PBN Implementation in En-route Environment – Thailand

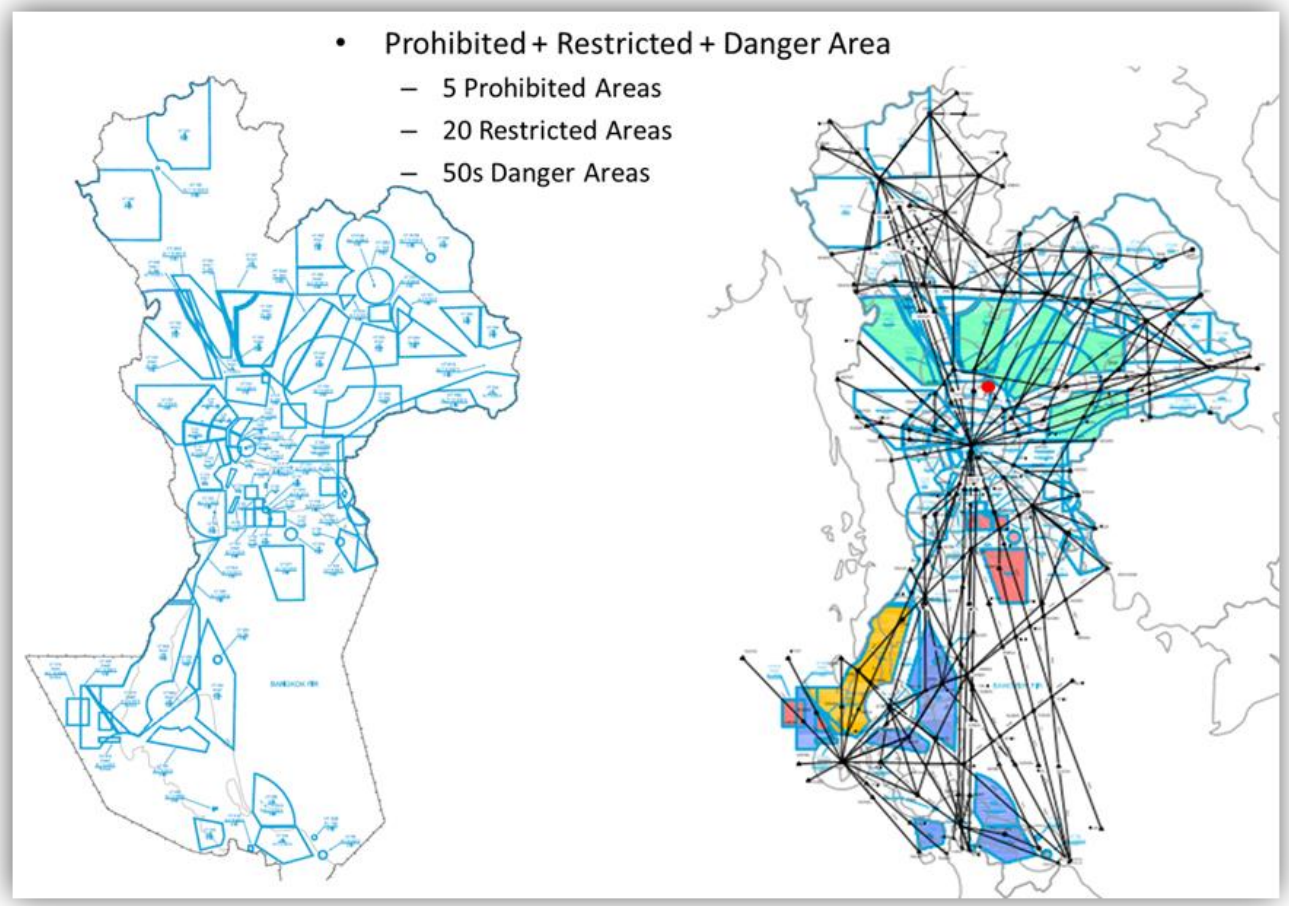
SAIOSEACG/3 16-19 April 2024

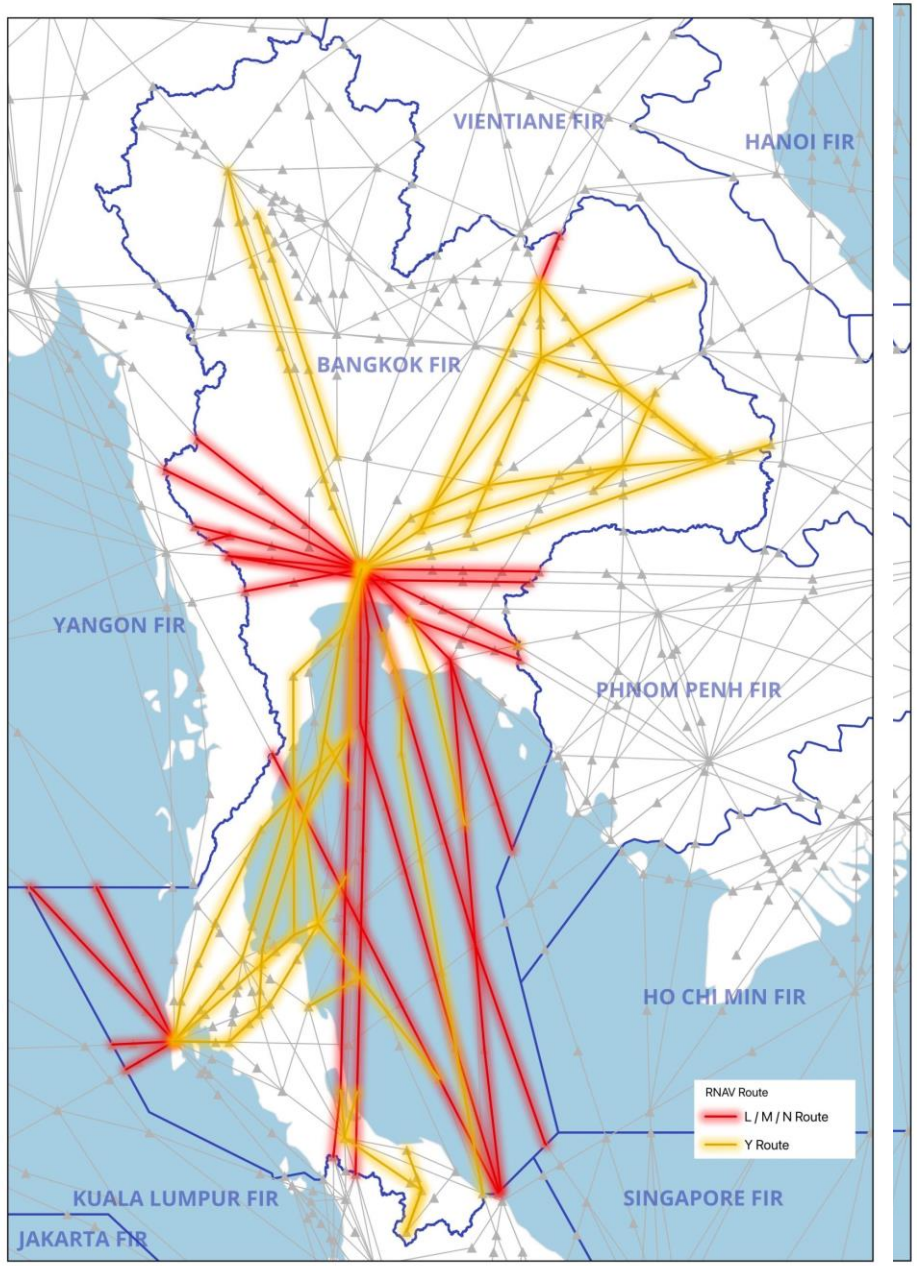
Topics

- Background
- PBN Implementation in En-route in Thailand
- PBN Airspace Establishment
- Future Plan
- Lesson Learned
- Operational experience and benefits

Background

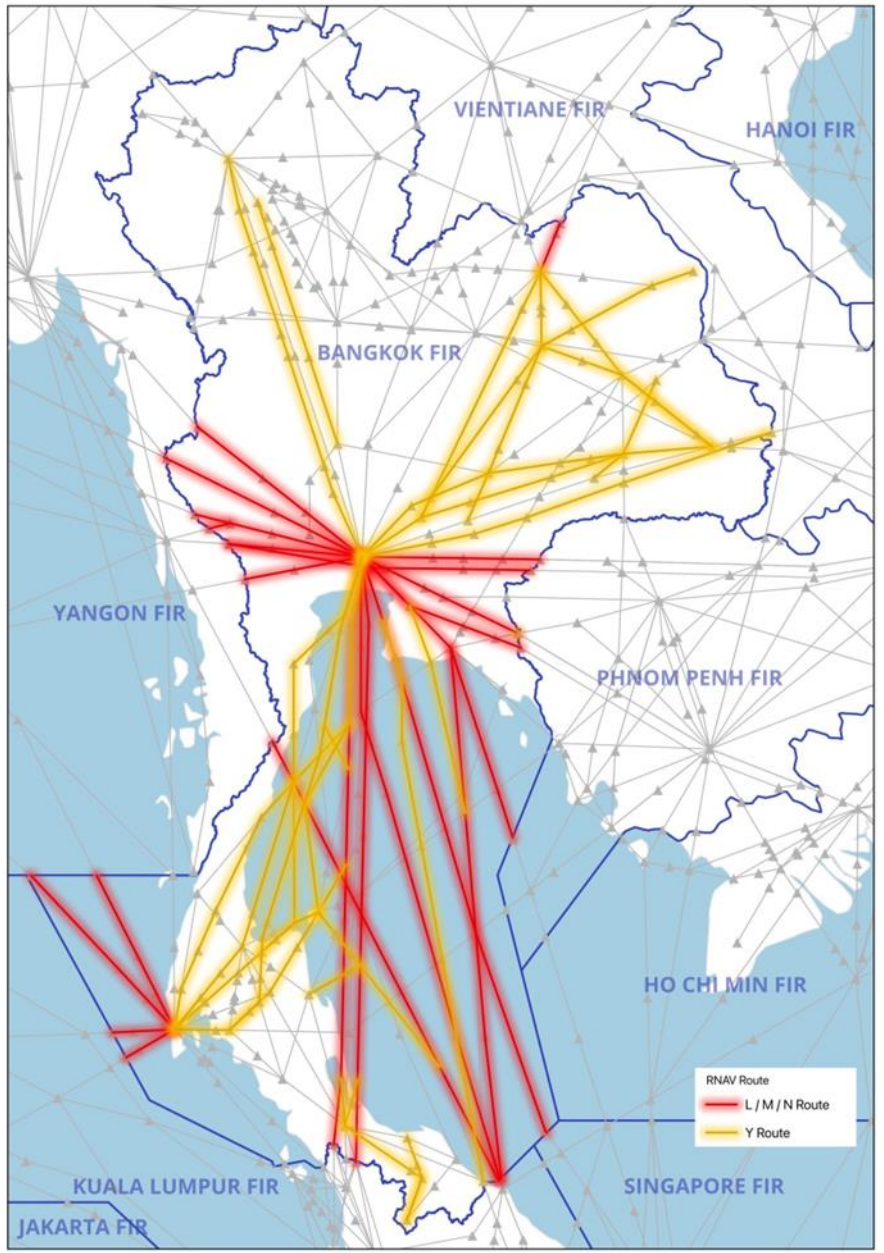
- Thailand airspace overview
- 52 RNAV2 routes (21 Inter/31 Dom)





Background

- Thailand introduced the first two PBN routes in about 2009
  - RNP10 (International)
  - RNAV5 (Domestic)
- Together with FUA concept
- Conditional Route (CDR)
- RNAV5 →RNAV2 (GNSS) (2019)
  - 2019 upgrade RNAV5 and RNP10 routes to RNAV2
  - 2020 established new RNAV2 routes and upgrade all PBN routes to RNAV2



ICAO

CAPACITY & EFFICIENCY

2016–2030
Global Air Navigation Plan

Doc 9750-AN/963 Fifth Edition – 2016

INTERNATIONAL CIVIL AVIATION ORGANIZATION

ICAO • OACI • ИКАО

ASIA/PACIFIC SEAMLESS ANS PLAN

Version 3.0, November 2019

This Plan was originally developed by the Asia/Pacific Seamless ATM Planning Group (APSAPG) and amended when appropriate by APANPIRG.

Approved by APANPIRG/30 and published by the ICAO Asia and Pacific Office, Bangkok

asean

ASEAN AIR NAVIGATION SERVICE MASTER PLAN

Seamless ASEAN Sky: One Sky for "One Vision, One Identity, One Community"

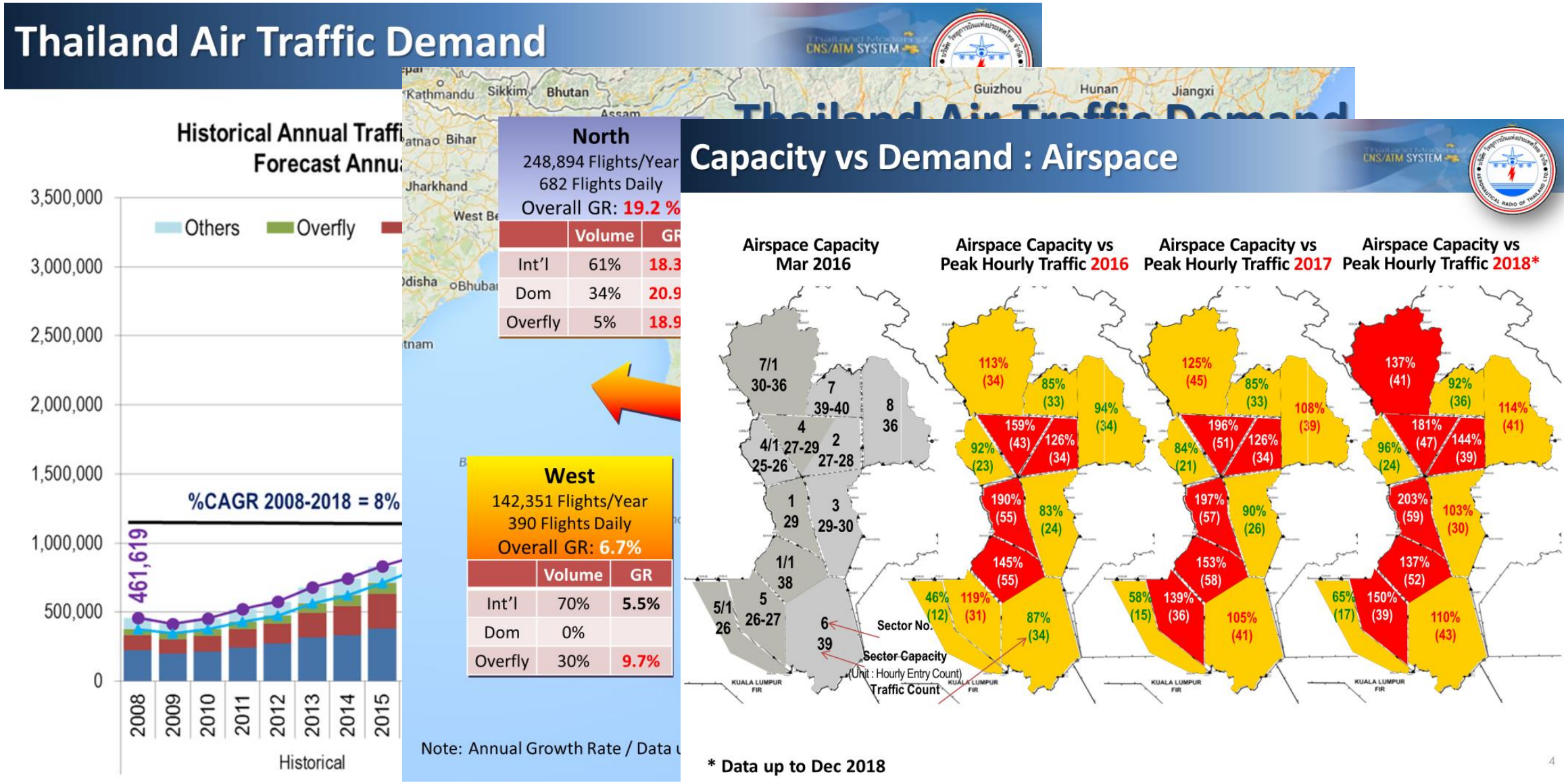
2020 Edition

ASEAN ANS Master Plan

Required ASEAN-Wide Harmonized Implementation

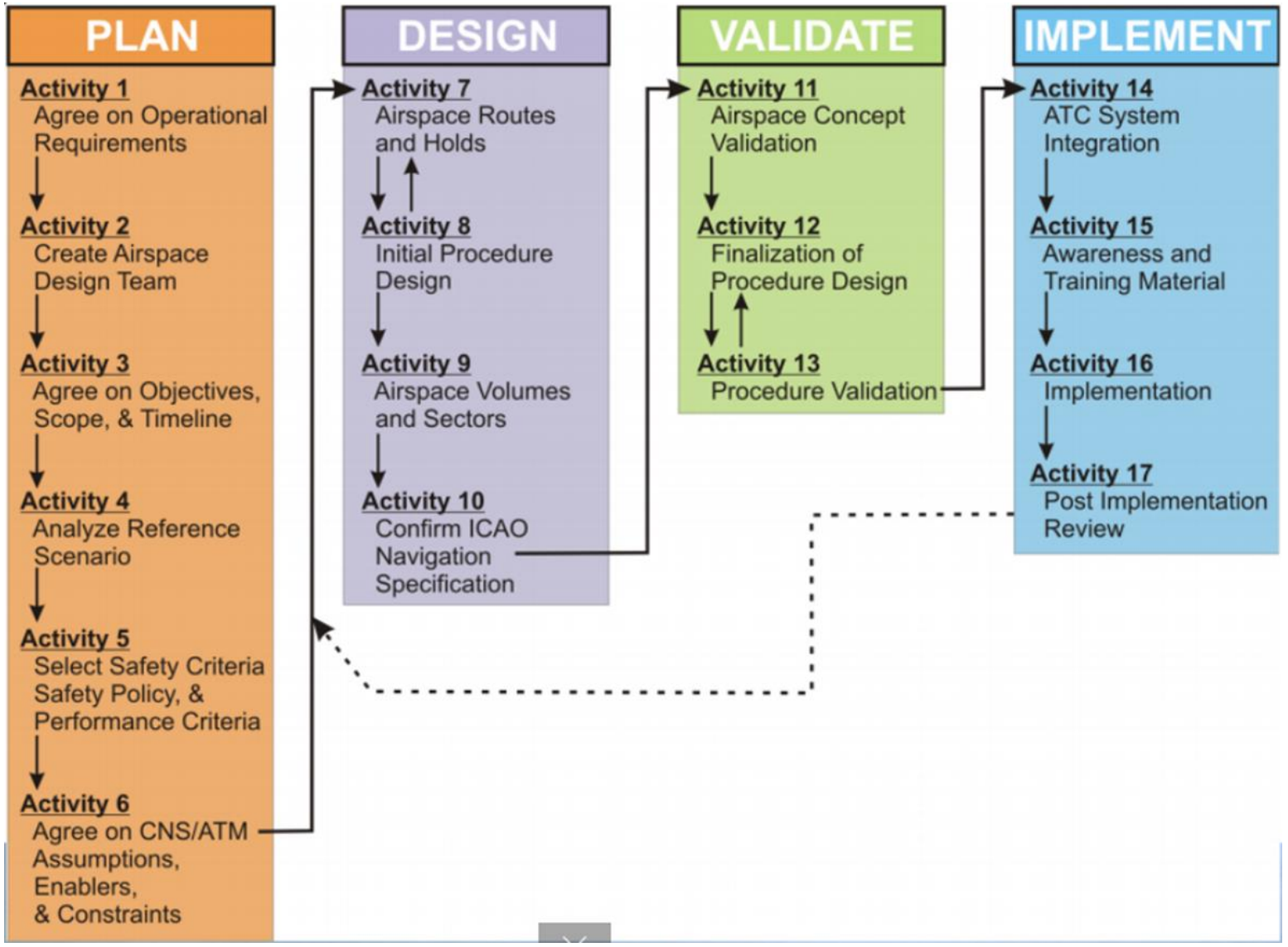
- Phase I (2018-2020)
  - En-route
    - PBN Routes: All ATS routes serving major aerodromes should be designated as RNAV2 or RNP2 (other acceptable - RNAV5).
- Phase II (2020-2022)
  - En-route
    - PBN Routes: PBN ATS routes serving major aerodromes should be designated as RNAV2 or RNP2.
- Phase III (2022-2025)
  - En-route
    - PBN Routes: PBN ATS routes serving major aerodromes should be designated as RNAV2 or RNP2. *(Initiative is continued from Phase II into Phase III)*

Why PBN routes implementation is needed?

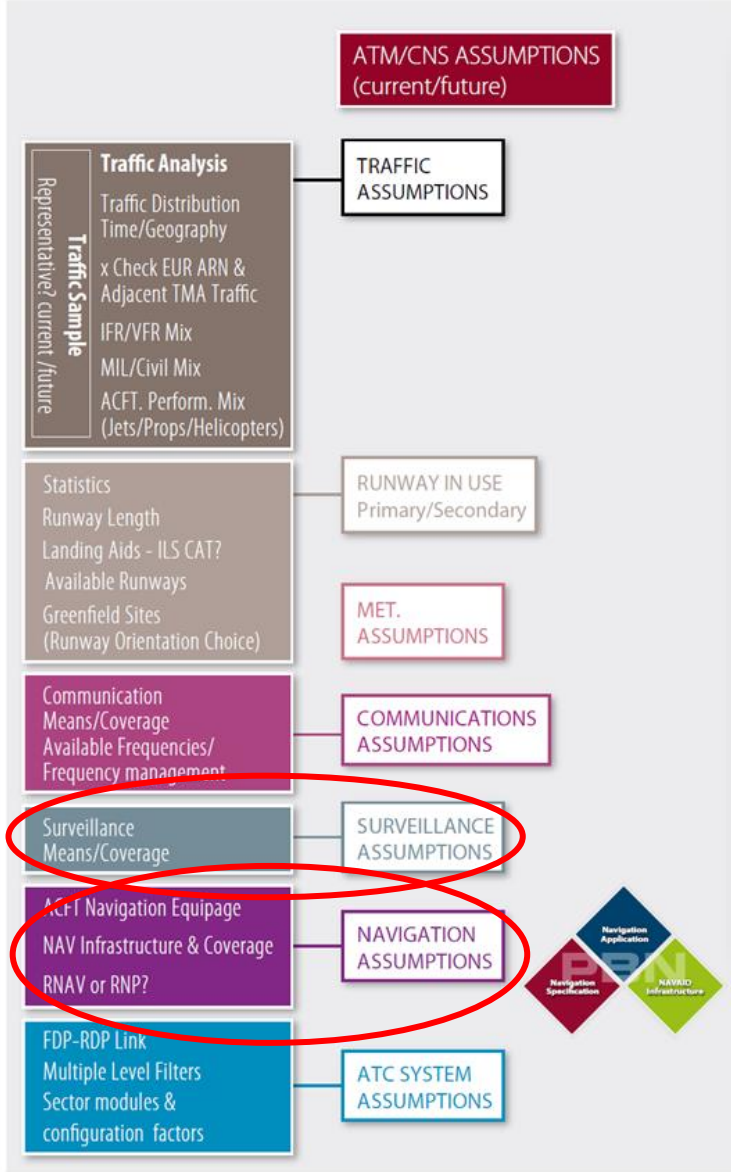


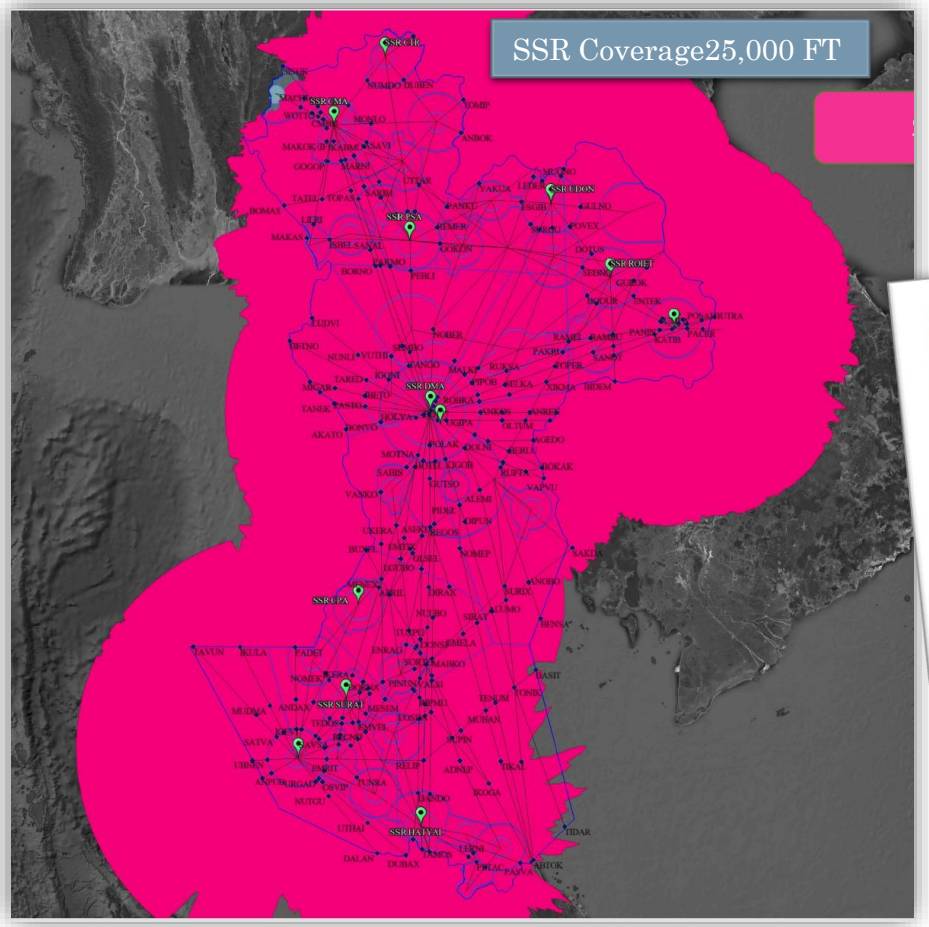
Reference ICAO Doc

Implementation process



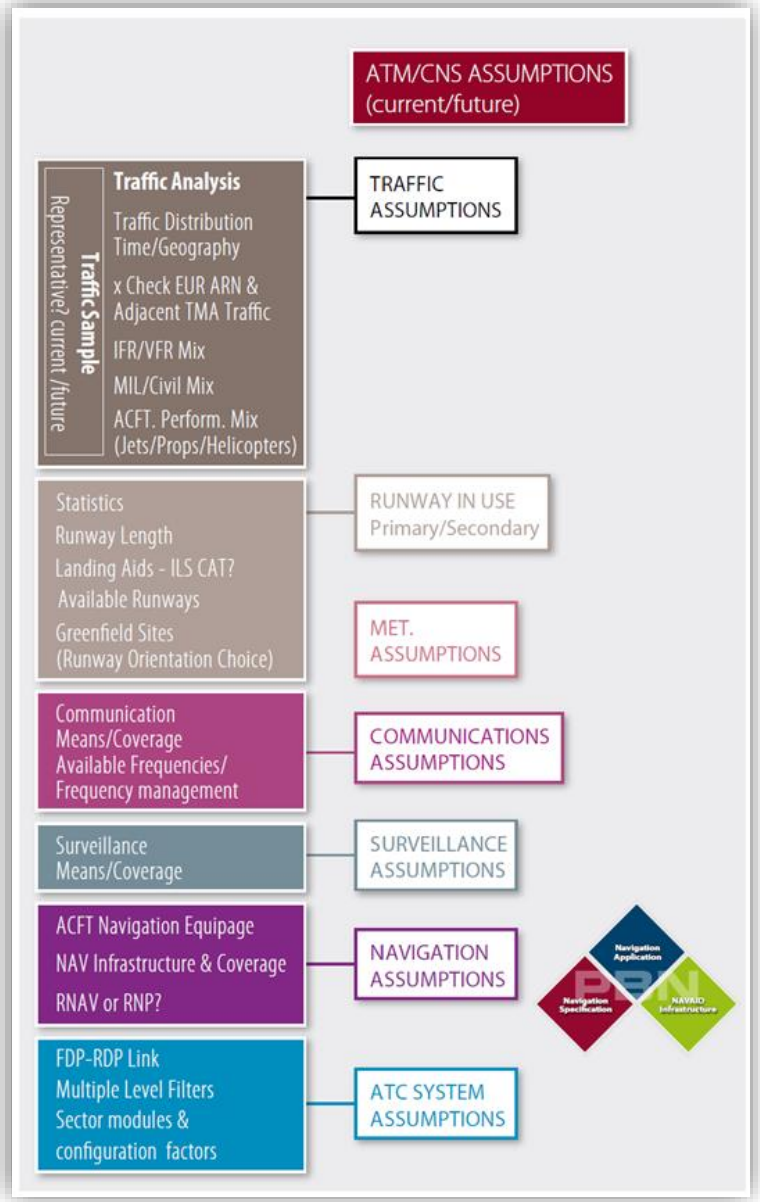
CNS Assumptions

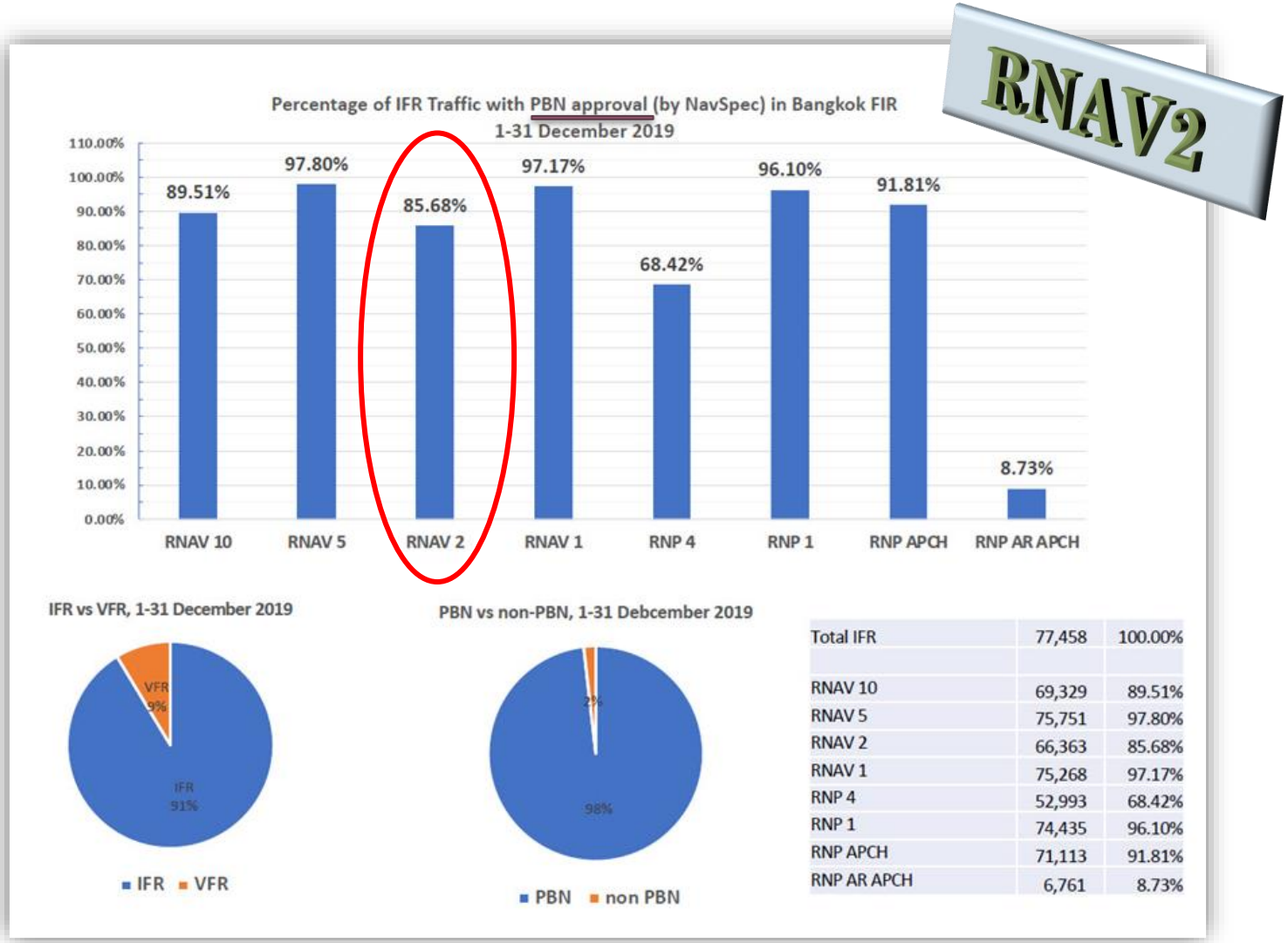




NAV SPEC	NAVAID				
	GNSS	IRU	DME/ DME	DME/ DME/ IRU	VOR/ DME
RNAV 10	✓	✓			✓
RNAV 5	✓	✓	✓		
RNAV 2 & 1	✓		✓	✓	
RNP 4	✓				
RNP 2	✓		✓	✓	
RNP 1	✓		✓	✓	
Advanced RNP	✓		✓	✓	
RNP APCH APV Baro	✓				
RNP APCH APV SBAS	✓ + SBAS				
RNP AR APCH	✓				
RNP 0.3	✓				

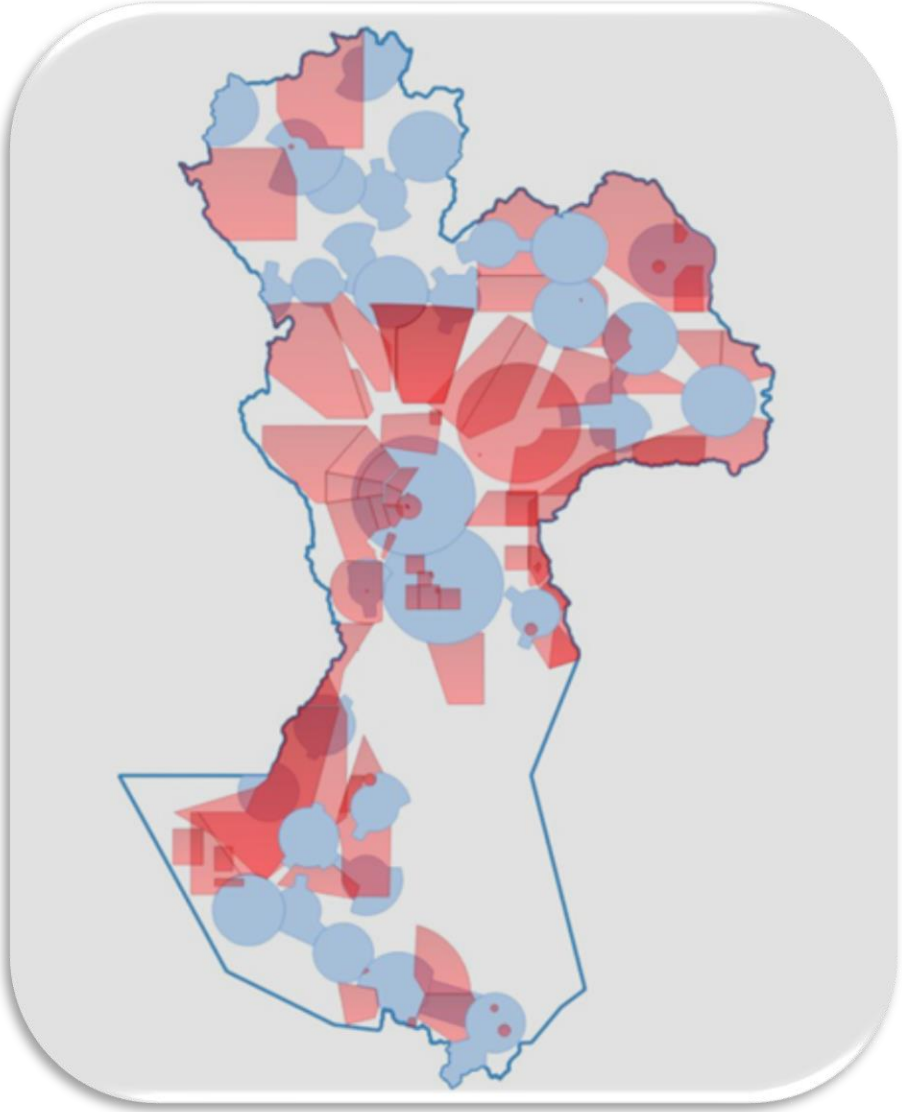
Airspace Users Readiness

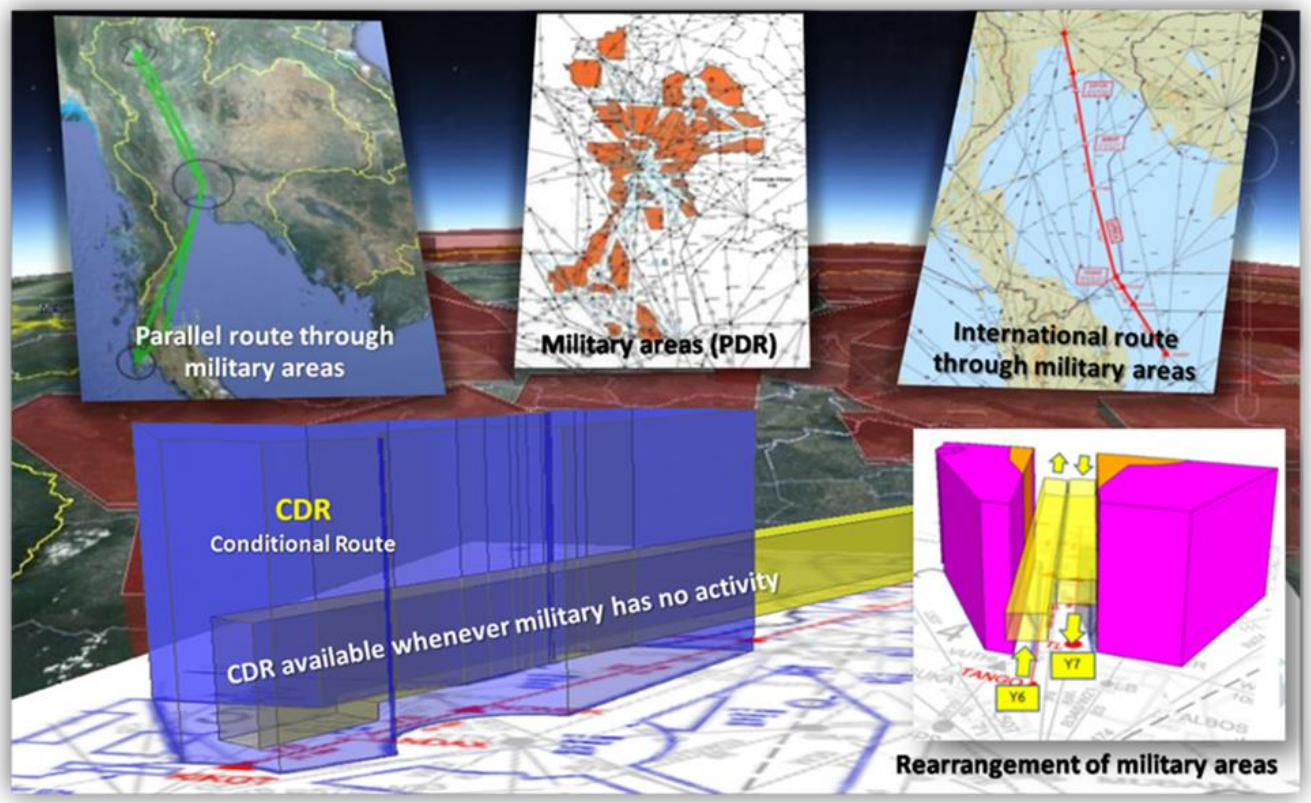




Total IFR	77,458	100.00%
RNAV 10	69,329	89.51%
RNAV 5	75,751	97.80%
RNAV 2	66,363	85.68%
RNAV 1	75,268	97.17%
RNP 4	52,993	68.42%
RNP 1	74,435	96.10%
RNP APCH	71,113	91.81%
RNP AR APCH	6,761	8.73%

Civil/Military Cooperation





Safety Assessment & Validation/Finalize the designed Routes

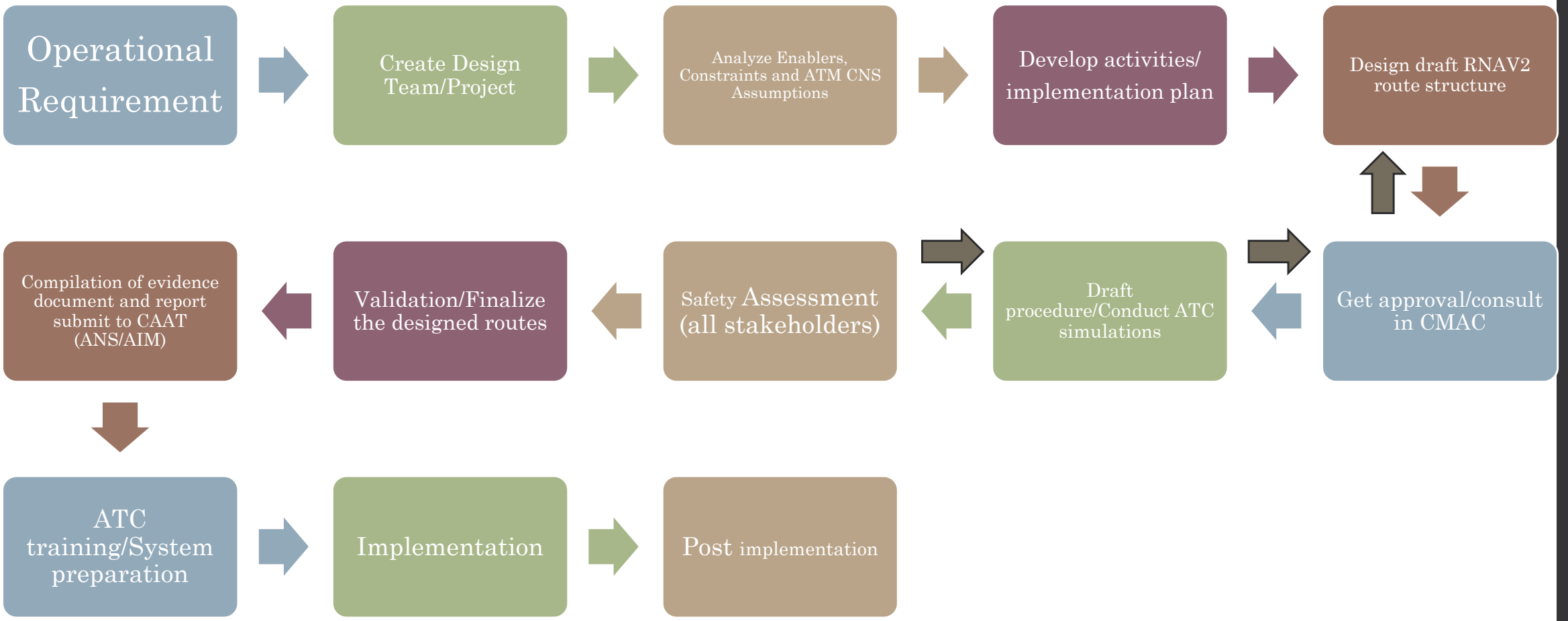
รายงานการวิเคราะห์และประเมินความปลอดภัย
Safety Assessment Report

โครงการจัดสร้างเส้นทางบินด้านเหนือ

กองบริหารความปลอดภัย
บริษัท วิทยุการบินแห่งประเทศไทย จำกัด

ฉบับที่ 1
กรกฎาคม 2564

Implementation process



PBN Routes Development

- The first two PBN routes in Thailand
  - RNAV 5 (2009)
  - Conditional routes (CDR)
    - Danger Area: MON - FRI, 2300-1000

Route designator (RNP type) Name of significant points Coordinates	Track MAG (GEO) VOR RDL DIST (COP)	Upper limits / Lower limits / or Airspace classification / Minimum flight altitude	Lateral limits NM	Direction of cruising levels Odd / Even	Remarks Controlling unit Frequency
1	2	3	4	5	6
Y1 (RNAV 2) [GNSS]					
UDON DVOR/DME (UDN)					
172304N 1024630E	206° / 026° / 30.0 NM	FL 460 / 12 000 FT / Class A / 13 000 FT			Uni-directional southbound route Conditional Route (CDR) availability: CDR1 1. Weekdays, Monday to Friday 1000 - 2300 UTC 2. From Friday 1000 UTC to Sunday 2300 UTC 3. Public Holidays CDR2 Other Periods, Availability shall be notified by Airspace use plan (AUP) published in www.thaicmac.aerothai.aero
TERCO	206° / 026° / 152.0 NM				
165550N 1023308E					
UBLOD	206° / 026° / 16.0 NM	FL 460 / 6 500 FT / Class A / 7 000 FT			
143715N 1012612E					
PIPOB					
142236N 1011914E					

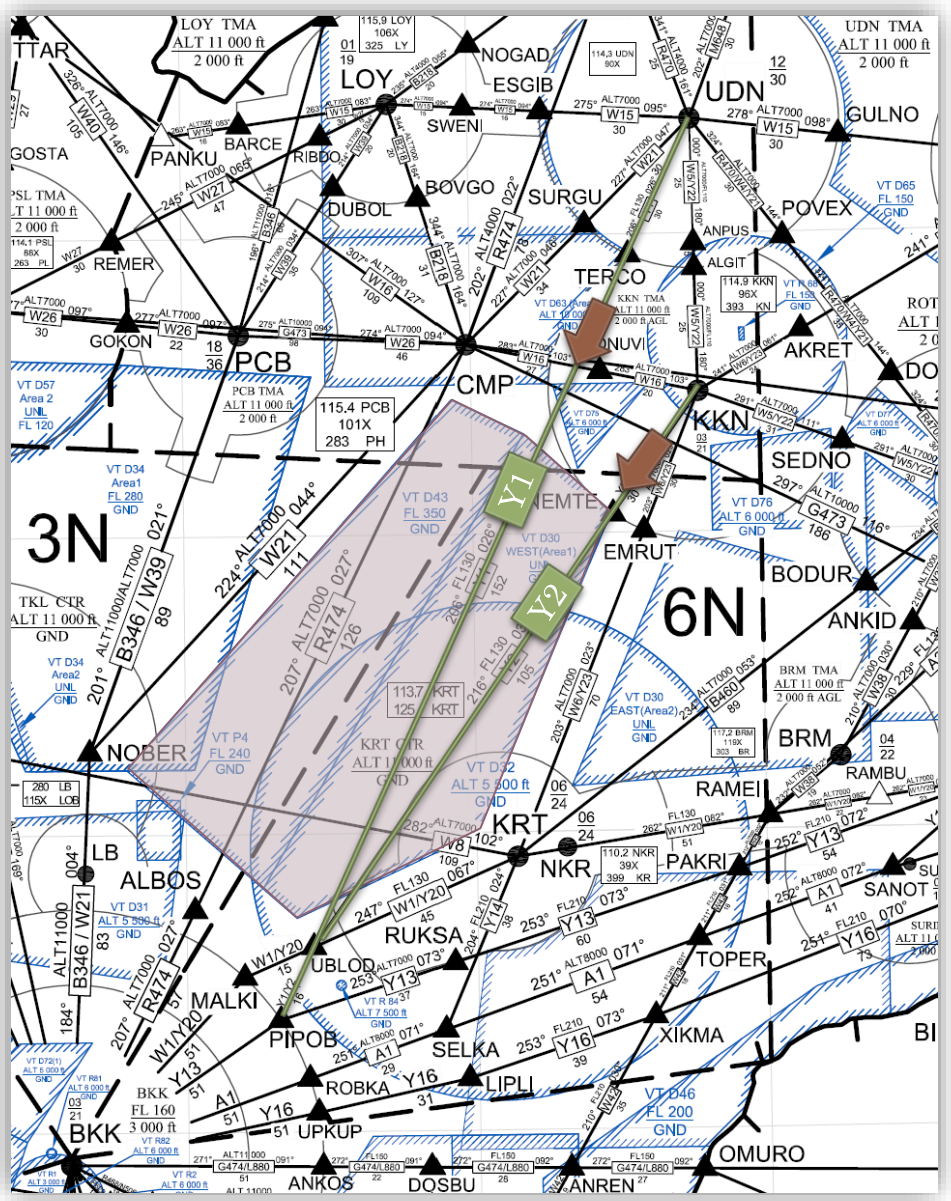
For flight planning procedure, see ENR 1.10.

Uni-directional southbound route

Conditional Route (CDR) availability:

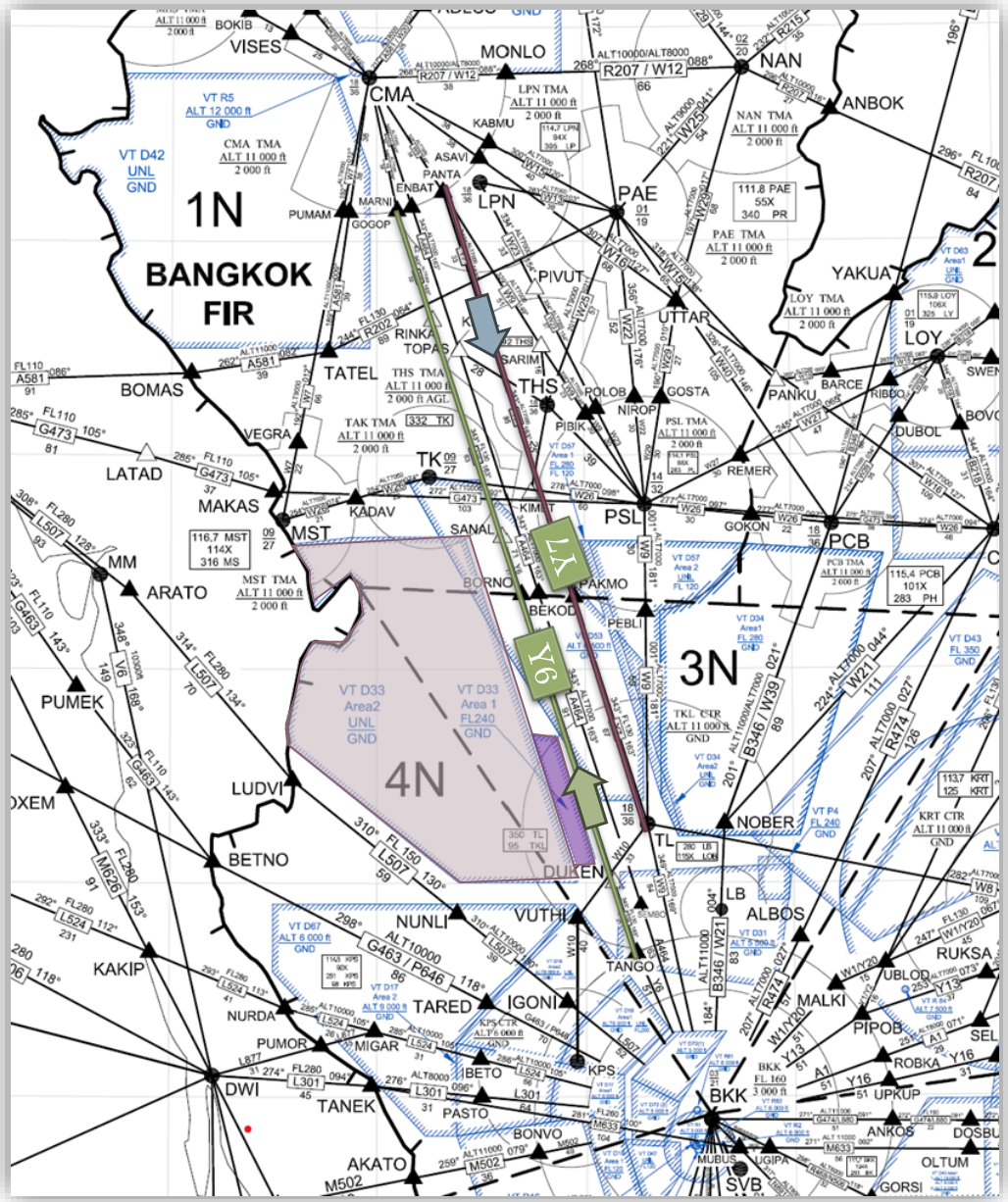
CDR1
1. Weekdays, Monday to Friday 1000 - 2300 UTC
2. From Friday 1000 UTC to Sunday 2300 UTC
3. Public Holidays

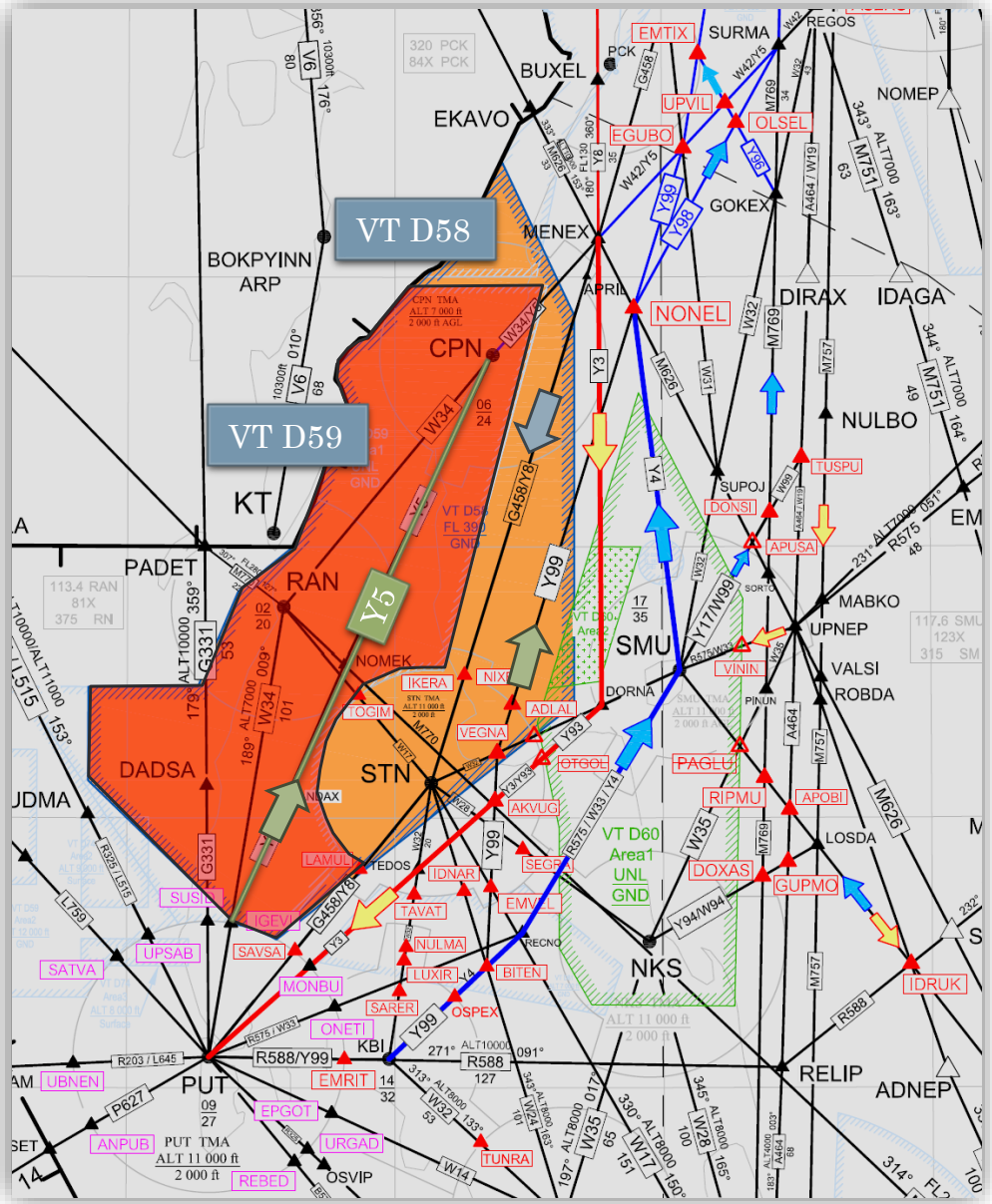
CDR2
Other Periods, Availability shall be notified by Airspace use plan (AUP) published in www.thaicmac.aerothai.aero



Y6 was stared from being CDR before changing to be a normal route with reshaping D area

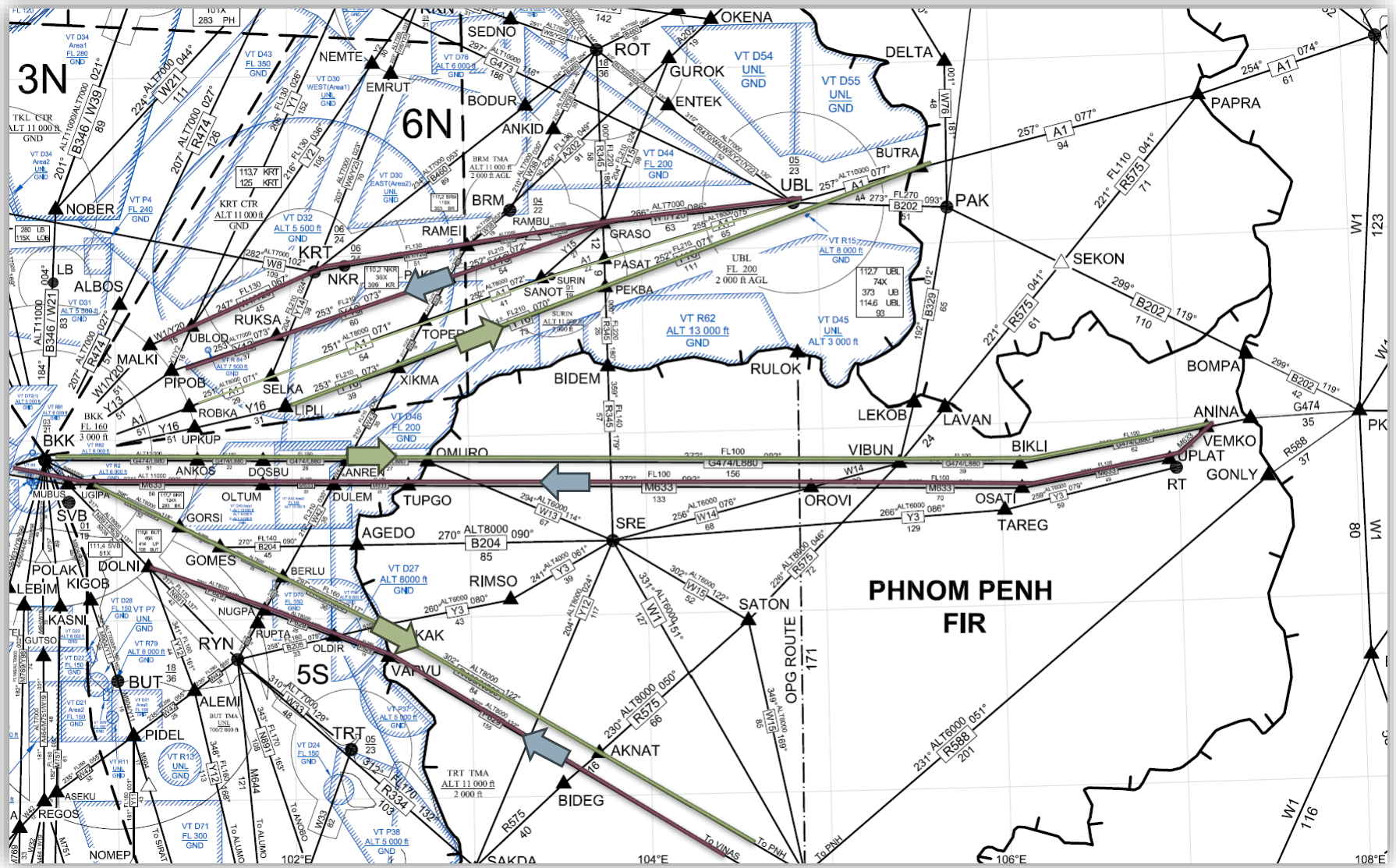
- Y3, Y4 and VT D58 established in 2012 (Activated by NOTAM)
- Y5 vs VT D59 (Y5's availability declared by NOTAM)





Establishment of International RNAV Routes

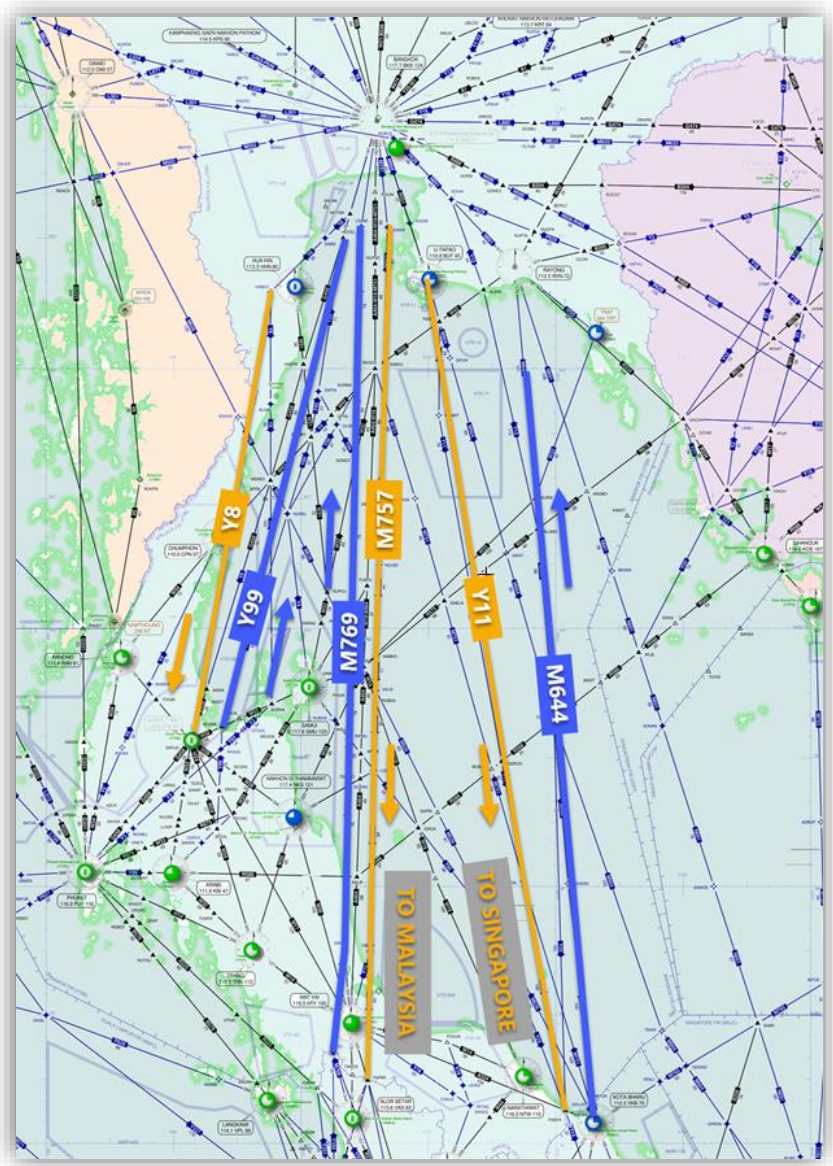
- 2020 Thailand and Cambodia implemented 4 International RNAV2 parallel routes L880, M633, N506, P629
- Using 8 NM route spacing
- FL assigned according to direction



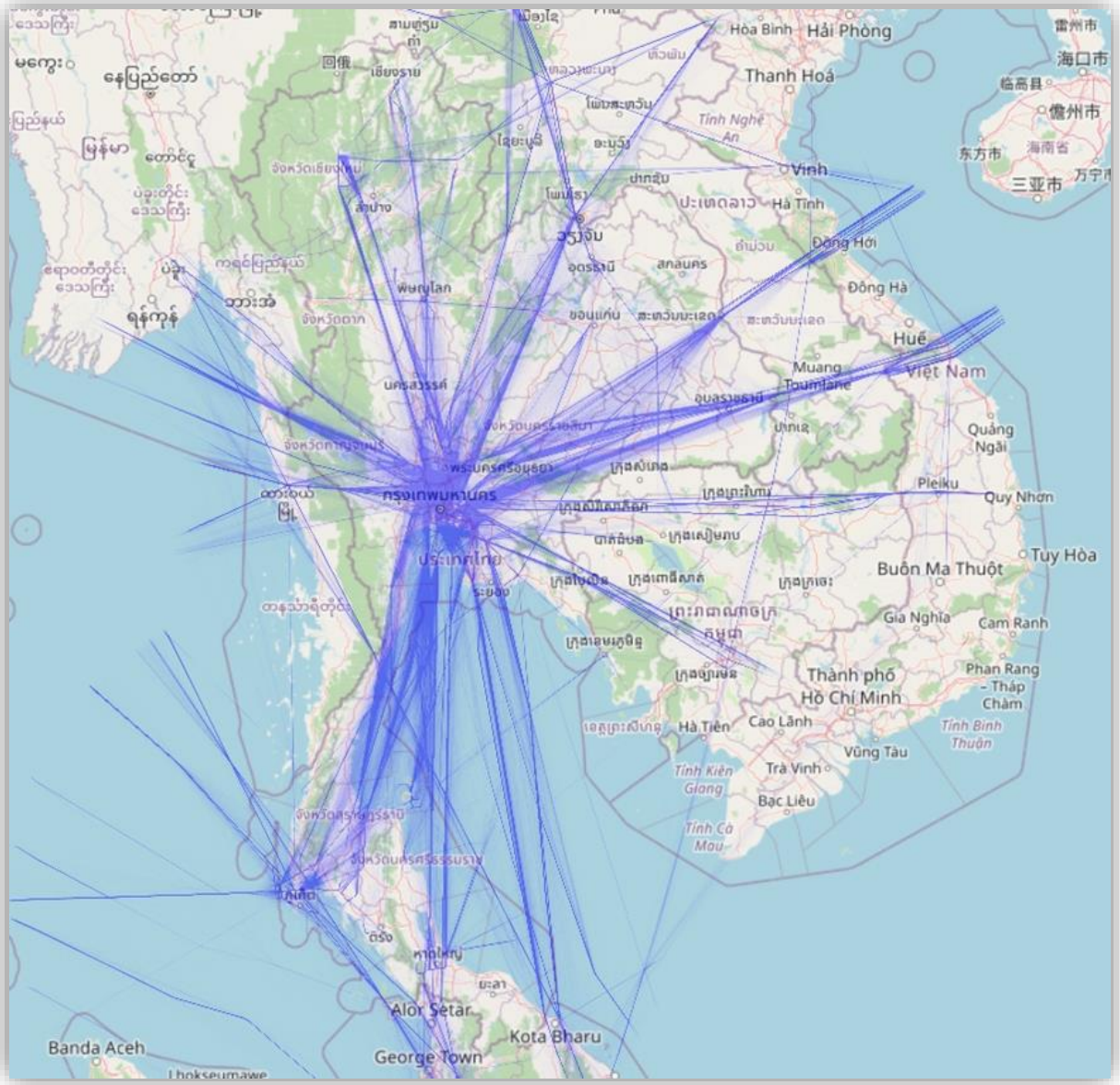
PBN NavSpecs and Route Spacing (PBN Manual Doc 9613 Volume II, Attachment

Nav Specs	Flight Phase (PANS-OPS Table III-1-1-1, PBN Manual Table II-A-1-1)								Supporting Nav. Infrastructure	Route Spacing (NM)
	En-route Remote	En-route Continental	Arrival	Approach				Departure		
				Initial	Intermediate	Final	Missed[1)]			
RNAV 10	10								Not require ground-based Naviad Dual LRNS (INS, IRS FMS, GNSS)	50 (PANS-ATM Para 5.4.1.2.1.6, Doc 9613 Vol II, Part B Para 1.2.3.3)
RNAV 5		5	5[3)]						VOR/DME DME/DME INS or IRS GNSS	16.5 - straight unidirectional racks (same direction route-ECAC) 18 - straight bidirectional tracks (opposite direction route- ECAC) 10 - ATC intervention capability (ECAC) 30 - No ATS Surveillance in high traffic density (ECAC) (Doc 9613, II-B Para 2.2.3.2, 2.2.3.3, Attachment B, Para 4.3, 4.3.1)
RNAV 2		2	2					2	GNSS DME/DME DME/DME/IRU	8 to 9 - straight tracks in high traffic density (en-route) (FAA) (Doc 9613, Vol II Attachment B, Para 4.4)
RNAV 1		1	1	1	1		1	1	GNSS DME/DME DME/DMe/IRU	8 - straight tracks in high density (terminal, Eurocontrol) (Doc 9613, Vol II Attachment B, Para 5.1) 7 for SIDs/STARs (PANS-ATM Para 5.4.1.2.1.4)

Uni-directional traffic flow in the southern airspace



Current traffic pattern in Bangkok FIR



PBN Airspace Establishment

Phase 1: non-RNAV2 using FL250 and below on Conventional ATS routes

Phase 2: Define non-exclusive PBN airspace: above FL250 (Q4 2024)

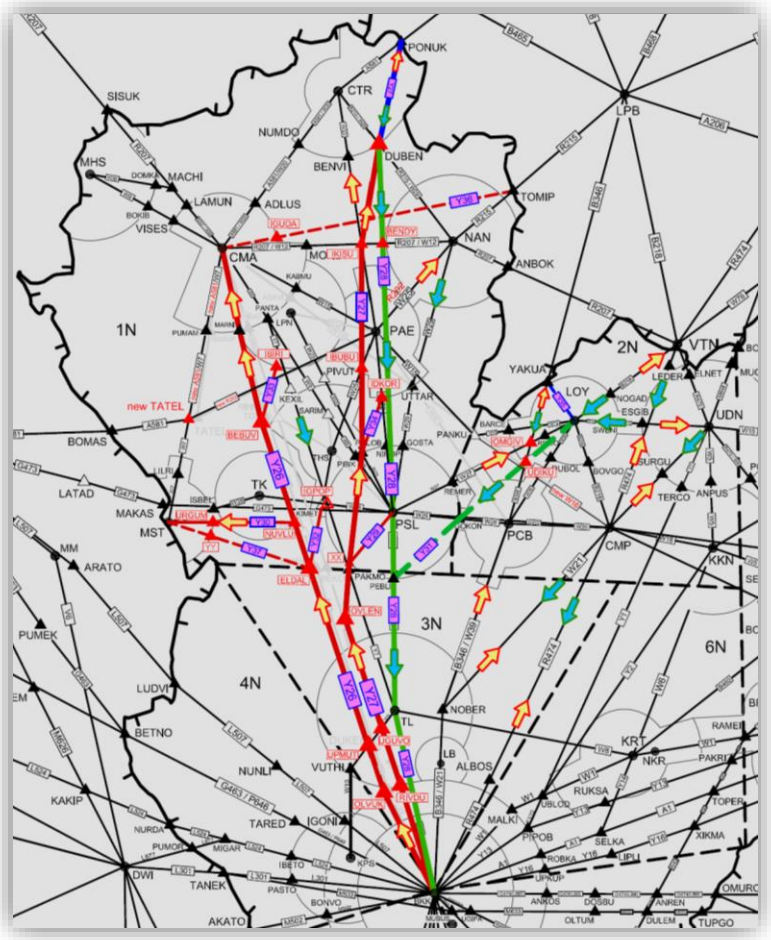
- IN and IS (Dec 2019)

From	To	Route	Maintain FL																	Grand Total	Note (A/C Fleet)
			60	130	200	210	220	230	240	260	280	300	320	340	350	360	370	380	390	N/A	
VTUD	VTBD	UDN W5 KKN W6 KRT W1 UBLOD										1									1 B739
VTUI	VTBD	SKN W6 KRT W1 UBLOD	1				1		26		1	8	59	13		1				1	111 A320, B738, DH8D
VTUK	VTBD	KKN W6 KRT W1 UBLOD			6		43		52	37	60	1									199 A20N, A320, B738, B739, DH8D
	VTBS	KKN W6 KRT W1 UBLOD							4	43	32	2	1							1	83 A320
	VTBU	KKN W6 KRT W1 BKK R201 BUT									1	5	8								14 A20N, A320
		KKN Y2 UBLOD W1 BKK R201 BUT									1		2								3
	VTSP	KKN W6 KRT W1 BKK Y8 SAVSA												1		2		10			13 A320
		KKN Y2 UBLOD W1 BKK Y8 SAVSA														2		3			5
	VTSS	KKN W6 KRT W1 BKK M757 OBLEX Y10 HTY													2	1	7		4		14 A320, B738
		KKN Y2 UBLOD W1 BKK M757 OBLEX Y10 HTY															1		2		3
VTUO	VTBD	BRM W38 RAMEI W1 UBLOD			31		85	1	47	6										3	173 A20N, A320, B738, C750, DH8D
VTUU	VTBD	UBL W1 UBLOD		1					9	2	43	185	157	3		1				1	402 A320, B738, B739
	VTBS	UBL W1 GRASO Y13 RUKSA								2	22	42	24	3							93 A320
VTUV	VTBD	ROT W38 RAMEI W1 UBLOD				1			1	7	78	18		1							106 A320
VTUW	VTBD	NKP W6 KRT W1 UBLOD											6	18		30		4		1	59 A20N, A320
Grand Total			1	1	37	1	129	1	139	97	238	262	257	39	2	37	8	17	6	7	1279

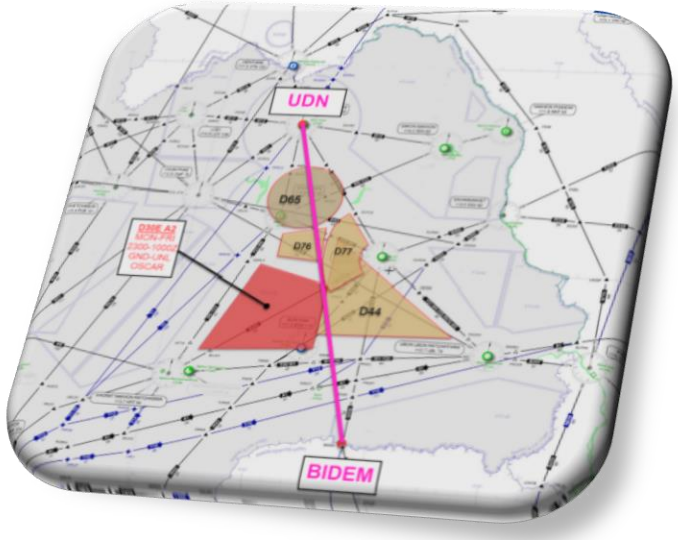
From	To	Route	Maintain FL																	Grand Total	Note (A/C Fleet)
			60	130	200	210	220	230	240	260	280	300	320	340	350	360	370	380	390	N/A	
VTUD	VTBD	UDN W5 KKN W6 KRT W1 UBLOD										0.08%									0.08% B739
VTUI	VTBD	SKN W6 KRT W1 UBLOD	0.08%				0.08%		2.03%		0.08%	0.63%	4.61%	1.02%		0.08%				0.08%	8.68% A320, B738, DH8D
VTUK	VTBD	KKN W6 KRT W1 UBLOD			0.47%		3.36%		4.07%	2.89%	4.69%	0.08%									15.56% A20N, A320, B738, B739, DH8D
	VTBS	KKN W6 KRT W1 UBLOD							0.31%	3.36%	2.50%	0.16%	0.08%							0.08%	6.49% A320
	VTBU	KKN W6 KRT W1 BKK R201 BUT									0.08%	0.39%	0.63%								1.09% A20N, A320
		KKN Y2 UBLOD W1 BKK R201 BUT									0.08%		0.16%								0.23%
	VTSP	KKN W6 KRT W1 BKK Y8 SAVSA												0.08%		0.16%		0.78%			1.02% A320
		KKN Y2 UBLOD W1 BKK Y8 SAVSA														0.16%		0.23%			0.39%
	VTSS	KKN W6 KRT W1 BKK M757 OBLEX Y10 HTY													0.16%	0.08%	0.55%		0.31%		1.09% A320, B738
		KKN Y2 UBLOD W1 BKK M757 OBLEX Y10 HTY															0.08%		0.16%		0.23%
VTUO	VTBD	BRM W38 RAMEI W1 UBLOD			2.42%		6.65%	0.08%	3.67%	0.47%										0.23%	13.53% A20N, A320, B738, C750, DH8D
VTUU	VTBD	UBL W1 UBLOD		0.08%					0.70%	0.16%	3.36%	14.46%	12.28%	0.23%		0.08%				0.08%	31.43% A320, B738, B739
	VTBS	UBL W1 GRASO Y13 RUKSA								0.16%	1.72%	3.28%	1.88%	0.23%							7.27% A320
VTUV	VTBD	ROT W38 RAMEI W1 UBLOD				0.08%			0.08%	0.55%	6.10%	1.41%		0.08%							8.29% A320
VTUW	VTBD	NKP W6 KRT W1 UBLOD											0.47%	1.41%		2.35%		0.31%		0.08%	4.61% A20N, A320
Grand Total			0.08%	0.08%	2.89%	0.08%	10.09%	0.08%	10.87%	7.58%	18.61%	20.48%	20.09%	3.05%	0.16%	2.89%	0.63%	1.33%	0.47%	0.55%	100.00%

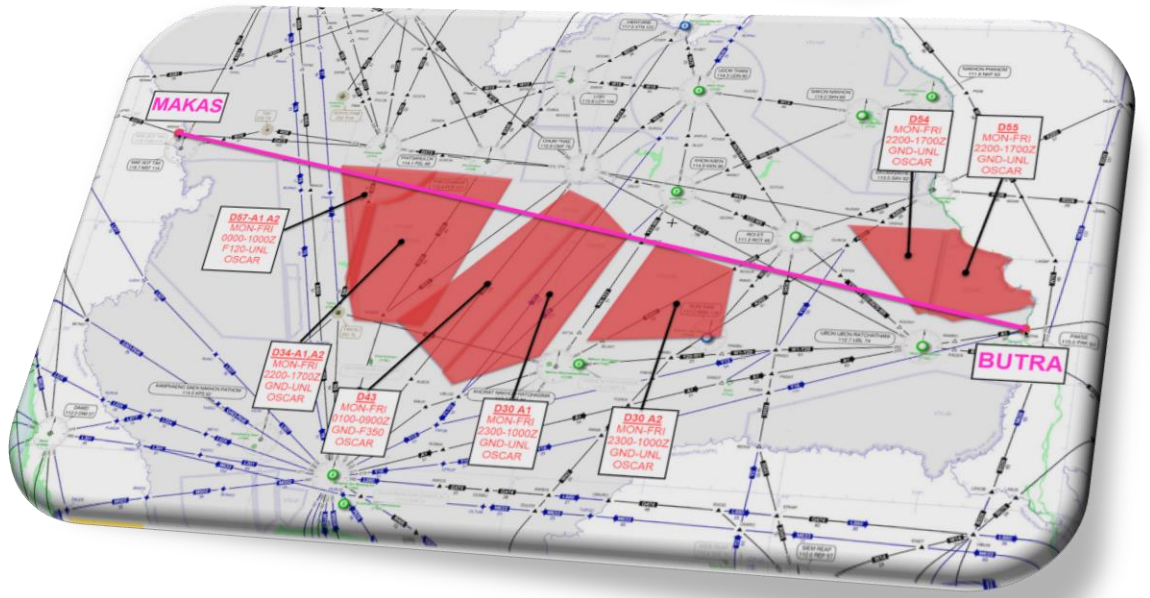
Future Plan

- New Uni-directional route structure in the Northern airspace



- Direct Routing (DCT)



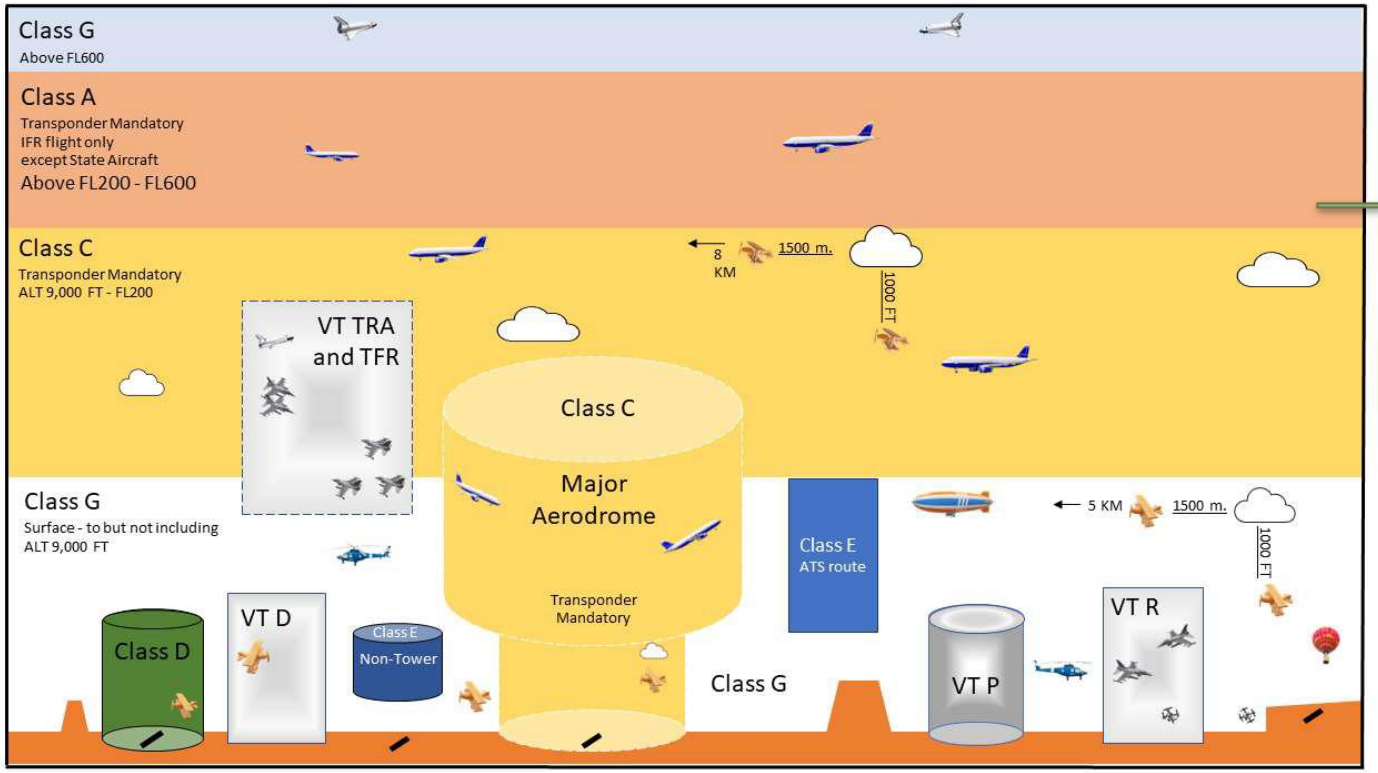


Future Plan

1.2 Airspace classification is defined all ATS routes within Bangkok FIR are as follows:

- **Class A from FL285 and above.**
- **Class B from Below FL285.**

New Airspace Classifications



Non-exclusive PBN airspace Above FL250

Lesson Learned

- Military cooperation has essential part in ATS routes development
- Stakeholders/Human in the loop ex: ATC, CNS, Military, Airlines, Regulator
- Cooperation between states involves (ANSP and Regulator)
- Balancing between benefits and deficiencies for all concerned units
- Post Operational review

Operational experience and benefits

- Parallel routes/Uni-directional/CDR
- Optimize airspace utilization
- Maximize airspace management capability & Flexibility
- Non-exclusive PBN airspace
- Optimize flight operation & efficiency
- Enhance traffic flow/ ATM efficiency
- ATC workload reduction/ATS efficiency
- Safety, Efficiency, Capacity, Environment


Thank You....