ANALYSIS OF AIRSPACE STRUCTURE AND AIR NAVIGATION SERVICES AUTHORIZATION AT RAHADI OSMAN AIRPORT-KETAPANG

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Abstract

Air Traffic Controller at Rahadi Osman Airport Ketapang faces dilemma dealing with the obligations of Article 272, Law No. 1 of 2009 on Civil Aviation concerning the provision of navigation services and 429 concerning the sanctions to officials who do not have a navigation service certificate as if the conflicting views of airspace condition and navigation service authority there. This study aims to analyze the structure of controlled airspace and air navigation service authority with parameters : separation, cruising altitude distribution, efficiency and effectiveness of air navigation services. The results are the structure of Aerodrome Traffic Zone airspace and aerodrome control tower services are not able to accommodate the development of air traffic which impact to the violation of Article 429. Restructuring the airspace into the Control Zone with the authority of navigation services as an Approach Control to accommodate the operational needs and the law's legality is the solution.

***Key words** : airspace, navigation services authority, separation*

Abstrak

Air Traffic Controller di bandara Rahadi Osman Ketapang menghadapi dilema dalam menyikapi pasal 272 undang-undang nomor 1 tahun 2009 tentang penerbangan mengenai kewajiban pemberian pelayanan navigasi dan pasal 429 mengenai sanksi pidana kepada petugas yang tidak mempunyai serifikat pelayanan navigasi yang seolah-olah saling bertentangan dilihat dari kondisi ruang udara dan wewenang pelayanan navigasi disana. Penelitian ini bertujuan untuk menganalisa struktur *controlloed airspace* dan wewenang pelayanan navigasi penerbangan dengan parameter : *separation*, distribusi ketinggian jelajah, efisiensi dan efektifitas pelayanan navigasi penerbangan. Hasilnya adalah struktur ruang udara *Aerodrome Traffic Zone* dan pelayanan *aerodrome control tower* tidak mampu mengakomodir perkembangan lalu lintas penerbangan yang berdampak pada pelanggaran pasal 429. Restrukturisasi ruang udara menjadi *Control Zone* dengan wewenang pelayanan navigasi *Approach Control* untuk mengakomodir kebutuhan operasional dan legalitas hukum adalah solusinya.

***Kata kunci** : ruang udara, wewenang pelayanan navigasi, separation*

INTRODUCTION

Air Traffic Control unit at Rahadi Osman Airport be authorized as an Aerodrome Control Tower to serve air navigation. This unit responsible to organize the controlled airspace where the horizontal dimensions in circle form with a radius of 20 Nautical Mile (Nm) from the coordinates of KTG VHF Omnidirectional Radio Range (VOR) and vertically from the earth's surface up to an altitude of 6.000 feet. Communication and conflict traffic resolution occurs outside the region described before. Rahadi Osman Aerodrome Control Tower seeks to act in accordance with Article 272 paragraph 2 of Law No. 1 of 2009 on Civil Aviation, air navigation services obligation start from the first contact until the last

contact between pilot and ATC or facility of air navigation. However, in terms of authority, an air navigation provider at Rahadi Osman Airport-Ketapang limited to Aerodrome Control Service only so it does not have a certificate and authority to provide Approach Control Service. Sanctions will be imposed on the officers as contained in article 429 of Law No. 1 of 2009 on Civil Aviation, any person organizes air navigation services which do not have a certificate of air navigation services as referred to in Article 275 paragraphs (1) shall be punished with imprisonment 5 (five) years and a maximum amercement of Rp 1.000.000.000,00 (one billion rupiahs). It becomes a dilemma for Air Traffic Controllers (ATC) at Rahadi Osman Airport-Ketapang.

The Objectives of this research are to evaluate the controlled airspace structure of Ketapang Air Traffic Zone (ATZ) in suitability terms between the operational needs and the legality of the law contained in the related articles in Law No. 1 of 2009 on Civil Aviation, to evaluate the authority of air navigation services by air traffic control unit of Rahadi Osman Aerodrome Control Tower in suitability terms between the operational needs and the legality of the law contained in the related articles in Law No. 1 of 2009 on Civil Aviation, to plan the alternative design concerning controlled airspace and air navigation services authority that is able to accommodate operational needs.

This study is limited to analyze problems between the imposition of criminal element in Article 429 of Law No. 1 of 2009 on Civil Aviation the cost of ownership associated with compliance certificate of air navigation services listed in Article 275 of Law No. 1 of 2009 air navigation services obligation in Article 272 paragraph (2) of Law No. 1 of 2009 about civil aviation seen from the air space infrastructure and services provision of air navigation authority in Ketapang Airport Rahadi Osman today.

THEORITICAL FRAMEWORK

DIMENSION AND CLASSIFICATION OF AIR TRAFFIC ZONE (ATZ) AIRSPACE

Indonesian Dictionary (2013) defines the dimension is a measure of spatial extent, especially width, height or length. Thus, the airspace dimension is the airspace that has length, width, height and a certain area. Tube shaped of Ketapang Air Traffic Zone (ATZ) airspace which is managed by Rahadi Osman Aerodrome Control Tower, have a horizontal dimension of a circle with a radius of 20 Nm focused on the center of the VOR navigational aids. Meanwhile, the vertical dimension starting from the surface of the earth up to a height of 6.000 feet. The definition of classification is a systematic arrangement in group or class according to the rules or standardization (Indonesian Dictionary, 2013). Based on documents of Aeronautical Information Publication (AIP), amendment 4, 1 September 2009, Ketapang ATZ Airspace classified in class B with the principal task for VFR flight services only.

FLIGHT SERVICE SECTOR (FSS) AUTHORITY

Region of Flight Service Sector (FSS) is uncontrolled airspace. There is no air traffic control services provided so it limited for air traffic advisory services. Document Advisory Circular 170-2, Manual of Air Traffic Services Operational Procedures (2009), ratified Doc 4444 ATM/501 Procedures for Air Navigation Services Air Traffic Management (2007) on the third point explains that air traffic advisory service does not afford the degree of safety and cannot assume the same responsibilities as air traffic control service in

respect of the avoidance of collisions, since information regarding the disposition of traffic in the area concerned available to the unit providing air traffic advisory service may be incomplete.

PRINCIPLES FOR THE DESIGN OF AIRSPACE STRUCTURE

Eurocontrol (2012) provide an explanation of the principles that need to be considered when designing the airspace structure prevailing in Europe. These principles include:

1. Safety shall be enhanced or at least maintained by the design of any airspace structure.
2. Operational Performance, airspace design shall be based on network-wide operational performance indicators and targets.
3. Airspace Continuum, airspace structure shall be designed as a continuum.
4. Airspace Configuration, airspace structure shall be based on airspace configurations.

STRUCTURE OF TERMINAL AIRSPACE

Based on Eurocontrol (2012), where the terminal airspace is surrounded by uncontrolled airspace, the protected airspace of designated terminal routes and holding areas are to be contained within the terminal airspace in both the lateral and vertical plane. To the extent possible and when necessitated by operational requirements, the upper limit of terminal airspace should coincide with the lower limit of superimposed controlled airspace in order to provide continuous protection to IFR flight paths (Eurocontrol, 2013). Responsibility for the control of all aircraft operating within a given block of airspace shall be vested in a single air traffic control unit. However, control of an aircraft or groups of aircraft may be delegated to other air traffic control units provided that coordination between all air traffic control units concerned is assured (ICAO, 2007).

APPROACH CONTROL OFFICE (APP)

1. Responsible Unit Providing APP Approach Control Service
   An APP office is normally responsible for the separation of aircraft operating in accordance with the instrument flight rules (IFR) within a defined airspace around an aerodrome. Approach Control Service shall be provided (Annex 11 Air Traffic Services, 2007) by an aerodrome control tower or an ACC or an approach control unit, when it is necessary or desirable to establish a separate unit.
2. Separation Using Procedural Method
    1. Aircraft on reciprocal tracks. Vertical separation shall be provided for at least ten minutes prior to and after the time the aircraft are estimated to pass, or are estimated to have passed
    2. Lateral Separation Criteria and Minima
        1. By use of the same navigation aid or method. By requiring aircraft to fly on specified tracks which are separated by a minimum amount appropriate to the navigation aid or method employed (ICAO, 2007)
        2. When aircraft are operating on tracks which are separated by considerably more than the foregoing minimum figures, States may reduce the distance at which lateral separation is achieved.

A METHOD OF ESTABLISHING ATS ROUTES DEFINED BY VOR

1. Protected airspace around the centre line of the route to allow for possible deviations (Annex 11, 2007):
    1. VOR routes with 93 km (50 NM) or less between VORs are ±7.4 km (4 NM);

2. VOR routes with up to 278 km (150 NM) between VORs are ±7.4 km (4 NM) up to 46 km (25 NM) from the VOR then expanding protected airspace up to ±11.1 km (6 NM) at 139 km (75 NM) from the VOR.

2. If two segments of a VOR-defined ATS route intersect at an angle of more than 25 degrees, additional protected airspace should be provided on the outside of the turn and also on the inside of the turn as necessary

RESEARCH METHOD

LOCATION

This research was conducted at the air navigation services unit known as Rahadi Osman Aerodrome Control Tower (TWR). This unit has authorized to managed the airspace of class B, that is shaped tube with horizontal dimensions of a full circle with a radius of 20 Nm, which is focused on the center of the VOR navigational aids. Meanwhile, the vertical dimension starting from the surface of the earth up to a height of 6.000 feet.

STAGE OF RESEARCH

1. Problems identification
2. Objectives
3. Literatures review
4. Data collection
    1. Primary data, consist of the initial phase of flight begins when the aircraft started to take off until it reaches cruising altitude, the middle phase of flight begins when the aircraft reaches cruising altitude until it leave the cruising altitude ,the final phase of flight begins when the aircraft leaving cruising altitude until to a landing, and aircraft maneuvers in Ketapang Aerodrome Traffic Zone Airspace.
    2. Secondary data that consist of : air traffic flow, enroute chart, two way communication between ATC-Pilot.
1. Data Analysis
   This research uses Airspace Organization for Procedural Control with parameters that include: separation, cruising altitude distribution, efficiency and effectiveness of air navigation services.
2. Conclusion

DATA ANALYSIS AND DISCUSSION

DATA ANALYSIS

Table 1 Distance and Direction of Flights

No	Route (Location)	(ICAO Location Indicator)	Distance (Nm)	Azimuth
1	Ketapang – Pontianak	WIOK – WIOO	110,30	341
2	Ketapang – Sintang	WIOK – WIOS	144,35	039
3	Ketapang – Nanga Pinoh	WIOK – WIOG	138,47	051
4	Ketapang – Pangkalan Bun	WIOK – WAOI	115,54	118
5	Ketapang – Semarang	WIOK – WARS	362,70	179
6	Ketapang – Jakarta	WIOK – WIII	350,00	217

Table 2 Handover Flow of Air Navigation Services Responsibilities

No	(Loc.Indicator)	Air Traffic Services Units Sequence
1	WIOK–WIOO	WIOK TWR–WIOO FSS–WIOO APP–WIOO TWR
2	WIOK–WIOS	WIOK TWR–WIOO FSS–WIOS AFIS
3	WIOK–WIOG	WIOK TWR–WIOO FSS–WIOG AFIS
4	WIOK–WAOI	WIOK TWR–WIOO FSS–WAOI APP/TWR
5	WIOK–WARS	WIOK TWR–WIOO FSS–WIOO APP–WIII FSS–WARS APP–WARS TWR
6	WIOK–WIII	WIOK TWR–WIOO FSS–WIOO APP–WIII ACC–WIII APP–WIII TWR

Table 3 Percentage of Instrument Flight Rule

No	Route (Location)	Persentase Jumlah Penerbangan IFR
1	Ketapang – Pontianak	98,8%
2	Ketapang – Sintang	0%
3	Ketapang – Nanga Pinoh	0%
4	Ketapang – Pangkalan Bun	98,9%
5	Ketapang – Semarang	100%
6	Ketapang – Jakarta	100%

Table 4 Percentage of Air Traffic Distribution From January 2013 to October 2013

No	Route (Location)	Percentage of Air Traffic Distribution	Type of Flight	
			IFR	VFR
1	Ketapang – Pontianak	53%	2.633	31
2	Ketapang – Sintang	4%	0	206
3	Ketapang – Nanga Pinoh	3%	0	151
4	Ketapang – Pangkalan Bun	24%	1.189	13
5	Ketapang – Semarang	7%	381	0
6	Ketapang – Jakarta	9%	467	0
	Total	100%	4.670	401

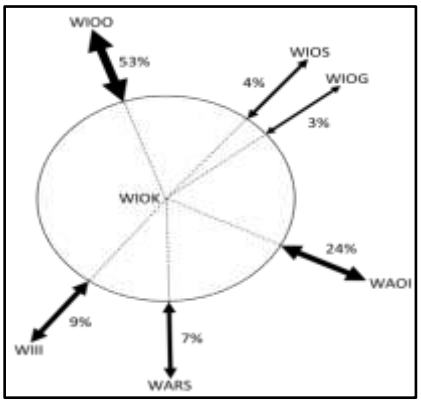

Figure 1 Air traffic distribution from and to Rahadi Osman Airport

Table 5 Cruising Altitude Distribution

No	Cruising Altitude (x 100 feet)	Flight Route (aircraft movement and it percentage in each route)							
		WIOK – WIOO	WIOO – WIOK	WIOK – WAOI	WAOI – WIOK	WIOK – WIII	WIII – WIOK	WIOK – WARS	WARS – WIOK
1	065	2 (0,15%)	-	-	-	-	-	-	-
2	075	-	46 (3,55%)	20 (3,35%)	-	-	-	-	-
3	085	431 (32,31%)	-	-	83 (14,02%)	-	-	-	-
4	095	-	969 (74,71%)	409 (75,84%)	-	-	-	-	-
5	105	852 (63,87%)	-	-	449 (75,84%)	-	-	-	5 (2,66%)
6	115	-	275 (21,20%)	160 (26,63%)	-	-	-	1 (0,52%)	-
7	125	44 (3,30%)	-	-	55 (9,29%)	-	-	-	-
8	135	-	6 (0,46%)	7 (1,17%)	-	-	-	-	-
9	145	2 (0,15%)	-	-	5 (0,84%)	-	-	-	18 (9,57%)
10	155	-	-	1 (0,17%)	-	-	-	87 (45,08%)	-
11	165	3 (0,22%)	-	-	-	-	-	-	149 (72,26%)
12	175	-	1 (0,08%)	-	-	-	-	104 (53,89%)	-
13	180	-	-	-	-	1 (0,43%)	-	-	-
14	185	-	-	-	-	-	-	-	16 (8,51%)
15	195	-	-	1 (0,17%)	-	-	-	1 (0,52%)	-
16	210	-	-	-	-	-	1 (0,43%)	-	-
17	240	-	-	-	-	232 (99,57%)	-	-	-
18	250	-	-	-	-	-	232 (99,15%)	-	-
19	270	-	-	-	-	-	1 (0,43%)	-	-

ANALYSIS OF AIRSPACE STRUCTURE

Parameter of Cruising Altitude Distribution of IFR Flight

The distribution of cruising altitude used by IFR flight showed that more than 95% of cruising altitude for WIOK – WIOO and WIOK – WAOI routes are within the uncontrolled airspace for each of these routes. Meanwhile, IFR flight for WIOK – WIII and WIOK – WARS routes, the descend process from cruising altitude to approach or climb towards to cruising altitude always pass through the uncontrolled airspace.

Annex 11 Air Traffic Services (2007) explains that the airspace is determined to provide air traffic control services to IFR flight should be in the form of the Control Area or the Control Zone. In this case, the airspace containing the arrival and departure flight paths of IFR should be appropriate as the Control Zone form.

Parameter of Air Navigation Services Efficiency

1. Route of WIOK – WIII flown by aircraft type BAE 146 with a rate of descend 1.250 feet/minute, meaning that from 12.000 feet to 6.000 feet only within 4,8 minutes so it was not efficient handled by the ATS unit separately.
2. Route of WIOK - WARS flown by aircraft type ATR 72-500 with a rate of descend 900 feet/minute, meaning that from 12.000 feet to 6.000 feet only within 6,67 minutes so it was not efficient handled by the ATS unit separately.
3. Route of WIOO – WIOK pass through Pontianak CTR and Pontianak FSS airspace, it shows a lack of uniformity services in these route. Moreover, traffic conflict resolution that approaching Ketapang Air Traffic Zone (ATZ) airspace was forced to be solved by Rahadi Osman Aerodrome Control Tower (TWR).
4. Route of WIOK – WAOI. Comparisons were made with regard to the IFR flight of cruising altitude phase and approach phase in Iskandar Airport-Pangkalan Bun. The whole flight process is protected in controlled airspace consists of Pangkalan Bun TMA and CTR. Responsibility of Approach Control Services and Aerodrome Control Services are handled integrated by a single ATS unit namely Iskandar Aerodrome Control Tower (TWR). But the opposite condition occurs for IFR flight to the Rahadi Osman Airport-Ketapang. The services are not provided uniformly and handled by two different ATS units so that the traffic conflict resolution becomes inefficient.

ANALYSIS OF AIR NAVIGATION SERVICES AUTHORITY

Parameter of Separation

Route of Ketapang - Pontianak by the percentage 53% of traffic movement, conflict traffic often occur in reciprocal direction so that the in-depth discussion is necessary in order to resolve these problems. The case was taken on October 24, 2013.

Table 6 Distance and time calculations

No	Time Segment		Travel Time	Travel Distance	Position from VOR
1	KLS 933 (*Arrival*)				
	a	0:00:20 – 0:02:00	1,67 minute	3 x 1,67 = 5 Nm	35 – 5 = 30 Nm
	b	0:02:00 – 0:07:00	5 minute	3 x 5 = 15 Nm	30 – 15 = 15 Nm
	c	0:07:00 – 0:09:30	2,5 minute	3 x 2,5 = 7,5 Nm	15 – 7,5 = 7,5 Nm
	d	0:09:30 – 0:12:00	2,5 minute	3 x 2,5 = 7,5 Nm	7,5 – 7,5 = 0 Nm (*landed*)
2	KLS 941 (*Departure*)				
	0:02:00 – 0:07:00		5 minute	3 x 5 = 15 Nm	15 Nm

No	Time Segment	Travel Time	Travel Distance	Position from VOR
3	TGN 120 (*Departure*)			
	0:07:00 – 0:09:30	2,5 minute	3 x 2,5 = 7,5 Nm	7,5 Nm

Note: Simplification : Conflict involving all three of these aircraft have the same type, so that is considered the same speed

Speed : 180 knots = 3 Nm/minute

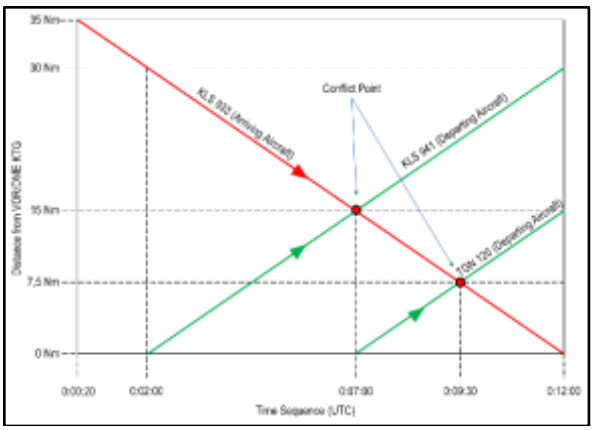

Figure 2 Traffic Conflict Graphic

First, the reciprocal track conflict between KLS 933 and KLS 941. Assuming the same speed, it is known that the estimation of the two aircraft passed each other at 0:07 UTC. The use of the technique 10 minute separation between aircraft on reciprocal tracks can not be applied. This condition is not efficient because KLS 933 will land more than 12:12 UTC. KLS 941 is taking off from runway 35 at 00:02 UTC directed to radial 335^0 from VOR/DME KTG and climb to cruising altitude 10.500 feet. At the same time, KLS 933 is directed to radial 350^0 from VOR radial/DME KTG and started to descend from a distance of 35 Nm at altitude 9.500 feet. KLS 941 reaches a distance of 15 Nm from VOR/DME KTG at a speed of 180 Knots takes 5 minute as well as KLS 933. This means that both aircraft are at a distance of 15 Nm so no need to do a height restriction in descend or climb process of both aircraft.

Second, the reciprocal track conflict between KLS 933 and TGN 120. Ten minute separation techniques use between aircraft on reciprocal tracks and lateral separation can not be applied because both aircraft at a distance of less than 15 Nm from VOR/DME KTG when passing each other, precisely at a distance of 7,5 Nm. Document 4444 Air Traffic Management (2007) explains that when aircraft are operating on tracks which are separated by considerably more than the foregoing minimum figures, States may reduce the distance at which lateral separation is achieved. Lateral separation between two aircraft exists when both aircraft are established on radials diverging by at least 30^0 and at least one aircraft is at a distance of 8 Nm or more from the VOR/DME KTG as seen in Figure 3 below.

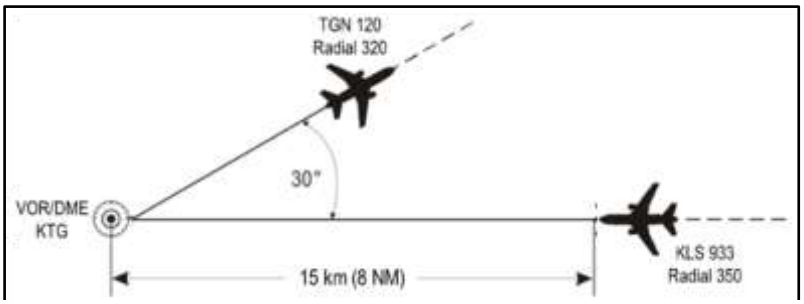

Figure 3 Lateral Separation using the same VOR (modification)

TGN 120 is taking off from runway 35 at 00:07 UTC directed to a radial 320^0 from the VOR/DME KTG and climb to cruising altitude. At the same time, KLS 933 is on radial 350^0 with a distance of 15 Nm from VOR/DME KTG. Both aircraft passed at a distance of 7,5 Nm so we need a temporary height restriction undertaken in the process of descend or climb both aircraft in order to maintain the vertical separation until TGN 120 passes a distance of 8 Nm from VOR/DME KTG. After that climb and descend process can be resumed. It should be noted that the conflict resolution techniques described above are Approach Control Services by units Approach Control Office. Meanwhile, the authority given to Rahadi Osman Aerodrome Control Tower only an Aerodrome Control Services.

Effectiveness of Air Navigation Services

Based on handover flow of air navigation services responsibilities in Table 2 above, Pontianak FSS Unit unserviceable and taken over by Pontianak APP Unit. However, due to the limited range air-to-ground communications equipment between the pilot and ATC unit owned by Pontianak APP causes handover flow is reduced according to conditions on the field so that the flow of handover sequence based on the configuration of the airspace structure becomes ineffective.

Table 7 Effectiveness of Air Navigation Services

No	Rute Destinasi	Direction	Effectiveness	Keterangan
1	Pangkalan Bun	East	Ineffective	Out of range of communication equipment
2	Jakarta	South	Ineffective	Out of range of communication equipment
3	Semarang	South	Ineffective	Out of range of communication equipment
4	Sintang	North	Ineffective	Out of range of communication equipment
5	Nangapinoh	North	Ineffective	Out of range of communication equipment
6	Pontianak	North West	Effective	In range of communication equipment

CONCLUSIONS

1. The structure of Ketapang ATZ airspace is not able to accommodate the operational needs due to traffic movement of the IFR flight protected no entirely in controlled airspace that is in the airspace used by aircraft for climb and descend. In terms of the legality of the law, Rahadi Osman Aerodrome Control Tower (TWR) Unit does not have the authorization to handle air traffic outside of Aerodrome Traffic Zone (ATZ) so it may be lead to criminal sanction as in Article 429 in Law No. 1 of 2009 on Civil Aviation.

2. Aerodrome Control Service authority by Rahadi Osman Aerodrome Control Tower (TWR) Unit is not able to accommodate the operational needs due to air traffic conflict of the IFR flight occurs in airspace that require Approach Control Services. In terms of the legality of the law, Rahadi Osman Aerodrome Control Tower (TWR) Unit does not have the authorization to provide Approach Control Services so it may be lead to criminal sanction as in Article 429 in Law No. 1 of 2009 on Civil Aviation.
3. Design of controlled airspace and flight route which are able to accommodate and protect traffic movement of IFR flight in Rahadi Osman Airport-Ketapang consists of:
    1. Establishing separate route of arrival and departure from Rahadi Osman Airport Ketapang to Supadio Airport Pontianak based on lateral separation using the same navigation aids VOR.
    2. Establishing of airspace structure Ketapang Control Zone (CTR) to protect the flight pattern that were previously not protected in controlled airspace. Ketapang Aerodrome Traffic Zone (ATZ) airspace and Ketapang Control Zone (CTR) airspace are integrated handled by Rahadi Osman Aerodrome Control Tower (TWR) with authority adjustments of aerodrome control services and approach control services.

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