the 11 main sites of NBT in scenario A

Figure 5.10: Coverage of the 11 main of Army TV-1 in in scenario A

Figure 5.11: Coverage of the 11 main sites of MCOT in scenario A

Figure 5.12: Coverage of the 11 main sites of TPBS in scenario A

Figure 5.13: Coverage of the 11 main sites of Army TV-2 in scenario A

5.4 Analogue TV coverage

In scenario A, DTTB interference to analogue TV is limited to a few cases.

The UHF analogue TV population coverage in scenario A is shown in Figure 5.14.a. Household coverage in scenario A is shown in Figure 5.14.b. A comparison of the population coverage before DTTB launch, in scenario A and B is shown in Section 4.4, Figure 4.9.a.

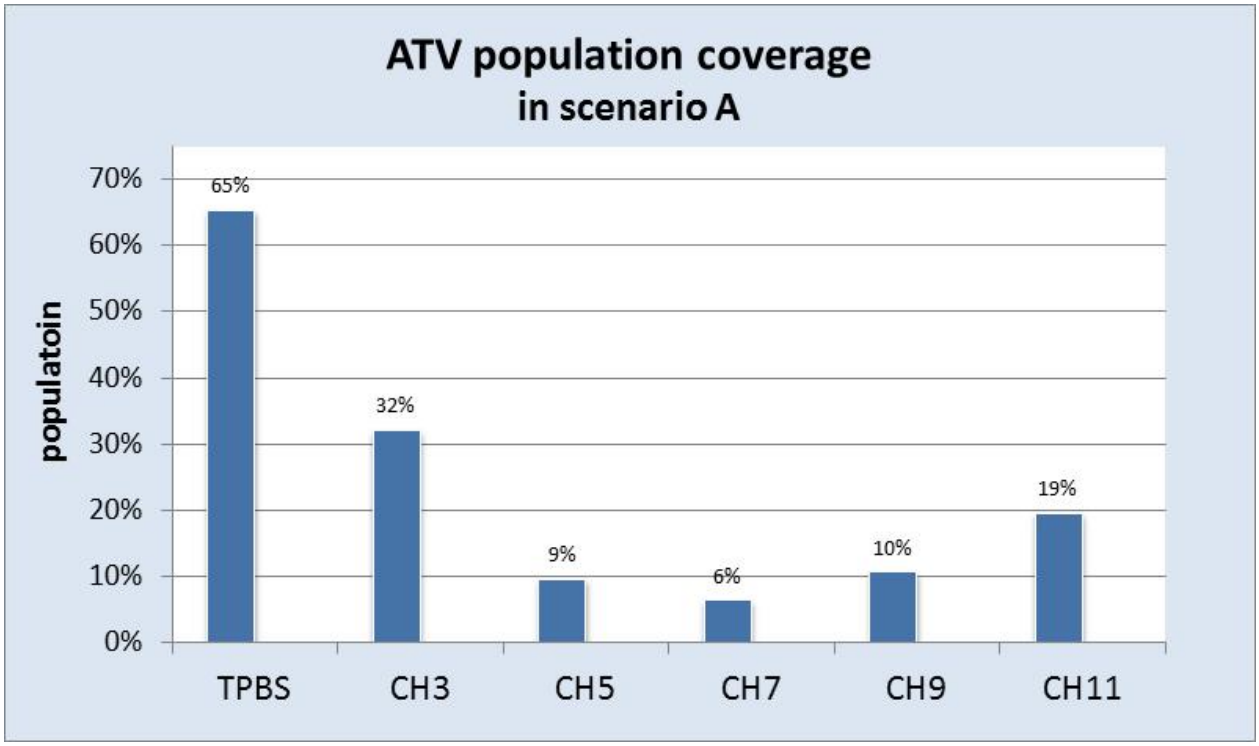

Figure 5.14.a: Analogue TV population coverage in scenario A

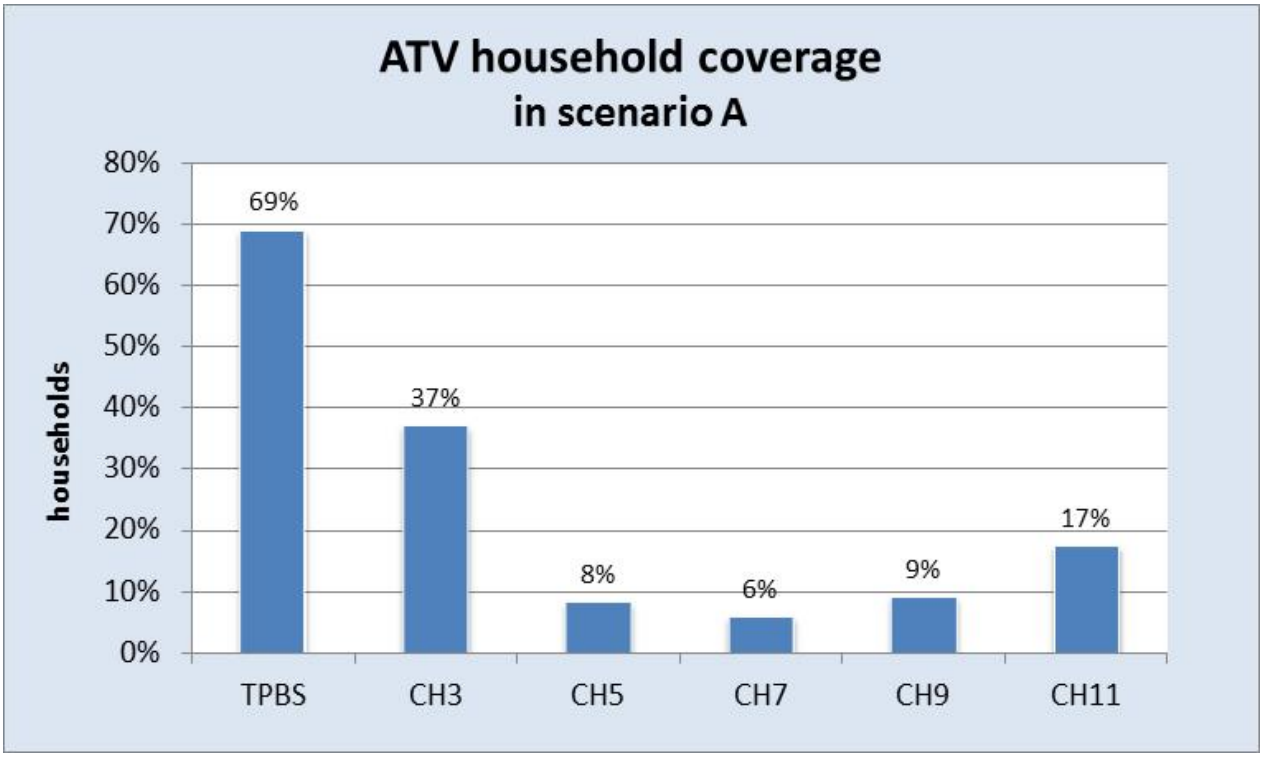

Figure 5.14.b: Analogue TV household coverage in scenario A

Figures 5.15 to 5.20 show the analogue TV area coverage per network in scenario A. The green coloured areas show locations with good analogue TV reception. In the red coloured areas reception is interfered by other analogue TV transmitters. The blue coloured areas indicate locations where good analogue TV reception, without interference by other analogue TV transmitters, is affected by interference from DTTB stations in scenario A.

Figure 5.15: UHF ATV coverage of CH3 in scenario A

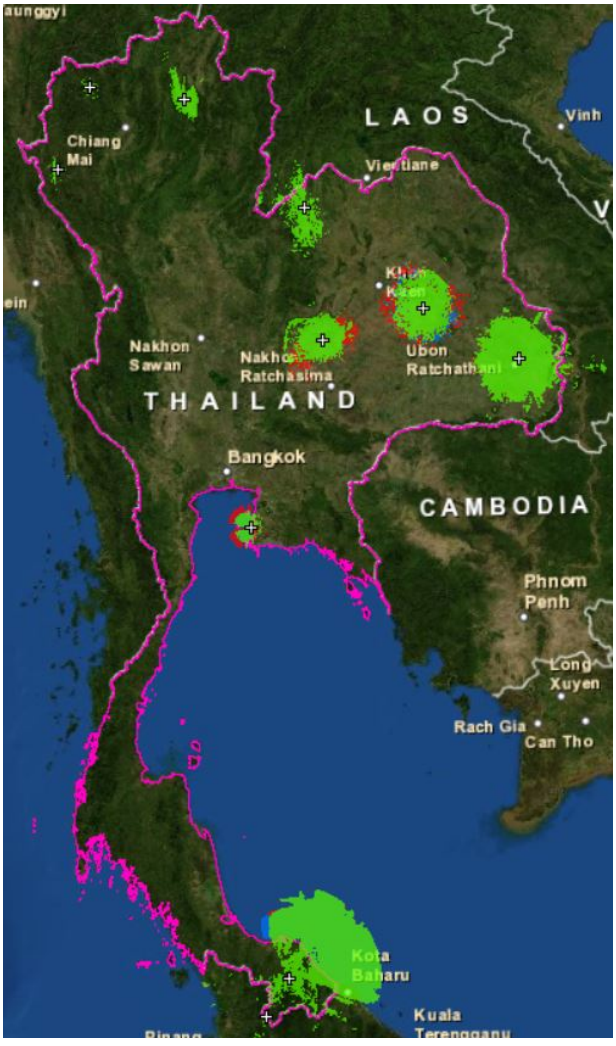

Figure 5.16: UHF ATV coverage of CH5 in scenario A

Figure 5.17: UHF ATV coverage of CH7 in scenario A

Figure 5.18: UHF ATV coverage of CH9 in scenario A

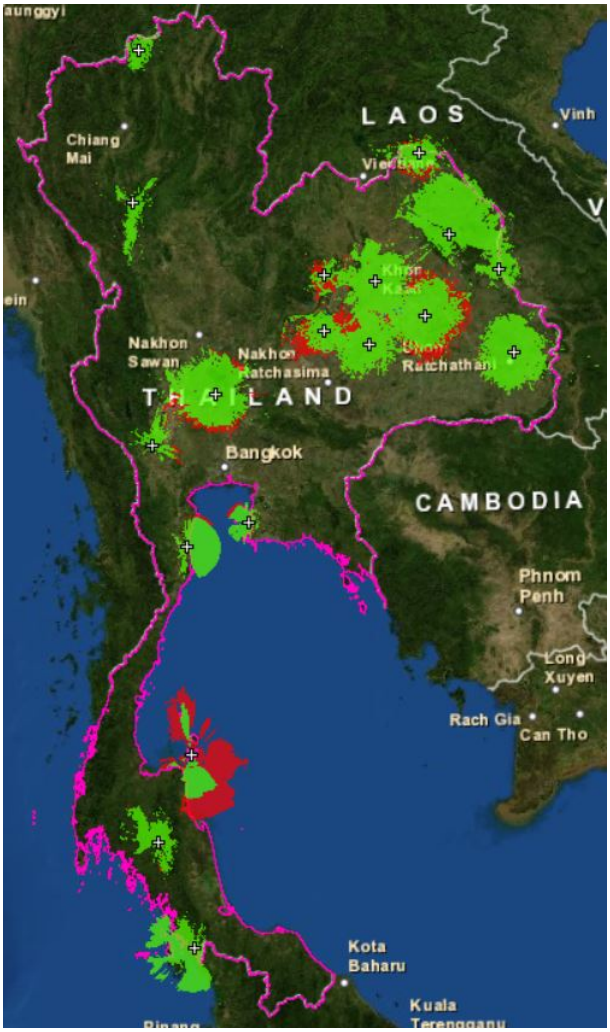

Figure 5.19: : UHF ATV coverage of CH11 in scenario A

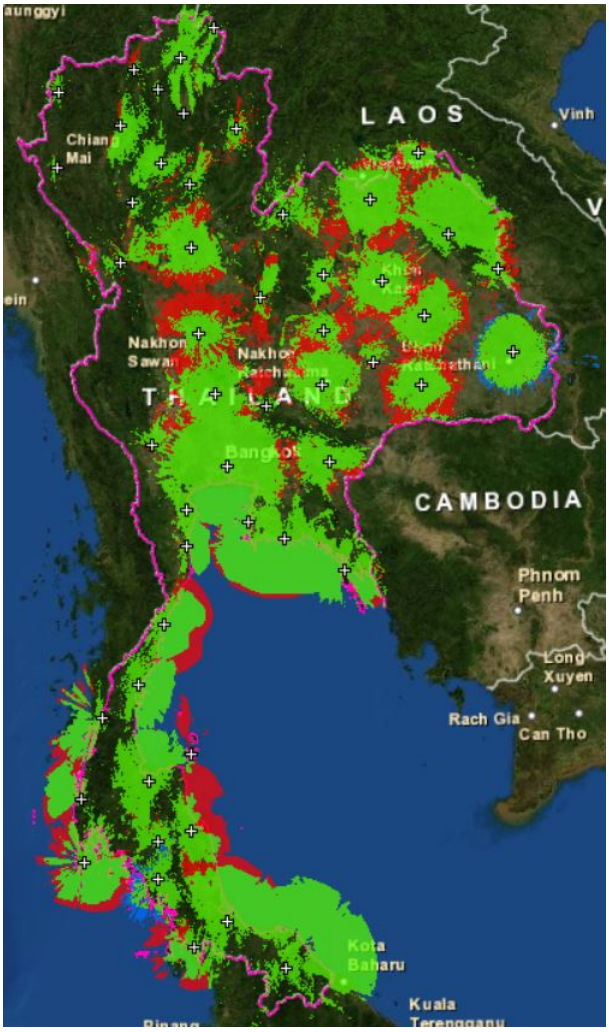

Figure 5.20: : UHF ATV coverage of TPBS in scenario A

6. Considerations regarding the plan implementation

In this section five aspects regarding the plan implementation are highlighted:

1) Coverage differences during the transition;
2) Implementation of the 6th multiplex;
3) Changing temporarily channels;
4) Transmitting antenna;
5) Receiving antenna.

6.1 Coverage differences during the transition

During the transition from scenario B to C a number of changes will take place in the networks and in the reception conditions of analogue TV as well as DTTB. For the viewers this might be very confusing and adequate information campaigns have to be set up.

Two situations are described below:

1) Analogue TV reception is affected by DTTB interference;
2) DTTB reception is affected by DTTB interference.

6.1.1 Analogue TV reception affected by DTTB interference

In Annex 4 it is indicated that DTTB interference was accepted in the coverage of thirteen analogue TV stations. These cases are listed in Table 6.1, together with the interfering DTTB sites and an indication when the DTTB service in the affected analogue TV coverage areas will be available.

Affected ATV station	Interfered by DTTB station in scenario A	Interfered by DTTB station in scenario B	DTTB coverage in affected areas
Roi-Et_CH5	Ubon Ratchathani_DTT	Ubon Ratchathani_DTT	In scenario B
Trang TPBS	Song Khla_DTT	Song Khla_DTT	In scenario B
Thung Song_TPBS		Phuket_DTT	In scenario A
Takua Pa_TPBS		Phuket_DTT	Not in scenario A, B and C
Tak_TPBS		Tak_DTT	In scenario B
Pattaya_TPBS		Prachaub Khiri Khun_DTT	Not in scenario A, B and C
Toen_CH11		Tak_DTT	Not in scenario A, B and C
Trang_CH7		Song Khla_DTT	In scenario B
Satun_CH7	Song Khla_DTT	Song Khla_DTT	In scenario B
Pattaya_CH7		Prachaub Khiri Khun_DTT	Not in scenario A, B and C
Kanchanaburi_CH7		Kanchanaburi_DTT	In scenario A
Pattaya_CH5		Prachaub Khiri Khun_DTT Sakaeo_DTT	Not in scenario A, B and C
Song Khla_CH3		Satun_DTT	In scenario A

Table 6.1: DTTB coverage of affected ATV viewers

In eight of the cases the affected analogue TV viewers will be able to receive DTTB signals. However, in three of these cases the interference occurs already in scenario A (due to one of the eleven DTTB sites of the first deployment phase), whereas the wanted DTTB transmitter will be launched in later. In five cases, the affected analogue TV viewers will have no DTTB reception from the 39 main sites and have to wait for additional sites to be brought into operation.

Below examples are given of two cases:

a) Analogue TV reception is interfered by a DTTB transmitter and the DTTB service for the area concerned is not yet available (Roi-Et CH5);
b) Analogue TV reception is interfered by a DTTB transmitter and the area concerned will not be covered by a DTTB main site (Pattaya TPBS).

a) Interfered analogue TV reception and no DTTB service yet

In Annex 4, Section 1.2 it is shown that one of the measures for resolving incompatibilities was to accept analogue TV interference if the analogue TV service is also available in VHF and if the potentially affected number of viewers is less than 1,000,000. This measure was applied to analogue TV station Roi ET Ch5 which is interfered by four DTTB stations.

The coverage of analogue TV station Roi Et Ch5 in scenario A is shown in Figure 6.1 (picture on the left). The green coloured areas show locations with good analogue TV reception. In the red coloured areas reception is interfered by other analogue TV transmitters. The blue coloured areas indicate locations where analogue TV reception, without interference by other analogue TV transmitters, is affected by interference from DTTB stations.

In scenario A the DTTB interference is caused by Ubon Ratchathani_DTT (site 12). The DTTB site Roi Et is not included in scenario A, consequently the people in the blue coloured locations lose analogue TV coverage of Roi ET ch5 but have not yet a DTTB alternative. In the north-west part of the coverage area the affected viewers in the blue coloured locations could receive the VHF analogue TV service from Khon Kaen (the coverage contour is indicated in the figure). However, about 130,000 affected people in the south-east part of the coverage area have no alternative.

It could be considered to install the DTTB transmitter in Roi Et as soon as possible after the DTTB transmitter in Ubon Ratchathani is operational to provide the viewers a DTTB alternative (see Figure 6.1 – right hand site picture).

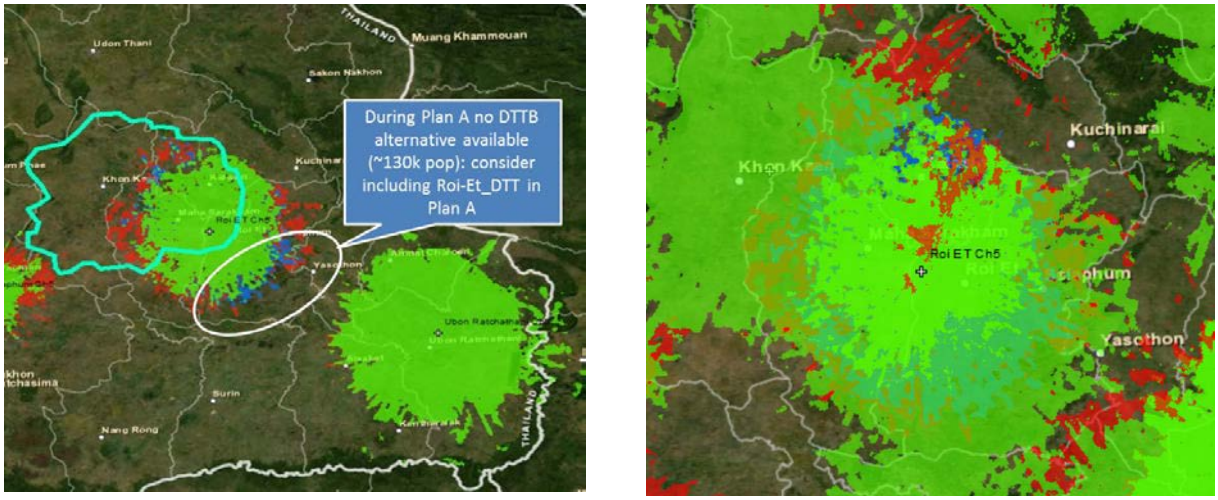

Figure 6.1: Coverage situation of Roi Et Ch5 in scenario A (left) and B (right)

b) Interfered analogue TV reception and no DTTB service from the 39 main sites

In the analogue TV coverage area of Pattaya TPBS 18,000 people will be affected by DTTB interference in scenario A (see blue coloured locations in Figure 6.2- left hand side picture). However, when all 39 DTTB main sites are on air, the affected viewers still have no DTTB coverage A (see blue coloured locations in Figure 6.2- right hand side picture). This situation will likely be resolved by an additional site.

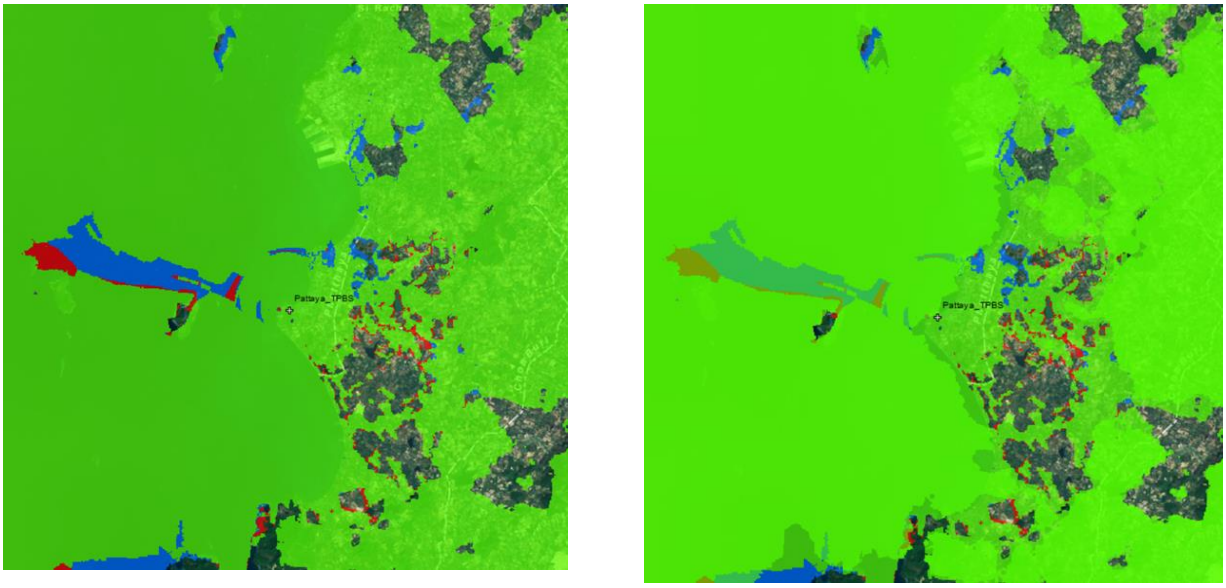

Figure 6.2: Coverage situation of Pattaya TPBS in scenario A (left) and B (right)

6.1.2 DTTB reception affected by DTTB interference

Due to interference from DTTB sites brought into operation after the first 11 main sites, some areas that have good DTTB reception in scenario A will not have good DTTB reception in scenario B. An example is given in Figure 6.3. The blue coloured areas encompass five sub-districts with a population of 11,000 that loose DTTB coverage in the transition from scenario A to B.

It could be considered not to include these areas in the communications to the public on DTTB coverage, to avoid disappointed viewers.

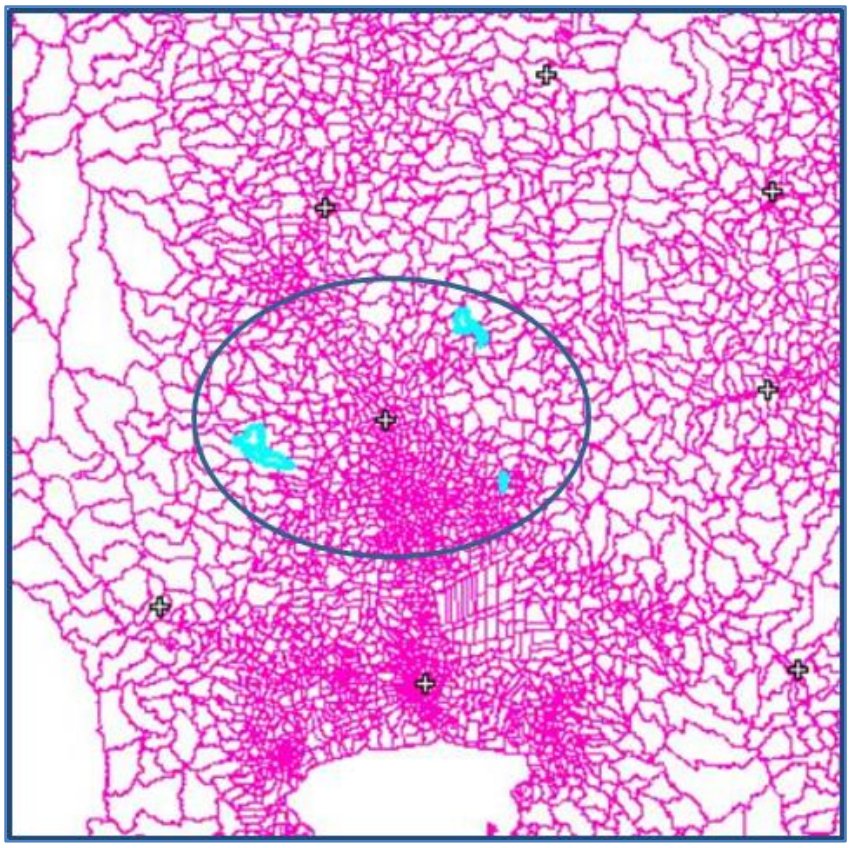

Figure 6.3 Coverage losses in the transition from scenario A to B

6.2 Implementation of the 6th multiplex

It is expected that the 6th multiplex, intended for community services, will be licensed early 2015. The stations of this multiplex will be brought into operation region by region, depending on:

- Switch-off of TPBS analogue TV stations;
- Conditions resulting from the scenario B plan.

The DTTB assignments to the sites of multiplex 6 consist of four categories as listed in Table 6.2.

DTTB assignment category in Mux 6	Number of sites
a) Channels in use by TPBS-ATV at or near the DTTB sites	23
b) Channels placed in multiplex 6 to avoid a temporarily channel assignment to multiplexes 1 to 5 in scenario B	6
c) Channels temporarily assigned to multiplexes 1 to 5 in scenario B	4
d) Channels without frequency planning constraints	6

Table 6.2: Categories of assignments in Mux 6

The conditions for bringing into operation the sites in the four categories are described below.

a) Channels in use by TPBS-ATV at or near the DTTB sites

The 23 DTTB assignments of this category could be brought into operation after the related TPBS analogue TV station has been switched off. The stations are indicated in column K of Annex 6 in orange print. The location of the sites is indicated in Figure 6.4

Figure 6.4: Sites of Mux 6 blocked by TPBS-ATV stations at or near the sites

b) Channels placed in multiplex 6 to avoid a temporarily channel assignment to multiplexes 1 to 5 in scenario B

These DTTB assignments resulted from applying the procedures for avoiding interference to or from analogue TV as described in Annex 4, Section 1.1 and in Annex 4, Section 2 and are shown Tables A4.1 and A4.9. The six DTTB assignments of this category can be brought into operation after the analogue TV sites shown in the table below are switched-off.

Site N°	Site name	Mux 6 ch	Related ATV station	ATV ch
4.0	**Rayong_DTT**	**48**	Pattaya Ch11	48
13.0	**Mukdahan_DTT**	**31**	Roi ET Ch11	31
14.0	**Roi ET_DTT**	**38**	Pratay N Ratchasima Ch11	38
15.0	**Khon Kaen_DTT**	**43**	Roi ET Ch9	43
28.0	**Tak_DTT**	**28**	Toen TPBS	28
36.0	**Trang_DTT**	**45**	Thung Song Ch11	45

Table 6.3: Sites of Mux 6 blocked by analogue TV stations

c) Channels temporarily assigned to multiplexes 1 to 5 in scenario B

These DTTB assignments resulted from applying the procedures for avoiding interference to analogue TV as described in Annex 4, Section 1.3 and are shown in Table A4.8. When the related analogue TV stations are switched-off, the temporarily channel assignments to multiplex 1 to 5 are not necessary anymore and the channels can be used in multiplex 6. The four DTTB sites and the channel in multiplex 6 together with the temporarily assignment (printed in red) and the related analogue TV stations are indicated in the table below.

Site N°	Site name	Mux 6 ch	Temporarily channel use		Related ATV station	ATV ch
			Mux	Channel		
11.0	**Sisaket_DTT**	37	TPBS	27/37	Ubon Ratchathani TPBS	27
12.0	**Ubon Ratchathani_DTT**	52	Army TV-1	30/52	Ubon Ratchathani Ch5	30
26.0	**Utaradit_DTT**	52	TPBS	37/52	Sukhothai Ch3	37
38.0	**Satun_DTT**	52	NBT	50/52	Trang Ch7	50

Table 6.4: Sites of Mux 6 blocked by analogue TV stations

d) DTTB channels without frequency planning constraints

The six DTTB assignments of this category could be brought into operation independently of analogue TV switch-off. The sites are listed in the table below.

Site N°	Site name	Mux 6 ch
2.0	**Kanchana Buri_DTT**	33
24.0	**Nan_DTT**	47
25.0	**Phrae_DTT**	53
30.0	**Phetchaboon_DTT**	26
34.0	**Phuket_DTT**	28
39.0	**Yala_DTT**	40

Table 6.5: Sites of Mux 6 not blocked by analogue TV stations

6.3 Changing temporarily channels

In total 26 temporarily channels have been assigned that need to be changed to the channels of the scenario C plan after the related analogue TV stations are switch-off. The related analogue TV stations are indicated in Annex 6. That means that the analogue TV switch-off process drives the channel channels changes and also the implementation of Mux 6 (see Section 6.2).

An example of a deployment schedule showing the launch of the DTTB sites as well as markers for channel changes after analogue TV sites are switched off(indicated as small triangles) is shown in Figure 6.5.

The example in Figure 6.5 shows that in the first DTTB deployment phase eleven main sites, giving a total household coverage with rooftop reception of more than 50% will be operational with five channels per

site. In 2015 the TPBS analogue stations will start to cease operation. Hence the sixth network (or multiplex) could be operational after a few months of the initial launch of the first five DTTB networks.

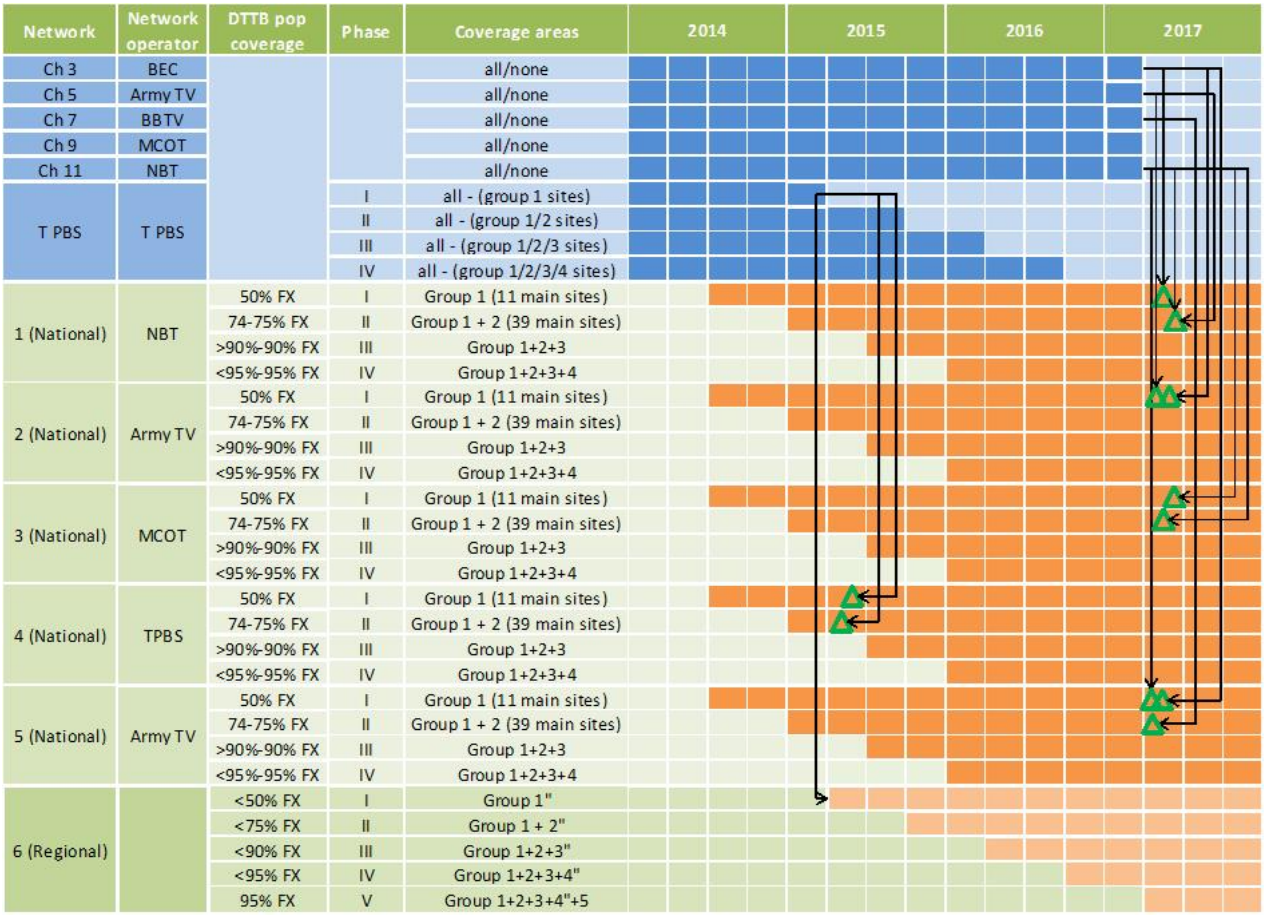

Figure 6.5: DTTB deployment schedule and ASO plan

The above figure shows the following:

- The moments when analogue television services will be discontinued (see the blue bars) and digital networks/services will be introduced (see the orange bars);
- The current and planned network providers operating the analogue and DTTB networks (see Network Operator column);
- The DTTB network coverage targets, expressed in % of the total population, per deployment Phase. Four deployment Phases have been identified (indicated with I, II, III and IV in the Phase column), each spanning a year (expressed in four quarters);
- The DTTB coverage areas, expressed in the coverage areas provided by a defined Group of sites, per deployment Phase;
- The services carried in each network (see Service column) and the type of reception, either analogue terrestrial television, or DTTB fixed rooftop or DTTB portable indoor (see Type column, respectively ATV, FX and PI).

- Multiplex 6 has different coverage areas and population coverage percentages per deployment stage (i.e. smaller than the other multiplexes) as not all sites can be taken into operations (some DTTB frequencies of the 6th mux are blocked by other ATV stations, other than TPBS ATV station - see Section 6.2). Consequently there is a fifth deployment stage to reach the 95%.

6.4 Transmitting antenna

In Table 3.2, Table 4.1 and Table 5.1 as well as Table A6.2 in Annex 6, the ERP of each of the sites is indicated. The given number is the maximum allowed effective radiated power for each of the six multiplexes at a site. The network operator should specify antenna gain and transmitter power and take into account losses in antenna cable and combiner, in such a way that the given ERP is:

- Not higher in any bearing to avoid interference;
- Not lower to avoid loss of coverage.

In developing Plan 3.0 the existing antenna diagrams were taken into account (see Annex 1, item 1.3). However, the DTTB Plan contains partly different channels than the ones for which the antennas were originally designed for. The network operators should check the antenna characteristics for the channels as included in the Plan and ensure that the antenna diagrams are generated by the antenna system when brought into operations for DTTB.

6.5 Receiving antennas

Experience learned that many receiving antennas used to receive analogue TV are not suitable for DTTB and need to be replaced for a number of reasons, among others:

- Analogue TV is transmitted in VHF whereas DTTB is transmitted in UHF;
- Analogue TV and DTTB signals are transmitted in different part of the UHF band;
- Analogue TV can be received marginally due to the poor state of the antenna, but DTTB cannot be received.

In the communication to the public the importance of a receiving antenna of good quality, for rooftop as well as indoor reception, should emphasized. It is also important to communicate the bearing of the DTTB transmitter, because the rooftop receiving antennas may need to be directed differently than analogue TV antennas. It should be noted that in areas where coverage of one more DTTB transmitters overlaps, the best server may not be the closest transmitter. For that reason a data base has been provided (see Annex 8, item 9) indicating for each reception location the best DTTB transmitter. The best server could be different per multiplex. However, advising the best server per multiplex could imply the use of more than one receiving antenna, which is not a practical proposition. Therefore the best server is only indicated for the middle channel of the six channels transmitted from a DTTB site.

In situations where, with a good quality receiving antenna, the DTTB signal strength is marginally an improvement can be reached by using an antenna amplifier with a low noise figure. For portable

reception antennas are available with integrated antenna amplifiers; these types of antenna are often referred to as active antennas. Application of antenna amplifier may give an improvement of about 5 dB for rooftop reception and 3 dB for indoor reception. However, an antenna amplifier does not contribute to better reception if the DTTB signal is interfered by DTTB or analogue TV transmissions. In those cases a more directional antenna could give a reception improvement.

Hence it is important that the broadcasters have customer care and logistic processes in place as to inform (potential) DTTB viewers about reception conditions as well as having good quality (broadband) receiving antennas, antenna amplifiers, active indoor antennas and receivers in sufficient supplies available. The detailed reception data (see Annex 8) provide a basis for the communication process.

Annex 1 Planning principles

The planning principles for the detailed planning of the 39 main sites are specified in the tables below.

1	Transmitter data	Specification
1.1	**Format for exchange of transmitter data**	ITU format
1.2	**ATV transmitter data**	a. UHF analogue TV station data as provided by NBTC and summarized in Annex 7; b. Antenna characteristics as provided by NBTC; – In case only the upper or lower halves are given, the diagram of the upper half will be taken.
1.3	**DTTB transmitter data**	a. Location and antenna height of 39 main sites from the DTTB station data as used in the DTTB Plan analysis and summarized in Annex 3 of report "Analysis of the DTTB plan v1.1"; b. Antenna characteristics as provided by NBTC; – In case only the upper or lower halves are given, the diagram of the upper half will be taken; – The diagram specified for the frequency closest to the DTTB frequency to be planned will be taken; c. Horizontal polarisation.
1.4	**Number of multiplexes per site**	a. During transition five multiplexes per site; b. After analogue switch-off six multiplexes per site.
1.5	**National and regional services**	a. National services on five multiplexes; b. Regional services in one multiplex; regional areas co-inside with coverage of main sites plus the related additional sites.

Table A1.1: Transmitter data

2	Planning software	Specification
2.1	**Progira Giraplan**	One license for planning expert during the duration of the project.
2.2	**Propagation model**	CRC predict
2.3	**Data bases**	a. Terrain and clutter data as provided by NBTC for the DTTB Plan analysis: – Terrain data base 100 by 100 m; – Clutter (morpho) 100 by 100 m; in addition 20 by 20 m for Bangkok (see also the Note 1 at the end of the Annex); b. Population database per sub-district as provided by NBTC with a total population of 64,505,166 people and 22,865,383 households; – Corrected for double counts in sub-districts with non-contiguous areas.

Table A1.2: Planning software data

3	DTTB planning principles	Specification
3.1	**Frequency band for DTTB plan**	a. Channels 26-60 b. In border area with Malaysia: – Even numbered channels in accordance with coordination agreement; – Only channels below 49 at request of NTBC to take account of IMT use in Malaysia (see (see also the Note 2 at the end of the Annex); – However, in Scenario B, due to lack of channels, channels above 48 are allowed.
3.2	**International coordination results**	In so far as incorporated in the transmitter data bases specified in 1.2 and 1.3.
3.3	**DVB-T2 system variant**	16k, extended bandwidth, 64QAM, code rate 3/5, PP2, guard interval 266 µs.
3.4	**Planning parameters**	a. Protection ratios and minimum field strength: Rec. ITU-R. BT.2033 (including adjacent channel protection ratios); b. FX receiving antenna characteristics: Rec. ITU-R BT.419-3; c. Outdoor reception standard deviation: 5.5 dB; d. Indoor reception: – Building penetration loss 11 dB and standard deviation of 6 dB (according to Rec. ITU-R P.1812).
3.5	**Signal summation**	Log normal method
3.6	**Reception mode**	a. FX reception for planning and coverage presentations of the 39 main sites; b. PI reception for coverage presentations of the 39 main sites.
3.7	**DTTB coverage target**	a. Optimal population coverage of the main sites within the limits of: – given main sites, antenna heights and antenna patterns; – the planning principles specified in 3.1, 3.2, 3.3, 3.4, 3,5, 3.6 and 3.8; b. Similar coverage of all multiplexes per site.
3.8	**Reception criteria**	Good reception if in a pixel of the terrain database: – The reception probability is at least 95% of locations with interference calculated for 1% of time; – The wanted field strength ≥ minimum median field strength.
3.9	**Power limitations**	a. Maximum ERP based on engineering judgement taking into account coverage and site characteristics; b. Directional antenna pattern (different from the pattern specified in 1.3) in case no other solution are available to resolve interference, will be indicated as option.

Table A1.3: DTTB planning principles

4	DTTB coverage presentation	Specification
4.1	**Area coverage**	a. Good reception with probability ≥ 95%: orange shaded; b. Reception with probability between 90% and 95%: yellow shaded; c. Reception with probability between 70% and 90%: green shaded; d. Reception with probability below 70%: not presented.
4.2	**Population coverage**	Population number and percentage of total population with good rooftop reception and good portable indoor reception in: – Composite coverage area of all transmitters concerned; – In each of the 185 municipalities that are of particular interest for portable indoor coverage.

Table A1.4: DTTB coverage presentation

5	ATV planning principles	Specification
5.1	**Frequency band**	UHF only
5.2	**Reception**	FX (rooftop)
5.3	**Protection ratios ATV**	ITU-R BT.655-7, Appendix 2 to Annex 1
5.4	**Protection ratios ATV interfered by DTTB (DVB-T2)**	Derived from Rec. ITU-R BT.1368-9, annex 1, section 2.1 (including adjacent channel protection ratios)
5.5	**Minimum field strength**	ITU-R BT.417-5, note 1
5.6	**Antenna discrimination**	ITU-R BT.419-3
5.7	**Signal summation**	Power sum
5.8	**Reception criteria**	Good reception if in a pixel of the terrain database: – The reception probability is at least 50% of locations with; interference calculated for 1% of time; – The wanted field strength ≥ minimum field strength.

Table A1.5: Analogue TV planning principles

Note 1

The heights specified in the clutter codes of the 20 by 20 m clutter data (see 2.3) have been modified to reflect the specific situation in Bangkok as shown in the table below. The 20 by 20m clutter data are also available for Chang Mai. However, the amended heights are not appropriate for the situation in Chang Mai. Therefore the 20 by 20m clutter codes are not applied in Chiang Mai.

Modified clutter codes	Original height (m)	Changed to (m)
10. Suburban	6	10
11. Industrial	10	No change
13. Urban	10	20
14. Dense urban	12	60
15. Dense urban high	30	100
16. Blocks of buildings	12	No change

Table A1.6: Clutter height

Note 2

In the planning process it turned out that no satisfactory coverage could be achieved in the border area with Malaysia by using only even numbered channels below 49. For that reason NBTC allowed using channel 50 and 52 where necessary.

Annex 2 Planning method

In developing DTTB Plan 3.0 with regard to the 39 main sites, the following assignment principles were adopted.

1) Optimisation of population coverage with fixed reception after analogue switch-off and temporarily power reductions and frequency assignments during the transition period to protect analogue TV at acceptable levels;
2) Use of Plan 1.1 as a basis, but with power reductions and channel changes to improve compatibility;
3) Application of regular channel groups to achieve more or less equal coverage of the multiplexes per site and a channel separation at a site of at least two channels, as far as possible in planning. One channel difference is technically feasible but requires more complex (hence more expensive) filtering and may be unavoidable in some cases;
4) Use of MFNs for the main sites, but if needed for planning reasons use of SFNs where possible for national services;
5) Avoiding unstable reception at the edge of the coverage areas due to time variations of the wanted signal;
6) Efficient spectrum usage by assigning channels in such way that temporarily channels are available during the transition period to protect analogue TV and that the coverage target of 95% coverage can most likely be reached by planning additional sites at a later stage.

The planning method is based on the above mentioned assignment principles and the main elements of the planning method are:

1) Application of regular channel groups;
2) ERP adjustments;
3) Use MFN and SFNs where needed for frequency planning reasons;
4) Three planning scenarios

These elements are described in the following sections.

1. Channel scheme

The DTTB plan analysis[3] indicated that six channels may be needed to plan a network with a high coverage target. For that reason the available 35 DTTB channels (26 to 60) were re-arranged into six unique channel groups.

Taking the existing channel scheme with four channel groups of seven channels and two spare groups as basis, two new groups were formed by taking one channel from the groups D1 to D4 and by using the spare groups D5 and D6 and the unused channel 60.

[3] See report Analysis of the DTTB plan v1.1, 2 July 2013; Section 3.2.

NBTC requested to take into account the announced use of IMT in the 700 MHz band in Malaysia by avoiding the use of channels above 48 in the border area. For that reason the channels above 48 in channel groups T-D1 and T-D2 have been deleted.

The new channel groups are nominated Da to Df in order to distinguish it from the formerly used channel groups. The former groups T-D1 and T-D2 used in the border area with Malaysia and reflecting the agreed channel use in that area are now called T-Da and T-Db. As there are 35 channels available and six channel groups are needed, one group (Df) can only contain five channels. The amended channel scheme is shown in Table A2.1

Group	Mux 1	Mux 2	Mux 3	Mux 4	Mux 5	Mux 6	Derived from	Changes compared to Plan 1.0
Da	28	31	35	39	47	51	D1	43 moved to De
Db	26	29	32	36	40	44	D2	48 moved to De
Dc	27	30	33	37	41	49	D3	45 moved to De
Dd	34	38	46	50	54	57	D4	42 moved to Df
De	43	45	48	53	56	59	D6	43, 45, 48 added
Df	42	52	55	58	60		D5	42, 60 added
T-Da	26	30	34	38	42	46	T-D1	50 deleted
T-Db	28	32	36	40	44	48	T-D2	52 deleted

Table A2.1: Amended channel scheme

The new channel arrangement is made in such a way that:

- Channels per group are separated by at least two channels;
- Application of the groups Da to De results in similar interference situations for the six channels at a site and avoids a number of the critical interference cases that were identified in the plan analysis[4].

In case the use of group Df is necessary, a sixth channel should be assigned. The channel should be determined by carrying out a spectrum analysis at the site. The channel found in this way results in an irregular channel arrangement and more interference may need to be accepted compared to the other (regular) channel assignments at the site or at other sites. As channel group Df will be less used than De due to the incompleteness of Df, channels of group Df can be used in cases where one or two channels need to be replaced in channel groups Da to De in order to:

- Avoid incompatibles caused by channel groups T-Da and T-Db;
- Protect analogue TV during the transition period;
- Future planning of additional sites;
- Any yet unforeseen critical interference cases.

[4] See report Analysis of the DTTB plan v1.1, 2 July 2013; Annex 7.

The use of channel 60 requires attention because of possible incompatibilities with IMT services above 790 MHz.

2. ERP adjustments

The plan analysis indicated that at many sites in Plan 1.0 the ERP is too high[5]. In the development of Plan 3.0 the ERP of the 39 main sites was initially reduced by a factor 4 (6 dB). This factor corresponds to the difference in C/N between the DVB-T2 system variant with which DTTV Plan 1.0 was originally designed (256 QAM, code rate 2/3) and the adopted DVB-T2 system variant (64QAM code rate 3/5). In the planning process the ERP per site was adjusted (up or down) to obtain the optimal population coverage.

In large coverage areas, near the edge of the coverage, the received field strength is subject to time variations and could be lower than the minimum required value in a considerable period of time, resulting in a black screen. Figure A2.1 shows the field strength variation between 1% and 99% of time as function of the distance from the transmitter for effective antenna heights of 75 m, 150 m and 300 m.

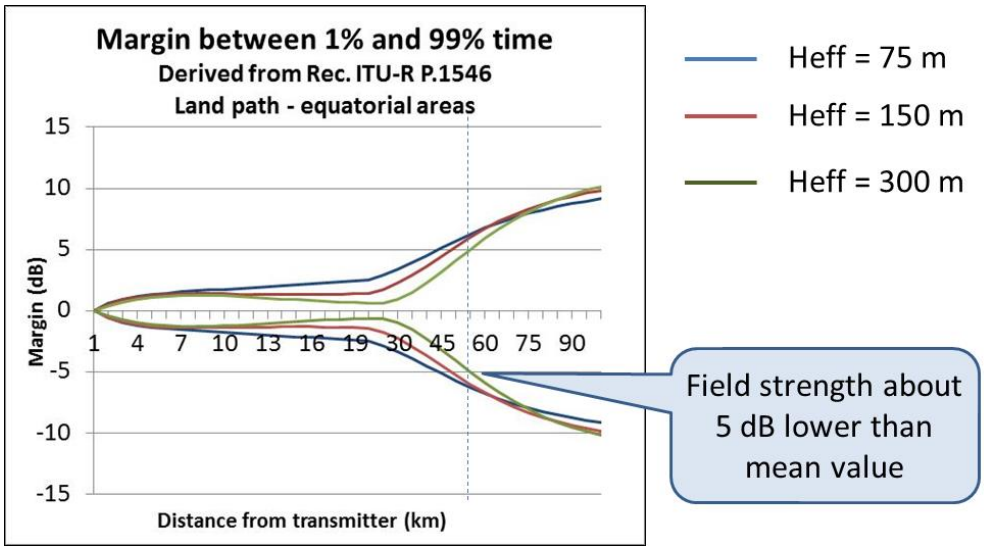

Figure A2.1: Field strength variations in time

Figure A2.1 shows that up to about 25 km from the transmitter the time variation is relative small. At larger distances the variation increases and is about 10 dB higher than the mean value for 1% of time and about 10 dB lower for 99% of time. Similar results were obtained by using the CRC propagation prediction model.

It should be noted that it is common practise in frequency planning to calculate interfering signals, normally arriving from a large distance, for 1% of time. It is also common practise to calculate the wanted signal for 50% of time in the assumption that the wanted signal is stable within the coverage area. However if the assumption of a stable wanted signal is not fulfilled in certain areas, these areas may be presented as having good coverage, while in practise there is no coverage for certain times in a year. For that reason in some countries the wanted signal is calculated for 99% of time.

[5] See report Analysis of the DTTB plan v1.1, 2 July 2013; Section 3.3.

Two methods have been considered to take account of time variations of the wanted signal: a power limitation and calculating all wanted signals for 99% of time. Judging the impact of both methods the choice was made to limit the ERP to 50 kW. With this limitation the coverage radius does not exceed about 50 km. In cases where reception problems arise, the margin of about 5 dB can be compensated by using an antenna amplifier. Table A2.2 summarises the aspects of both methods.

Aspect	Wanted signal calculated for 99% time	Maximum power of 50 kW
Probability that field strength is below minimum value at edge of coverage	• 1% of the time.	• About 2 to 5 dB below minimum value at 1% of the time.
Overall impact compared to calculation of wanted signal for 50% time	• All coverage areas, including small ones decrease; • Overall population coverage reduction of 14%.	• Limits coverage of large areas, no impact on small coverage areas.
Compensation of coverage loss compared to calculation of wanted signal for 50% time	• Power increase at all sites of 2 dB to 5 dB and consequently more interference.	• Use of antenna amplifier at receiving locations near edge of coverage.

Table A2.2: Aspects of methods to take account of time variations of the wanted signal

It should be noted that with 50 kW and the DVB-T2 system variant 64QAM, code rate 3/5, the coverage area of high power transmitters is still larger than the coverage area with 150 kW in Plan 1.0 and the DVB-T2 system variant for which Plan 1.0 was originally designed (256QAM, code rate 2/3).

3. SFN

Application of SFNs could resolve interference cases. In Table A2.3 the main sites are shown which are separated by less than 80 km from each other, the distance corresponding to the duration of the guard interval.

Sites within 80 km				Separation distance
12.0	Ubon Ratchathani_DTT	**11.0**	Sisaket_DTT	72.8 km
25.0	Phrae_DTT	**22.0**	Lampang_DTT	57.7 km
26.0	Utaradit_DTT	**25.0**	Phrae_DTT	37.1 km
27.0	Sukhothai_DTT	**26.0**	Utaradit_DTT	71.3 km
32.0	Ranong_DTT	**31.0**	Chumphon_DTT	78.3 km
38.0	Satun_DTT	**37.0**	Song Khla_DTT	69.0 km

Table A2.3: Potential SFN sites

4. Planning scenarios

The 39 main sites were planned in three scenarios representative for the following situations:

A. The situation by mid-2014 when the first group of main sites will be in operation with five DTTB multiplexes and all analogue TV in operation;
B. The period when all 39 main sites will be in operation with five DTTB multiplexes and all analogue TV in operation;
C. The all-digital situation when 39 main sites will be in operation with six multiplexes and all analogue TV has been switched off.

The plan was optimized for situation C and temporarily frequency assignments were applied to protect analogue TV at acceptable levels.

The planning process is shown in the flow chart in Figure A2.2.

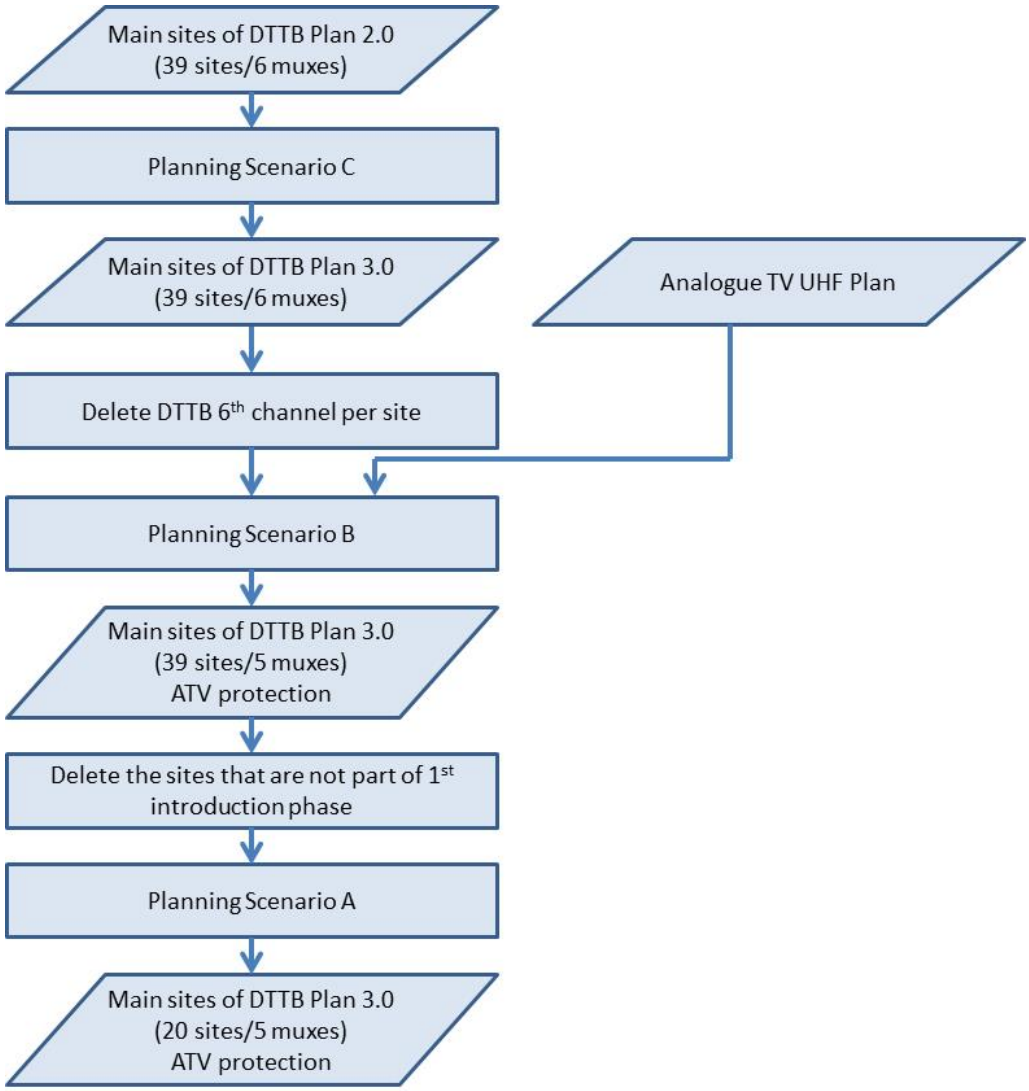

Figure A2.2: Flowchart of planning process

The 39 main sites with the characteristics given in DTTB Plan 2.0 were the starting point. Subsequently scenarios C, B and A were planned. The planning scenarios are summarised in Table A2.4.

Planning scenario		Result	Coverage calculation and presentation
C	• **39 main site** • **Six multiplexes**	Compatible DTTB plan without protection of ATV.	Population and area coverage with fixed and portable indoor reception of six DTTB networks with 39 main sites.
B	• **39 main sites** • **Five multiplexes**	Compatible DTTB plan and protection of ATV, based on results of scenario C, with temporary frequency changes and power restrictions.	Population and area coverage with fixed and portable indoor reception of five DTTB networks with 39 main sites.
A	• **11 main sites** • **Five multiplexes**	Subset from result of scenario B.	Population and area coverage with fixed and portable indoor reception of five DTTB networks with 11 main sites.

Table A2.4: Overview of planning scenarios

Annex 3 Planning scenario C

Planning scenario C consisted of the following steps.

1) Identifying channel changes in DTTB Plan 1.1;
2) Assignment of the new channel groups;
3) Compatibility analysis of all 39 sites;
4) Optimising population coverage by ERP adjustments;
5) Resolving remaining critical interference cases;
6) Preparing plan results.

Initial plan results from step 6 were presented and discussed with NBTC and the network operators. The conclusions on the comments received were taken into account and the coverage plots, population coverage statistics and transmitter list were prepared.

Steps 1 to 5 are described in the following sections.

1) Identifying channel changes in DTTB Plan 1.1

Critical interference cases that were identified in the plan analysis[6] were examined by means of compatibility matrices. The critical interference cases were resolved by changing the channels at one or more of the involved sites in order to reduce the interference to at least "non-critical" levels. An example of a compatibility matrix is shown in Figure A3.1

MAIN SITES			Loie_DTT	Chiang Mai_DTT	Phrae_DTT	Nakhon Sawan_DTT
	Ch gr		D4	D4	D4	D4
WANTED			16	20	25	29
Phrae_DTT	D4	25	0	0	xxxxxx	0
Nakhon Sawan_DTT	D4	29	1	1	0	xxxxxx

Figure A3.1: Example compatibility matrix

The dark red shaded block represent mutual interference and the light red shade blocks one-way interference. To resolve the critical interferences in this example, site 25 needs a different channel group.

It should be noted that the plan analysis was carried out with the propagation prediction model of Recommendation ITU-R P.1812. As indicated in the plan analysis report[7], this method tends to predict higher field strengths than the CRC propagation model used in the detailed planning of the main sites. The identified interference cases are therefore on the safe side and may be less critical when calculated with the CRC model.

2) Assignment of the new channel groups

In principle the sites with group D1 to D4 in Plan 2.0 were assigned group Da to Dd. Sites that were identified for requiring a different channel, were assigned group De or Df. If not possible, use of SFNs of sites situated within the guard interval was considered.

[6] See Report Analysis of the DTTB plan v1.1, 2 July 2013; Annex 7.
[7] See Report Analysis of the DTTB plan v1.1, 2 July 2013; Annex 2.

By assigning the regular channel groups a great number of interference cases involving one or two channels per site were resolved.

Critical interference cases were identified in the north-east part and in the southern part of Thailand. The sites involved are shown in Figure A3.2 and A3.3 respectively. Tables A3.1 and A3.2 show the channel groups in DTTB Plan 1.1, the proposed channel group and the agreed channel group, taken into account the preference of the network operators as well as improvements resulting from discussions with NBTC (See Section 3.1, Table 3.1). To obtain an optimal coverage in the southern part (sites 36 to 39) NBTC accepted a relaxation of the planning principles by allowing a few channels above 48 in that area; see item 5).

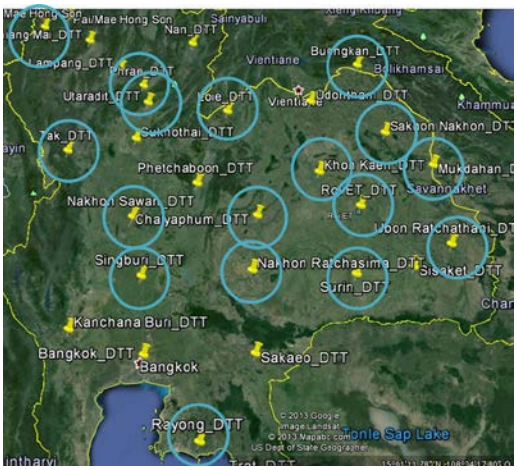

Figure A3.2: Sites involved in critical interference in N-E part

Site N°	Site name	Channel group Plan 1.1	Proposed channel group	Agreed channel group
4.0	**Rayong**	D1	De	De
11.0	**Sisaket**	D4	De	Dc
12.0	**Ubon Ratchathani**	D3/5	De	Dc
13.0	**Mukdahan**	D2	Da	Da
14.0	**Roi-Et**	D1/5	Dd	Dd
15.0	**Khon Kaen**	D2	De	De
25.0	**Phrae**	D4	De	De
26.0	**Utaradit**	D1	De	Dc

Table A3.1 Channel groups at sites in N-E part

Figure A3.3: Sites involved in critical interference in S part

Site N°	Site name	Channel group Plan 1.1	Proposed channel group	Agreed channel group
33.0	**Surat Thani**	D2	De	Db
34.0	**Phuket**	D1	Da/f	Da
35.0	**Nakhon Sri Thumarat**	D3/6	Dc/f	Dc
36.0	**Trang**	T-D1	T-Db	De
37.0	**Song Khla**	T-D1	T-Da/f	T-Da
38.0	**Satun**	T-D2	T-Da/f	T-Da
39.0	**Yala**	T-D2	T-Db	T-Db

Table A3.2: Channel groups at sites in S part

In the above mentioned agreed channel assignments three SFN are included, see Table A3.3.

Channel group	SFN site	SFN site	Separation distance
Dc	11.0 Sisaket	12.0 Uban Ratchathani	72.8 km
Dc	26.0 Utaradit	27.0 Sukhothai	71.3 km
T-Da	37.0 Song Khla	38.0 Satun	69.0 km

Table A3.3: Agreed SFNs

3) Compatibility analysis of all 39 sites

The ERP of all sites were initially reduced by a factor 4 (6 dB). This factor corresponds to the difference in C/N between the DVB-T2 system variant with which DTTV Plan 1.0 was originally designed (256 QAM, code rate 2/3) and the adopted DVB-T2 system variant (64QAM code rate 3/5).

The compatibility analysis showed the remaining incompatibilities. These were addressed in the following steps.

4) Optimising population coverage by ERP adjustments

Population coverage of all sites was maximised by adjusting the ERP (up or down) of each of the sites, on the one hand to reduce interference, on the other hand to increase coverage. In most cases this was done on the lowest channel of a site.

An example of compatibility matrix for coverage optimisation by ERP adjustments is shown in Figure A3.4. Figure A3.5 shows the interfered areas (red shaded).

Wanted	Interfering		
	Khon Kaen	Sisaket	Uban R
Khon Kaen	XXXX		
Sisaket		XXXX	SFN
Uban R		SFN	XXXX

Figure A3.4: Example compatibility matrix

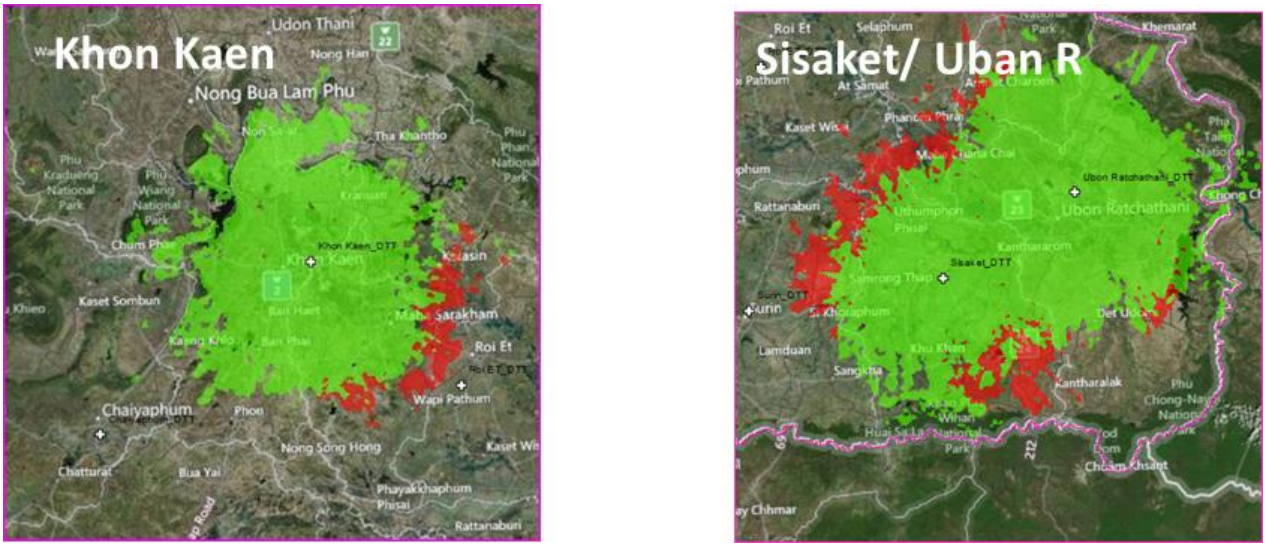

Figure A3.5: Interfered areas (red shaded)

Figure A3.6 shows the optimisation process and the impact on the overall coverage.

Khon Kaen	Sisaket	Uban R	Population
No change	No change	- 3dB	- 108 776
No change	No change	- 6 dB	- 195 795
- 3dB	No change	No change	- 118 938
- 6 dB	No change	No change	- 255 899
- 3 dB	No change	- 3 dB	- 211 063
- 6 dB	No change	- 3 dB	- 300 224
- 3 dB	No change	- 6 dB	- 344 908
- 6 dB	No change	- 6 dB	- 434 282
No change	+ 3 dB	No change	+ 99 337
No change	+ 6 dB	No change	+ 177 620

Figure A4.6: Power increases and decreases and impact on overall coverage

In this example it was decided to accept the interference, retain the ERP at Khon Kaen and Uban Ratchathani and increase the ERP at Sisaket by a factor 4 (6dB), because this resulted in the highest overall population coverage (see last line in Figure A4.6).

After having made all ERP adjustments the EPR values were rounded up within about 1.5 dB to:

- Multiples of 5 kW for ERPs between 3 kW and 25 kW;
- Multiples of 10 kW for ERPs above 25 kW to 35 kW;
- ERPs of 40 kW and more to 50 kW.

The reason for the rounding is that the calculation accuracy does not justify ERPs rounded to multiples of 1 kW above 10 kW and 1.5 dB is within the calculation accuracy.

5) Resolving remaining critical interference cases

Several options were developed to resolve remaining interference cases; in some cases by relaxing some of the planning principles. An example of an alternative solution is shown in Table A3.4. This example shows two options for the situation that the sites using the special groups T-Da and T-Da have to be made compatible with the sites north of it using the regular group Da to De.

Site N°	Site name	Channel group Plan 1.1	Channel group Option A	Channel group Option B
33.0	**Surat Thani**	D2	De	Db
34.0	**Phuket**	D1	Da/f	Da
35.0	**Nakhon Sri Thumarat**	D3/6	Dc/f	Dc
36.0	**Trang**	T-D1	T-Db	De
37.0	**Song Khla**	T-D1	T-Da/f	T-Da’
38.0	**Satun**	T-D2	T-Da/f	T-Da’
39.0	**Yala**	T-D2	T-Db	T-Db

Table A3.8: Alternative channel groups at southern sites

The channel groups in Option A comply with the planning principles (even numbered channels below 49). However, in this option interference between the sites could not satisfactorily be removed. The groups in Option B give acceptable results but require some channels above 48. The site Trang is just more than 100 km from the border and therefore does not have to comply with the coordination agreement with Malaysia. This gives the possibility to assign a regular channel group at that site. The channel group nomination T-Da' is used to indicate that the group deviates from group T-Da indicted in Table A2.1because a channel 50 is used instead of channel 30.

Annex 4 Planning scenario B

Scenario B consisted of three consecutive steps which are described in the following sections:

1. Compatibility assessment of DTTB to analogue TV;
2. Compatibility assessment of analogue TV and DTTB to DTTB;
3. Composition of the scenario B plan;
4. Preparing plan results.

Initial results from step 4 were presented and discussed with NBTC and the network operators. The conclusions on the comments received were taken into account and the coverage plots, population coverage statistics and transmitter list were prepared.

Steps 1 to 3 are described in the following sections.

1. Compatibility assessment of DTTB to analogue TV

A compatibility analysis was carried out to identify DTTB interference to analogue TV, in addition to the already existing interference from other analogue TV stations. In the transmitter databases used in this analysis contained:

a) The scenario C plan as approved by NBTC the 19th of November and distributed the 20th of November and including the assignments to multiplexes 1 to 5;
b) The analogue UHF TV transmitters (96 assignments).

In addition, the assignments of the 6th multiplex that are not in use by analogue TV were included in the transmitter database, because these assignments could be used to replace DTTB channels that cause interference to analogue TV.

Incompatibilities to analogue TV were resolved in close cooperation with NBTC by the following measures:

1) Acceptance of non-critical interference to analogue TV;
2) Replacement of DTTB channels that cause critical interference to analogue TV by using the channel of the sixth multiplex, where possible;
3) Acceptance of critical interference to analogue TV in the following situations
    a. If affected viewers < 30% and < 100,000 ;
    b. With VHF overlap, if affected UHF viewers < 1,000,000 and
        i. Assignment of interfering DTTB channels to the operator that owns the related ATV site;
        ii. Indication of DTTB ERP reductions to reduce interference;
4) Temporarily replacement of DTTB channels if critical interference to analogue TV was not acceptable.

Measures 2), 3) and 4) are shown in the flowchart below and are described in the following sections.

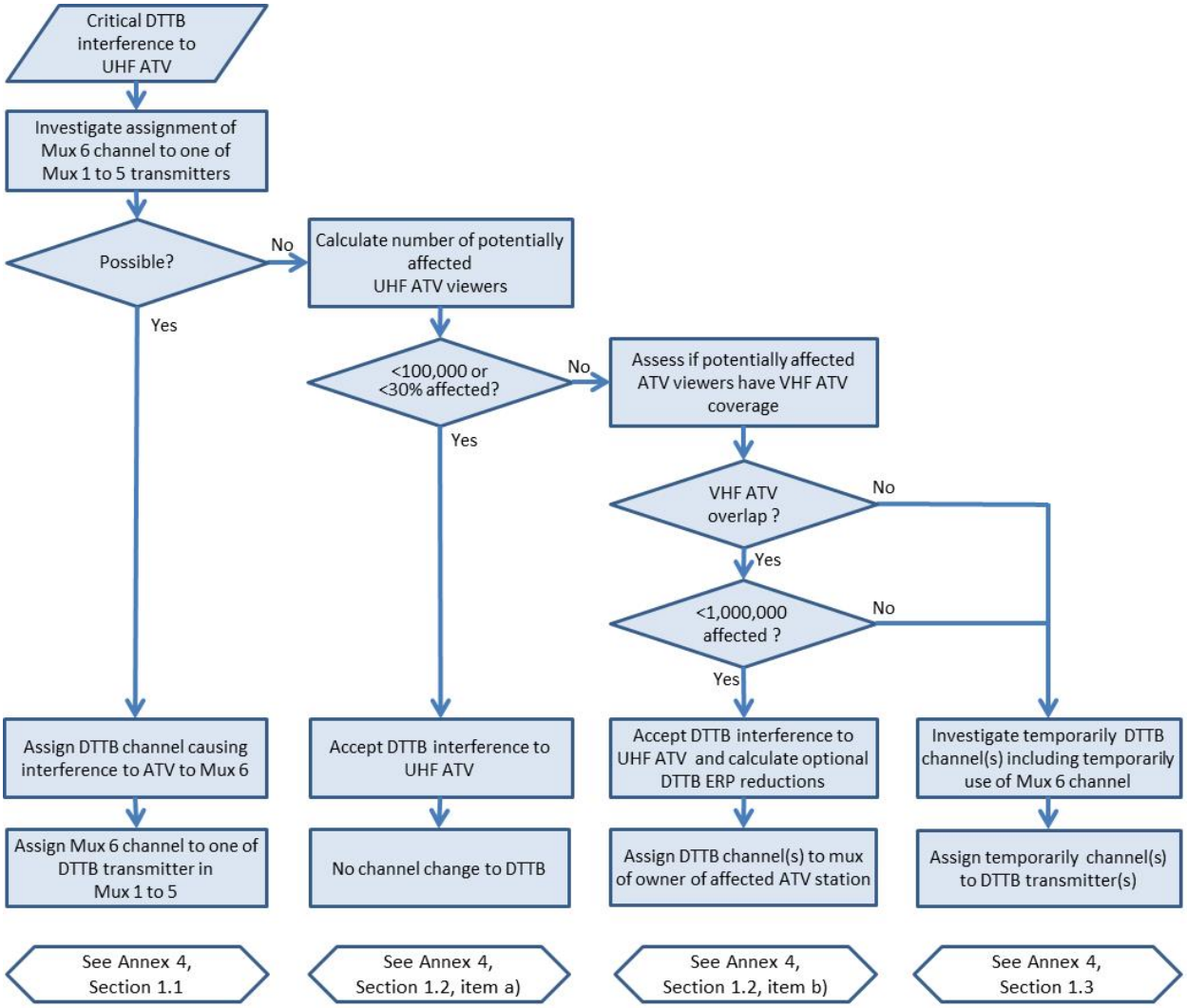

Figure A4. 1: Flowchart for resolving incompatibilities to analogue TV

1.1 Use of the channel of the 6th multiplex

At 23 of the 39 sites in multiplex 6 the channel is in use by TPBS analogue TV transmissions at or near the site. The multiplex 6 channel at the remaining 16 sites was included in the compatibility analysis to test possible use as replacement for a channel in multiplex 1 to 5. In some cases interference was detected and measure 3) was applied to determine if the interference was acceptable.

In measure 2) DTTB channels in multiplex 1 to 5 which cause critical interference to analogue TV, were interchanged with the channel of the 6th multiplex. These assignments are indicated in the grey shaded fields in the table below. These assignments are an amendment to the scenario C plan and do not need to be changed after analogue TV switch-off.

Site N°	Site name	Mux 1-5	Mux 6
4.0	**Rayong_DTT**	59	48
14.0	**Roi ET_DTT**	57	38
15.0	**Khon Kaen_DTT**	59	43
28.0	**Tak_DTT**	35	28
36.0	**Trang_DTT**	59	45

Table A4.1: Rearranged assignments that do not need to be changed after analogue switch-off

1.2 Acceptance of critical interference to analogue TV

In measure 3) critical interference to analogue TV was accepted if the number of potentially affected analogue TV viewers is:

a) Less 30% of the total population in a coverage area, or less 100,000;
b) Less than 1,000,000 provided that an alternative VHF analogue TV coverage is available.

The conditions a) and b) are described below.

a) Accepted interference to ATV coverage if affected viewers are less than 100,000 or 30%

The analogue stations to which the interference was accepted are shown below. The columns "Affected ATV viewers" and "% affected ATV viewers" indicate the potentially affected people in the existing interference limited analogue TV coverage due to interference by DTTB. In the TBPS analogue TV network there is some overlap between the coverage of the sites. Taking into account the overlap the potentially affected population is indicated in the last two columns.

Interfered ATV sites	ATV ch	Affected ATV viewers	% affected ATV viewers	Affected ATV viewers in TPBS network	% affected ATV viewers in TPBS network	Interfering DTTB site N° and channel
Takua Pa_TPBS	28	1,969	4.5%	1,965	4.5%	Site 34.0, ch 28
Tak_TPBS	34	11,250	8.6%	7,495	5.8%	Site 28.0, ch 34
Pattaya Ch7	50	26,422	15.2%			Site 7.0, ch 50
Satun Ch7	51	34,704	27.6%			Site 37.0, ch 50
Toen Ch11	31	38,202	28.5%			Site 28.0, ch 31
Pattaya_TPBS	46	47,186	20.9%	18,424	8.2%	Site 7.0, ch 46
Pattaya Ch5	38	58,408	28.2%			Site 7.0, ch 38 Site 5.0, ch 38
Kanchanaburi Ch7	48	61,741	18.1%			Site 2.0, ch 48
Trang Ch7	50	71,105	12.5%			Site 37.0, ch 50
Song Khla Ch3	38	73,854	6.3%			Site 38.0, ch 38
Trang_TPBS	46	80,647	13.3%	60,746	10.0%	Site 37.0, ch 46
Thung Song_TPBS	51	93,182	26.1%	56,968	16.0%	Site 34.0, ch 51

Table A4.2: Accepted interference to analogue TV without VHF overlap

By accepting the interference, twelve DTTB stations are considered compatible.

Particular cases were the analogue TV stations Trang Ch7 on channel 50 and Trang TPBS on channel 46. The interference situation resulting from the compatibility analysis is indicated in Table A4.3.

Interfered ATV sites	ATV ch	Interfered by	DTTB ch	Total affected ATV viewers	% total affected ATV viewers	Affected ATV viewers per DTTB station	% affected ATV viewers per DTTB station
Trang Ch7	50	Satun_DTT	50	117,031	20.6%	87,721	15.4%
		Song Khla_DTT	50			71,105	12.5%
Trang_TPBS	46	Satun_DTT	46	130,437	21.5%	83,818	13.8%
		Song Khla_DTT	46			60,746	10.0%

Table A4.3: Interference situation at Trang Ch7 and Trang TPBS resulting from the compatibility analysis

The total number of affected viewers at both analogue TV stations is above 100,000 however the interference by the individual DTTB stations is less than 100,000 and less than 30%. Although the total interference is not acceptable, one of the two DTTB stations is acceptable in both cases. The choice was made to accept interference from Song Khla_DTT on channel 46 and 50 and not accept interference from Satun_DTT channel 46 and 50. Therefore in Table A4.3 Trang Ch7 is indicated with 71,105 affected viewers and Trang TPBS with 60,746 affected viewers. Consequently, Satun_DTT on channel 46 and 50 requires a temporarily channel change (see Section 1.3 in this Annex).

b) Accepted interference to ATV coverage with VHF overlap

The analogue station to which the interference was accepted under part b) of the procedure is shown below.

ATV Victim	ATV ch	Affected UHF ATV viewers	% affected ATV viewers
Roi ET Ch5	49	529,619	30.9%

Table A4.4: Accepted interference to analogue TV coverage with VHF overlap

According to the procedure, these stations were assigned to operator owning the analogue TV station; hence to one of the multiplexes operated by Army-TV.

The interfering DTTB stations and the multiplexes are shown in the table below.

Site N°	Site name	Ch	Mux
11.0	**Sisaket_DTT**	49	Army TV-2
12.0	**Ubon Ratchatani_DTT**	49	Army TV-2
14.0	**Roi Et_DTT**	50	Army TV-1
19.0	**Sakhon Nakhon_DTT**	49	Army TV-1

Table A4.5: Interfering DTTB stations

The interference to Roi Et Ch5 could be reduced by ERP reduction of DTTB stations mentioned above. Figure A4.2 shows the impact of several combinations of ERP reductions of 6 dB and 3 dB and no reduction at the four DTTB stations.

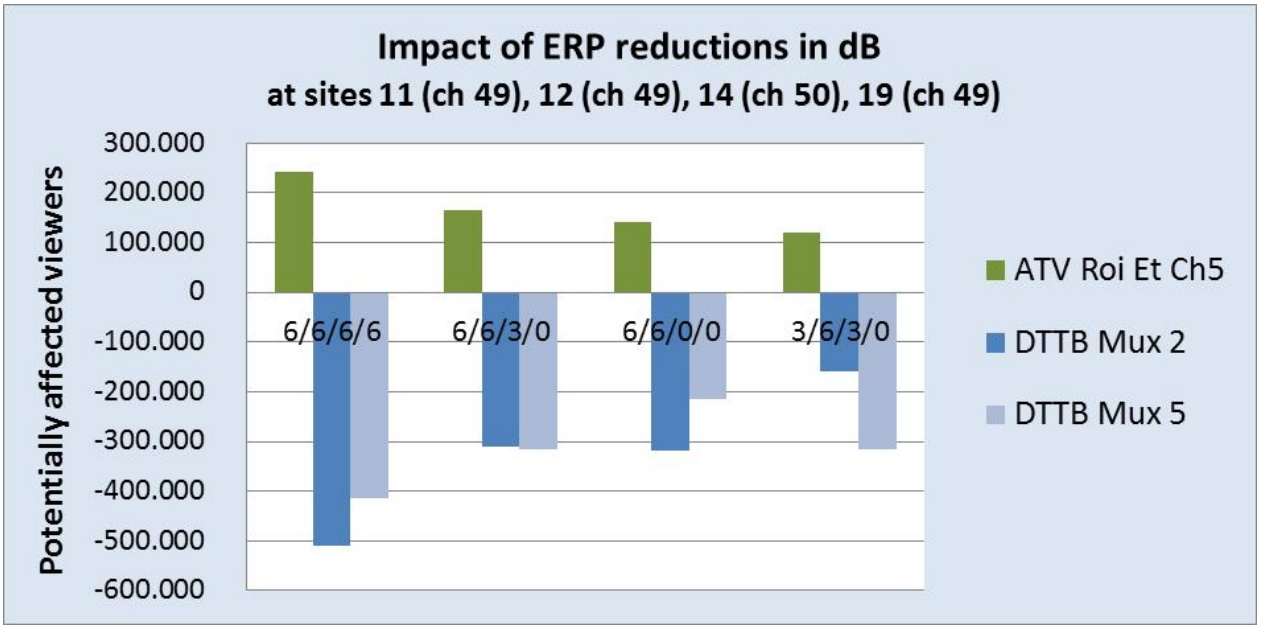

Figure A4.2: Impact of ERP reduction at four DTTB sites to reduce interference to ATV station Roi ET CH5

The effect of ERP reductions is an increase of up to about 243,000 potential viewers in the UHF analogue TV service, whereas the decrease of potential DTTB viewers is down to about 510,000 in multiplex 2 and 414,000 in multiplex 5.

Army TV did not consider it necessary to apply any power reduction.

1.3 Temporarily replacement of DTTB channels

In measure 4) temporarily channel replacements were assigned to eighteen DTTB stations that cause critical interference to analogue TV. For this purpose the channel groups Da to De were temporarily expended with a channel from group Df as shown in Table A4.6, in order to maintain regular channel assignments, where possible.

Channel group	Temporarily extension channel
Da	55
Db	52
Dc	58
De	60

Table A4.6: Temporarily additional channel per channel group

Where a temporarily channel from the table above was not possible, channels were selected in the following order:

a) Channels not in use by analogue TV (channels 39, 40, 47, 54, 56, 57, 58, 59, 60);
b) Channel from multiplex 6;

c) Channels resulting from a spectrum scan.

The temporarily assignments, printed in red, are indicated in the grey shaded fields in the table below. Also the analogue TV stations that need to be switched-off before operation of temporarily channels can be ceased are indicated. Contrary to the planning principles, in the border area with Malaysia temporarily channels above 48 were assigned, due to lack of available channels below 49.

Site N°	DTT site name	DTTB channel	ATV stations to be switched-off before use of temporarily channel can be ceased	ATV channel
1.0	**Bangkok_DTT**	32/52	Bangkok Ch3	32
3.0	**Singburi_DTT**	31/55	Singburi Ch11	31
5.0	**Sakaeo_DTT**	50/42	Sakaeo Ch7	50
8.0	**Nakhon Ratchasima_DTT**	41/58	Nakhon Ratchasima Ch3	41
		49/52	Chaiyaphum Ch5	49
9.0	**Chaiyaphum_DTT**	31/55	Chaiyaphum Ch11	31
10.0	**Surin_DTT**	26/42	Khon Kaen Ch11	26
11.0	**Sisaket_DTT SFN**	30/52	Ubon Ratchathani Ch5	30
		33/58	Ubon Ratchathani Ch11	33
		27/37	Ubon Ratchathani TPBS	27
12.0	**Ubon Ratchathani_DTT SFN**	30/52	Ubon Ratchathani Ch5	30
		33/58	Ubon Ratchathani Ch11	33
		27/26	Ubon Ratchathani TPBS	27
14.0	**Roi ET_DTT**	54/60	Mahasarakham Ch7	54
		34/55	Chumpuang_TPBS	34
15.0	**Khon Kaen_DTT**	53/52	Mahasarakham Ch7	53
16.0	**Loie_DTT**	50/42	Loie Ch5	50
17.0	**Udonthani_DTT**	31/55	Udonthani Ch9	31
18.0	**Buengkan_DTT**	26/52	Buengkan Ch11	26
19.0	**Sakhon Nakhon_DTT**	37/58	Sakhon Nakhon Ch11	37
20.0	**Chiang Mai_DTT**	46/60	Chiang Mai Ch3	46
26.0	**Utaradit_DTT SFN**	37/52	Sukhothai Ch3	37
27.0	**Sukhothai_DTT SFN**	37/52	Sukhothai Ch3	37
37.0	**Song Khla_DTT SFN**	38/54	Song Khla Ch3	38
38.0	**Satun_DTT SFN**	50/52	Trang Ch7	50
		46/60	Trang TPBS	46

Table A4.7: Temporarily channel assignments in scenario B

The above mentioned table includes four sites where the channel from multiplex 6 has been temporarily assigned to one of multiplexes 1 to 5. These sites are part of an SFN. At these sites the channel concerned should be assigned to multiplex 6 after analogue TV switch-off, since the sites in multiplex 6

contain different program content and cannot operate in SFN. These assignments are indicated in the grey shaded fields in the table below.

Site N°	Site name	Mux 1-5	Mux 6
11.0	**Sisaket_DTT SFN**	27/37	37
12.0	**Ubon Ratchatani_DTT SFN**	30/52	52
26.0	**Utaradit_DTT SFN**	37/52	52
38.0	**Satun_DTT SFN**	50/52	52

Table A4.8: Rearranged assignments that need to be changed after analogue switch-off

2. Compatibility assessment of analogue TV and DTTB to DTTB

A compatibility analysis of the intermediate plan resulting from Section 1 plus the UHF analogue TV plan was carried out to identify interference to DTTB. Incompatibilities to DTTB have been resolved in close cooperation with NBTC by the following measures:

1) Acceptance of non-critical interference to DTTB;
2) Rearrangement of channels per site to avoid critical interference, making use of the original assignment to multiplex 6, where possible. The channel does not need to be changed after analogue TV switch-off;
3) Acceptance of critical interference and
    i. Assignment of the interfered DTTB channels to the operator that owns the related ATV site;
    ii. Indication of temporarily DTTB replacement channels.

Measure 2) was applied to one DTTB station as indicated in the table below. These assignments are an amendment to the scenario C plan.

Site N°	Site name	Mux 1-5	Mux 6
13.0	**Mukdahan_DTT**	47	31

Table A4.9: Rearranged assignment that does not need to be changed after analogue switch-off

In measure 3) interference was accepted in the coverage of two DTTB sites:

- Mukdahan_DTT channel 28 interfered by Roi Et TPBS; potentially affected people about 186,000 or 39%;
- Tak_DTT channel 31 interfered by Toen CH11; potentially affected people about 336,000 or 36%.

According to the procedure, these stations were assigned to operator owning the analogue TV station; hence to TPBS and NBT respectively.

The optional temporarily channel assignments resulting from measure 3) are indicated in the grey shaded fields in the table below.

Site N°	Site name	NBT	TPBS
13.0	**Mukdahan_DTT**		31/40
28.0	**Tak_DTT**	28/55	

Table A4.10: Optional temporarily assignments

TPBS and NBT did not consider it necessary to apply the temporarily channels.

3. Composition of the DTTB plan in scenario B

For the composition of the plan, a number of items and new requests were considered in addition to the temporarily channel changes and channel rearrangements described in Section 1 and 2. The additional items are:

a) Avoiding channel 37 in Uban Ratchathani (site 12);
b) SFN assignments;
c) No rearrangements, as far as possible, to the first seven sites of the network deployment schedule.
d) Balancing low, medium and high channels across the multiplexes 1 to 5 in Scenario C plan;
e) Balancing the number of channel changes across the network operators in the Scenario B plan.

These items are described below.

a) Avoiding channel 37 in Uban Ratchathani (site 12)

NBTC requested to avoid the use of channel 37 at Uban Ratchathani (site 12), since it might have interference to or from Laos[8]. It should be noted that this is not a formal coordination agreement and that the station characteristics of the DTTB sites in Laos are not known. It is expected that the DTTB station on channel 37 in Laos will be put into operation at the end of 2014.

Channel 37 in Ubon Ratchthani (site 12) could be avoided by rearranging a number of channels in the scenario C plan:

a) At site 12, use channel 52 in multiplex 6 and at site 11, use channel 37 in multiplex 6;
b) At site 11 and at site 12, use channel 27 in multiplex 1 to 5 instead of 37.

The above mentioned channel re-arrangements related to scenario C, are shown in Table A4.11a in the grey shaded fields. These assignments are an amendment to the scenario C plan.

[8] See emails of Mr. Supatrasit Suansook of 25 November 2013 and 2 December 2013.

Site N°	Site name	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6
11.0	**Sisaket_DTT SFN**	41	30	33	27	49	37
12.0	**Ubon Ratchathani_DTT SFN**	41	30	33	27	49	52

Table A4.11a: Channel re-arrangement in Scenario C to avoid the use of channel 37 in Ubon Ratchthani (site 12)

In scenario B, in addition to the replacement of channels 30 and 33 as mentioned in Section 2, also a temporarily replacement is necessary of channel 27, which is in operation with analogue TV in Ubon Ratchthani. In Sisaket the channel from multiplex 6 (37) could be temporarily used and in Ubon Ratchthani the temporarily channel 26.

The above mentioned channel changes are shown in Table A4.11b in the grey shaded fields. For completeness the other temporarily channel assignments are also indicated.

Site N°	Site name	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6
11.0	**Sisaket_DTT SFN**	41	30/52	33/58	27/37	49	37
12.0	**Ubon Ratchathani_DTT SFN**	41	30/52	33/58	27/26	49	52

Table A4.11b: Channel re-arrangement in Scenario B

b) SFN assignments

The assignments at the sites in the three SFNs are indicated below. For information also multiplex 6 is indicated. The sites in multiplex 6 should not operate in SFN, because in this multiplex contain regional services with different content per site. The bold printed channels indicated in the grey shaded fields in Table A4.12 should therefore be assigned to multiplex 6 after analogue TV switch-off.

Site N°	Site name	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6
11.0	**Sisaket_DTT SFN**	41	30/52	33/58	27/37	49	**37**
12.0	**Ubon Ratchathani_DTT SFN**	41	30/52	33/58	27/26	49	**52**
26.0	**Utaradit_DTT SFN**	41	30	33	37/52	49	**52**
27.0	**Sukhothai_DTT SFN**	41	30	33	37/52	49	**27**
37.0	**Song Khla_DTT SFN**	50	42	46	38/54	26	**34**
38.0	**Satun_DTT SFN**	50/52	42	46/60	38	26	**52**

Table A4.12: Channel arrangements at sites that are part of a SFN

Taking into account the temporarily channel replacements and the channel arrangements per site, not all of the indicated sites operate in SFN before analogue TV switch-off:

- Site 11/12: multiplexes operated by TPBS is in SFN;
- Site 37/38: multiplexes operated by NBT, MCOT and TPBS are not in SFN.

In principle at site 37/38 the temporarily channel assignments could be applied to both sites, but that would result in two additional channel changes at Song Khla and one additional channel change at Satun.

The aim was to avoid channel changes where possible, therefore during the transition period non-SFN operation at some of the five multiplexes was accepted.

c) No rearrangements, as far as possible, to the first seven sites of the network deployment schedule

In the first deployment phase four DTTB sites will be put into operation on 1 March and three sites at 1 May 2014. NBTC requested to keep unchanged, as far as possible, because the channels were communicated already based on the Scenario C plan of 19 November 2013. The sites concerned are shown in the table below.

Site N°	Site name	NBT	Army-TV1	MCOT	TPBS	Army-TV2	Mux 6	In operation
1.0	**Bangkok_DTT**	26	36	40	44	32/52	29	1 April 2014
4.0	**Rayong_DTT**	45	59	53	56	43	48	1 May 2014
8.0	**Nakhon Ratchasima_DTT**	41/58	49/52	30	33	37	27	1 April 2014
12.0	**Ubon Ratchathani_DTT**	41	30/52	33/58	27/26	49	52	1 May 2014
20.0	**Chiang Mai_DTT**	46/60	50	54	57	38	34	1 April 2014
33.0	**Surat Thani_DTT**	26	36	40	44	32	29	1 May 2014
37.0	**Song Khla_DTT**	50	42	46	38/54	26	34	1 April 2014

Table A4.13: Seven sites that will be launched first

The red indicated channels refer to changes compared to the plan of 19 November 2014 resulting from resolving incompatibilities. These changes should be taken into account, but the rearrangements described in items d) and e) below were not applied to the sites shown above.

d) Balancing low, medium and high channels across the multiplexes 1 to 5 in Scenario C plan

In order to assign equitable numbers of high, medium and low channels to the different multiplexes the available channels were grouped into three categories:

a. Low channels 26 to 36;
b. Mid channels 37 to 48;
c. High channels 49 to 60.

These channel categories were reshuffled per site across the multiplexes 1 to 5, with the exception of the sites mentioned in item c).

The resulting channel distribution is shown in Figure A4.3. For information multiplex 6 is also shown.

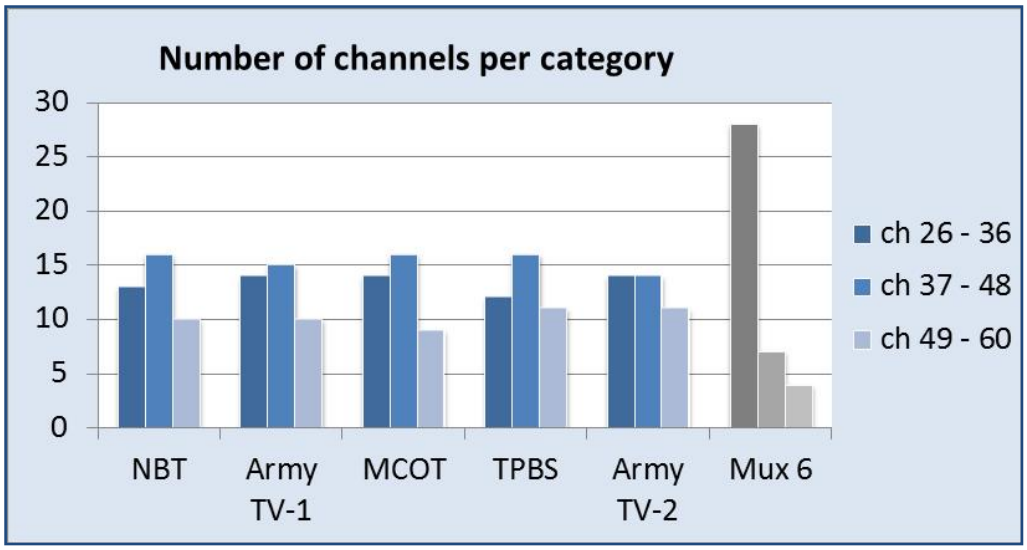

Figure A4.3: Balance of channel categories across the multiplexes

Multiplex 6 contains many channels in the lower part of the band. These channels are in operation by TPBS analogue TV (see Section 6.2). Including multiplex 6 in the balancing of low, medium and high channels across the multiplexes, would result in many additional temporarily channel assignments in multiplexes 1 to 5 and was therefore not considered.

e) Balancing the number of channel changes across the network operators

The number of channel changes per network operator was also balanced, without affecting the balance achieved in d). The total number of channel changes after analogue TV switch-off is 26. The resulting number of channel changes per multiplex is indicated in Table A4.14.

Network operator	Number of channel changes
NBT	5
Army TV1	5
MCOT	5
TPBS	6
Army TV2	5

Table A4.14: Number of channel changes after analogue TV switch-off

Annex 5 Planning scenario A

In scenario A, compatibility was analysed between a subset of the DTTB transmitter database of scenario B, containing the DTTB sites that will be operational by mid-2014, and analogue TV.

The resulting DTTB and analogue TV coverage was presented.

The DTTB sites taken into account in scenario A are listed in Table A5.1, for information the launch date has been indicated.In the table below the shading of the sites has the following meaning:

- Sites with launch date of 1 April 2014 are shaded light red;
- Sites with launch date of 1 May 2014 are shaded light green;
- Sites with launch date of 1 June 2014 are shaded light blue;

Site N°	Site name	In operation
1.0	**Bangkok_DTT**	1 April 2014
8.0	**Nakhon Ratchasima_DTT**	1 April 2014
20.0	**Chiang Mai_DTT**	1 April 2014
37.0	**Song Khla_DTT**	1 April 2014
4.0	**Rayong_DTT**	1 May 2014
12.0	**Ubon Ratchathani_DTT**	1 May 2014
33.0	**Surat Thani_DTT**	1 May 2014
3.0	**Singburi_DTT**	1 June 2014
15.0	**Khon Kaen_DTT**	1 June 2014
17.0	**Udonthani_DTT**	1 June 2014
27.0	**Sukhothai_DTT SFN**	1 June 2014

Table A5.1: DTTB sites in scenario A

Annex 6 Summary of DTTB Plan 3.0 regarding the 39 main sites

The table below shows a summary of the DTTB Plan 3.0 as agreed by NBTC at 16 January 2014 and endorsed by the network operators on 20 January 2014.

The site names in the shaded boxes in column B are part of the first deployment phase (scenario A); the shading has the following meaning:

- Sites with launch date of 1 April 2014 are shaded light red;
- Sites with launch date of 1 May 2014 are shaded light green;
- Sites with launch date of 1 June 2014 are shaded light blue.

Column C shows the maximum ERP in kW and column D the channel group in scenario C.

In the columns headed with the DTTB network operators (columns E to I) the assigned channels are presented as follows:

- Channel numbers printed in red in the grey shaded fields are temporarily channels, separated by a slash from the channel to be used after switch-off of the related analogue TV stations indicated in column K;
- Single channel numbers printed in red are channels originating from a shift with the channel in multiplex 6;
- Bold printed channel numbers indicate that the channel has been assigned to a specific multiplex resulting from:
    - The measures for resolving incompatibilities;
    - The requirement that multiplex 6 contains different services per site and should not operate in SFN.

Column L shows the analogue TV stations where critical interference from DTTB has been accepted resulting from the measures for resolving incompatibilities.

The channel assignments of the 6th multiplex are indicated in column J. However, in Scenario B the 6th multiplex will not be in operation. The grey shaded fields in column J indicate that the channels cannot be brought into operation before the related analogue TV site indicated in column K have been switched-off. In Column K TPBS-ATV stations in operation at or near the DTTB sites are printed in orange.

Scenarios A, B and C represent the following situations.

Scenario	DTTB	Analogue TV
A	11 DTTB main sites of first deployment phase with five multiplexes	All UHF ATV stations in operation
B	39 DTTB main sites with five multiplexes	All UHF ATV stations in operation
C	39 DTTB main sites with six multiplexes	Analogue TV switch-off

Table A6.1: Planning scenarios

A	B	C	D	E	F	G	H	I	J	K	L
Site N°	Site name	ERP (kW)	Sc C CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6	ATV stations to be switched off before scenario C channel can be used	ATV stations with accepted critical DTTB interference
1.0	Bangkok_DTT	50	Db	26	36	40	44	32/52	29	Bangkok Ch3 (32) Bangkok TPBS (29)	
2.0	Kanchana Buri_DTT	25	Dc	49	37	41	30	27	33	No constraints	Kanchanaburi Ch7 (48)
3.0	Singburi_DTT	15	Da	35	51	47	39	31/55	28	Singburi Ch11 (31) Singburi TPBS (28)	
4.0	Rayong_DTT	50	De	45	59	53	56	43	48	Pattaya Ch11 (48)	
5.0	Sakaeo_DTT	50	Dd	54	50/42	46	38	57	34	Sakaeo Ch7 (50) Sakaeo TPBS (34)	Pattaya Ch5 (38)
6.0	Trat_DTT	50	Dc	33	37	41	49	30	27	Trat TPBS (27)	
7.0	Prachaub Khiri Khun_DTT	20	Dd	46	50	54	57	38	34	Prachaub Khiri Khun TPBS (34)	Pattaya_TPBS (46) Pattaya Ch7 (50) Pattaya Ch5 (38)
8.0	Nakhon Ratchasima_DTT	50	Dc	41/58	49/52	30	33	37	27	Nakhon Ratchasima Ch3 (41) Chaiyaphum Ch5 (49) Nakhon Ratchasima TPBS (27)	
9.0	Chaiyaphum_DTT	15	Da	31/55	47	39	35	51	28	Chaiyaphum Ch11 (31) Chaiyaphum TPBS (28)	
10.0	Surin_DTT	50	Db	26/42	32	40	36	44	29	Khon Kaen Ch11 (26) Surin TPBS (29)	
11.0	Sisaket_DTT **SFN**	20	Dc/f	41	30/52	33/58	27/37	**49**	**37**	Ubon Ratchathani Ch5 (30) Ubon Ratchathani Ch11 (33) Ubon Ratchathani TPBS (27)	Roi ET CH5 (49)
12.0	Ubon Ratchathani_DTT **SFN**	50	Dc	41	30/52	33/58	27/26	**49**	**52**	Ubon Ratchathani Ch5 (30) Ubon Ratchathani Ch11 (33) Ubon Ratchathani TPBS (27)	Roi ET Ch5 (49)
13.0	Mukdahan_DTT	20	Da	47	39	35	**28**	51	31	Roi ET Ch11 (31)	
14.0	Roi ET_DTT	50	Dd	57	**50**	46	54/60	34/55	38	Mahasarakham Ch7 (54)	Roi ET Ch5 (49)

A	B	C	D	E	F	G	H	I	J	K	L
Site N°	Site name	ERP (kW)	Sc C CG	NBT	Army-TV 1	MCOT	TPBS	Army-TV 2	Mux 6	ATV stations to be switched off before scenario C channel can be used	ATV stations with accepted critical DTTB interference
										Chumpuang_TPBS (34) Pratay N Ratchasima Ch11 (38)	
15.0	Khon Kaen_DTT	50	De	59	45	53/52	56	48	43	Mahasarakham Ch7 (53) Roi ET Ch9 (43)	
16.0	Loie_DTT	20	Dd	46	50/42	57	54	38	34	Loie Ch5 (50) Loie TPBS (34)	
17.0	Udonthani_DTT	50	Da	47	35	31/55	39	**51**	28	Udonthani Ch9 (31) Udonthani TPBS (28)	
18.0	Buengkan_DTT	10	Db	44	32	36	40	26/52	29	Buengkan Ch11 (26) Buengkan TPBS (29)	
19.0	Sakhon Nakhon_DTT	50	Dc	30	**49**	41	33	37/58	27	Sakhon Nakhon Ch11 (37) Sakhon Nakhon TPBS (27)	Roi ET Ch5 (49)
20.0	Chiang Mai_DTT	50	Dd	46/60	50	54	57	38	34	Chiang Mai Ch3 (46) Chiang Mai TPBS (34)	
21.0	Mae Hong Son Doi kong mu_DTT	1	Dc	37	41	49	30	33	27	Mae Hong Son Doi kong mu TPBS (27)	
22.0	Lampang_DTT	50	Db	26	44	32	36	40	29	Lampang TPBS (29)	
23.0	Chiang Rai_DTT	50	Dc	49	30	33	37	41	27	Chiang Rai TPBS (27)	
24.0	Nan_DTT	50	Da	**28**	31	35	39	51	47	No constraints	
25.0	Phrae_DTT	30	De	45	48	59	56	43	53	No constraints	
26.0	Utaradit_DTT **SFN**	2	Dc/f	41	30	**33**	37/52	49	**52**	Sukhothai Ch3 (37)	
27.0	Sukhothai_DTT **SFN**	50	Dc	41	30	33	37/52	49	**27**	Sukhothai Ch3 (37) Sukhothai TPBS (27)	
28.0	Tak_DTT	50	Da	**31**	**35**	39	51	47	28	Toen TPBS (28)	Tak_TPBS (34) Toen Ch11 (31)
29.0	Nakhon Sawan_DTT	50	Dd	57	46	50	54	38	34	Nakhon Sawan TPBS (34)	

A	B	C	D	E	F	G	H	I	J	K	L
Site N°	**Site name**	**ERP (kW)**	**Sc C CG**	**NBT**	**Army-TV 1**	**MCOT**	**TPBS**	**Army-TV 2**	**Mux 6**	**ATV stations to be switched off before scenario C channel can be used**	**ATV stations with accepted critical DTTB interference**
30.0	Phetchaboon_DTT	10	Db	40	44	29	32	36	26	No constraints	
31.0	Chumphon_DTT	50	Da	51	47	31	35	39	28	Chumphon TPBS (28)	
32.0	Ranong_DTT	15	Dc	49	30	37	41	33	27	Ranong TPBS (27)	
33.0	Surat Thani_DTT	50	Db	26	36	40	44	32	29	Surat Thani TPBS (29)	
34.0	Phuket_DTT	25	Da	**35**	39	51	47	31	28	No constraints	Thung Song_TPBS (51) Takua Pa_TPBS (28)
35.0	Nakhon Sri Thumarat_DTT	30	Dc	30	33	37	41	49	27	Nakhon Sri Thumarat TPBS (27)	
36.0	Trang_DTT	40	De	43	59	48	53	56	45	Thung Song Ch11 (45)	
37.0	Song Khla_DTT **SFN**	50	TDa’	50	42	46	38/54	26	**34**	Song Khla Ch3 (38) Song Khla TPBS (34)	Satun Ch7 (51) Trang Ch7 (50) Trang_TPBS (46)
38.0	Satun_DTT **SFN**	30	TDa’/f	50/52	42	46/60	38	26	**52**	Trang Ch7 (50) Trang TPBS (46)	Song Khla Ch3 (38)
39.0	Yala_DTT	30	TDb	32	48	36	44	28	40	No constraints	

Table A6.2: Summary of DTTB Plan 3.0 regarding the 39 main sites

Annex 7 Overview of the UHF analogue TV stations

The table below gives a summary of the characteristics of the UHF analogue television stations in Thailand that were taken into account in scenarios A and B.

Site Name	Longitude (decimal degrees)	Latitude (decimal degrees)	Channel	Frequency (MHz)	Ant. Height (m)	ERP (kW)	Polarization	Vision Offset
Bangkok Ch3	100.540000	13.754444	32	559.25	328	758.6	Horizontal	0
Bangkok_TPBS	100.540000	13.754444	29	535.25	328	1000.0	Horizontal	0
Betong Yala Ch5	101.053056	5.771111	52	719.25	55	0.1	Horizontal	0
Buengkan Ch11	103.559167	18.351667	26	511.25	120	5.0	Horizontal	0
Buengkan_TPBS	103.559167	18.351389	29	535.25	100	10.0	Horizontal	0
Chaiprakan_TPBS	99.144861	19.628389	29	535.25	19	1.0	Horizontal	0
Chaiyaphum Ch11	102.030000	15.759167	31	551.25	120	63.1	Horizontal	0
Chaiyaphum Ch5	101.967222	15.665833	49	695.25	106	251.2	Horizontal	0
Chaiyaphum_TPBS	102.030000	15.759167	28	527.25	120	100.0	Horizontal	0
Chiang Mai Ch3	98.912778	18.809167	46	671.25	106	1349.0	Horizontal	0
Chiang Mai_TPBS	98.917500	18.809722	34	575.25	78	501.2	Horizontal	0
Chiang Rai_TPBS	99.867041	19.813755	27	519.25	64	501.2	Horizontal	-8
ChiangKhong_TPBS	100.401667	20.254722	29	535.25	60	1.3	Horizontal	0
Chum Pae Ch11	102.061324	16.562602	38	607.25	120	2.0	Horizontal	-8
Chum Pae_TPBS	102.061324	16.562602	34	575.25	120	50.1	Horizontal	-8
Chumphon_TPBS	99.191590	10.530820	28	527.25	154	323.6	Horizontal	8
Chumpuang_TPBS	102.796667	15.274722	34	575.25	120	9.3	Horizontal	8
Fang Chiang Mai Ch11	99.217222	19.919722	26	511.25	100	100.0	Horizontal	0
Hua Hin Ch11	99.938500	12.566589	33	567.25	60	5.0	Horizontal	0
Hua Hin Ch7	99.935278	12.565000	55	743.25	60	25.7	Horizontal	0
Hua Hin_TPBS	99.938500	12.566589	27	519.25	60	5.0	Horizontal	0
Kanchana Buri Ch11	99.420556	14.074444	38	607.25	120	50.1	Horizontal	8

Site Name	Longitude (decimal degrees)	Latitude (decimal degrees)	Channel	Frequency (MHz)	Ant. Height (m)	ERP (kW)	Polarization	Vision Offset
Kanchana Buri_TPBS	99.420556	14.074444	34	575.25	120	100.0	Horizontal	8
Kanchanaburi Ch7	99.387222	14.057500	48	687.25	90	13.5	Horizontal	8
Khon Kaen Ch11	102.833572	16.476943	26	511.25	150	100.0	Horizontal	-8
Khon Kaen_TPBS	102.946425	16.463758	29	535.25	150	501.2	Horizontal	-8
Ko Samui Ch11	99.992222	9.491111	38	607.25	60	100.0	Horizontal	0
Ko Samui_TPBS	99.992222	9.491111	34	575.25	60	11.5	Horizontal	0
Lampang_TPBS	99.563029	18.243457	29	535.25	80	501.2	Horizontal	0
Loie Ch5	101.714722	17.611667	50	703.25	136	794.3	Horizontal	0
Loie_TPBS	101.444519	17.470655	34	575.25	30	323.6	Horizontal	0
Mae Hong Son_TPBS	97.957985	19.297351	27	519.25	60	50.1	Horizontal	-8
Mae Kra Jan_TPBS	99.520192	19.339816	28	527.25	45	0.5	Horizontal	0
Mae Sariang Ch5	97.945406	18.169829	42	639.25	40	4.0	Horizontal	8
Mae Sariang_TPBS	97.945406	18.169829	46	671.25	40	4.0	Horizontal	8
Mahasarakham Ch7	103.332536	15.973445	53	727.25	150	416.9	Horizontal	-8
Muaklek_TPBS	101.153715	14.652015	34	575.25	20	2.5	Horizontal	-8
Mukdahan Ch11	104.723611	16.608333	36	591.25	120	10.0	Horizontal	8
Mukdahan_TPBS	104.718181	16.613679	29	535.25	124	100.0	Horizontal	8
Nakhon Ratchasima Ch3	102.003760	14.947722	41	631.25	156	1000.0	Horizontal	8
Nakhon Ratchasima_TPBS	101.995052	14.947688	27	519.25	156	501.2	Horizontal	8
Nakhon Sawan_TPBS	100.133636	15.715740	34	575.25	80	501.2	Horizontal	0
Nakhon Sri Thumarat_TPBS	99.981063	8.357335	27	519.25	124	501.2	Horizontal	-8
Nan_TPBS	100.741214	18.742635	27	519.25	64	102.3	Horizontal	0
Pai Ch5	98.424444	19.384167	50	703.25	55	4.0	Horizontal	-8
Pattaya Ch11	100.866216	12.921622	48	687.25	40	1.0	Horizontal	8
Pattaya Ch5	100.866216	12.921622	38	607.25	40	1.0	Horizontal	8
Pattaya Ch7 - Corrected	100.866220	12.921620	50	703.25	40	1.0	Horizontal	8

Site Name	Longitude (decimal degrees)	Latitude (decimal degrees)	Channel	Frequency (MHz)	Ant. Height (m)	ERP (kW)	Polarization	Vision Offset
Pattaya_TPBS	100.866216	12.921622	46	671.25	40	1.0	Horizontal	8
Phayao Ch5	99.880617	19.194025	44	655.25	98	50.1	Horizontal	8
Phayao_TPBS	99.906289	18.986856	34	575.25	37	3.2	Horizontal	8
Phetchaboon_TPBS	101.071373	16.251014	27	519.25	150	323.6	Horizontal	-8
Phetchaburi_TPBS	99.928483	13.105428	34	575.25	81	1.3	Vertical	-8
Phrae_TPBS	100.000940	17.932527	34	575.25	64	100.0	Horizontal	-8
Phuket_TPBS	98.395395	7.898698	27	519.25	60	323.6	Horizontal	8
Prachaub Khiri Khun_TPBS	99.588368	11.418028	34	575.25	84	323.6	Horizontal	0
Pratay N Ratchasima Ch11	102.726111	15.529444	38	607.25	120	100.0	Horizontal	8
Ranong_TPBS	98.670259	10.024825	27	519.25	123	100.0	Horizontal	0
Rayong_TPBS	101.412906	12.676200	28	527.25	40	501.2	Horizontal	0
Roi ET Ch11	103.591389	15.937500	31	551.25	120	501.2	Horizontal	-8
Roi ET Ch5	103.492878	16.099522	49	695.25	126	251.2	Horizontal	-8
Roi ET Ch9	103.596889	16.075556	43	647.25	150	1202.3	Horizontal	-8
Roi ET_TPBS	103.591500	15.937667	28	527.25	126	501.2	Horizontal	-8
Sakaeo Ch7	102.107878	13.783750	50	703.25	40	25.1	Horizontal	8
Sakaeo_TPBS	102.104231	13.804003	34	575.25	156	501.2	Horizontal	0
Sakhon Nakhon Ch11	103.987778	17.137778	37	599.25	105	100.0	Horizontal	0
Sakon Nakhon_TPBS	103.987778	17.137778	27	519.25	105	501.2	Horizontal	-8
Satun Ch11	100.025305	6.635252	31	551.25	60	100.0	Horizontal	0
Satun Ch3	100.025305	6.635252	55	743.25	60	147.9	Horizontal	0
Satun Ch7	100.105833	6.658056	51	711.25	110	436.5	Horizontal	0
Satun_TPBS	100.025305	6.635252	27	519.25	60	100.0	Horizontal	0
Singburi Ch11	100.377004	14.836115	31	551.25	120	251.2	Horizontal	8
Singburi Ch9	100.427960	14.962647	53	727.25	150	1174.9	Horizontal	8
Singburi_TPBS	100.377004	14.836115	28	527.25	120	251.2	Horizontal	8

Site Name	Longitude (decimal degrees)	Latitude (decimal degrees)	Channel	Frequency (MHz)	Ant. Height (m)	ERP (kW)	Polarization	Vision Offset
Song Khla Ch3	100.517778	7.007778	38	607.25	106	602.6	Horizontal	0
Song Khla_TPBS	100.520195	7.015850	34	575.25	60	1000.0	Horizontal	0
Sukhothai Ch3	99.967222	16.963333	37	599.25	156	676.1	Horizontal	0
Sukhothai_TPBS	100.010563	16.984763	27	519.25	150	501.2	Horizontal	0
Surat Thani_TPBS	99.348510	9.091700	29	535.25	80	501.2	Horizontal	-8
Surin_TPBS	103.512500	14.919444	29	535.25	126	501.2	Horizontal	0
Tak_TPBS	98.927687	16.778691	34	575.25	80	323.6	Horizontal	8
Takua Pa_TPBS	98.351506	8.839300	28	527.25	63	25.1	Horizontal	0
Thung Song Ch11	99.490030	8.210169	45	663.25	60	50.1	Horizontal	8
Thung Song_TPBS	99.490030	8.210169	51	711.25	60	100.0	Horizontal	0
Toen Ch11	99.104908	17.664115	31	551.25	80	50.1	Horizontal	0
Toen_TPBS	99.104908	17.664115	28	527.25	80	0.3	Horizontal	0
Trang Ch7	99.549784	7.466077	50	703.25	110	758.6	Horizontal	-8
Trang_TPBS	99.486511	7.656956	46	671.25	120	1000.0	Horizontal	-8
Trat_TPBS	102.298661	12.195907	27	519.25	60	323.6	Horizontal	-8
Ubon Ratchathani Ch11	104.923611	15.381667	33	567.25	120	100.0	Horizontal	0
Ubon Ratchathani Ch5	104.909589	15.338844	30	543.25	140	446.7	Horizontal	0
Ubon Ratchathani_TPBS	104.923611	15.381667	27	519.25	120	501.2	Horizontal	0
Udonthani Ch9	102.794088	17.664041	31	551.25	150	616.6	Horizontal	8
Udonthani_TPBS	102.794088	17.664041	28	527.25	150	501.2	Horizontal	0
Yala khao pok yo Ch5	101.391111	6.333056	41	631.25	106	1995.3	Horizontal	0
Yala_TPBS	101,390278	6,333611	37	599.25	84	1995.3	Horizontal	0

Table A7.1: UHF analogue TV stations that were taken into account in scenarios B and A

Annex 8 Overview of the planning results

The table below gives an overview of the planning results that were handed over to NBTC.

Plan results	Format	Scenario A		Scenario B		Scenario C
		DTTB	UHF-ATV	DTTB	UHF-ATV	DTTB
1. DTTB Plan 3.0 regarding main sites	xlsx	55 assignments		195 assignments		234 assignments
2. FX population coverage per network and per sub-district	xlsx	Mux 1-5	6 ATV networks	Mux 1-5	6 ATV networks	Mux 1-6
3. FX household coverage per network and per sub-district	xlsx	Mux 1-5	6 ATV networks	Mux 1-5	6 ATV networks	Mux 1-6
4. PI population coverage per network and per target municipality	xlsx	Mux 1-5		Mux 1-5		Mux 1-6
5. PI household coverage per network and per target municipality	xlsx	Mux 1-5		Mux 1-5		Mux 1-6
6. FX coverage plots per network	jpeg	Mux 1-5	6 ATV networks	Mux 1-5	6 ATV networks	Mux 1-6
7. PI coverage plots per network	jepg	Mux 1-5		Mux 1-5		Mux 1-6
8. FX reception probability per pixel for each network	Arcgis rasterfile	Mux 1-5	6 ATV networks	Mux 1-5	6 ATV networks	Mux 1-6
9. FX reception best server per pixel for each network	Arcgis rasterfile	Mid-channel		Mid-channel		Mid-channel
10. PI reception probability per pixel for each network	Arcgis rasterfile	Mux 1-5		Mux 1-5		Mux 1-6

Table A8.1: Planning results