



# Airspace Safety Monitoring (WP04)

Presented in the SAIOACG/10 and SEACG/27 based on RASMAG/25 Outcomes  
Agenda Item 3: Review of Current Operations and Problem Areas

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APAC Regional Sub-Office, 29 March – 02 April 2021





# Outline

- Introduction
- Discussion on Airspace Risk Assessment & Hot Spots
  - Vertical & Horizontal Risk Estimates (LHDs/LLDs/LLEs reports)
  - Long-Term Height Monitoring (LTHM) Compliance
  - Safety Reporting
- Conclusion



# RASMAG/25

- **Held from 27 to 30 October 2021 by VTC, ICAO Asia and Pacific Regional Office, Bangkok, Thailand**
    - 117 participants, 19 States/Administration, IATA, IFALPA and ICAO
    - 40 Working Papers (WPs), 5 Information Papers (IPs), 3 Flimsies
  - **Full Report is available at:**
    - <https://www.icao.int/APAC/Meetings/2020%20RASMAG25/Final%20Report%20RASMAG25.pdf>
- ❖ *Note: Airspace safety estimates in this report are measured in terms of fatal accidents per flight hour (fapth).*

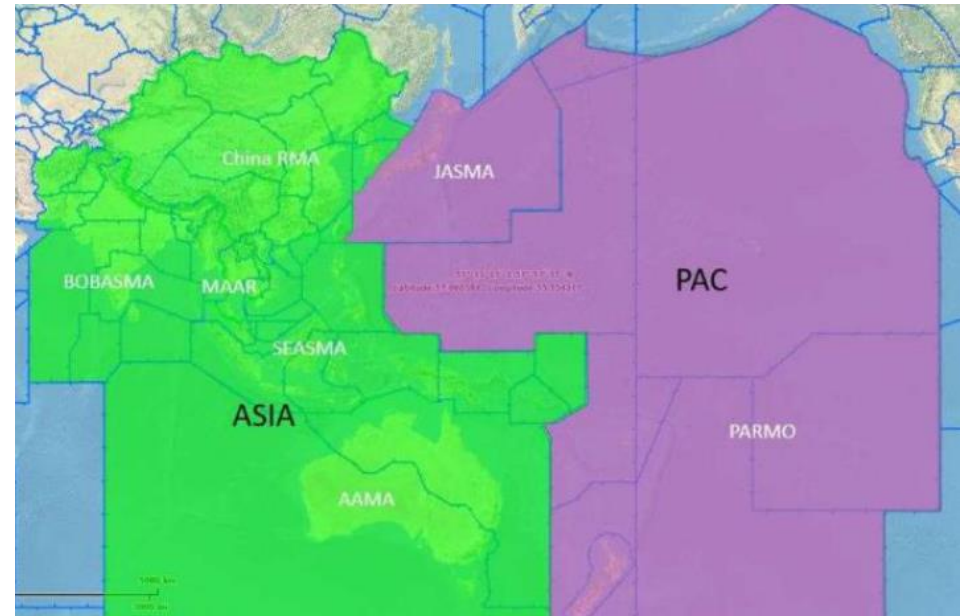


# Background

- **APAC Monitoring Agencies agreed to consolidate key elements from their safety risk analysis into one report to give an overall picture of airspace safety risk in MAWG/5.**
  - The report is divided into the sub-areas: Pacific, Asia
  - In the reports:
    - Vertical collision risk estimates
    - LHD summary and their hot spots
    - Horizontal collision risk estimates, LLD & LLE summary and their hot spots (if any)
    - Reporting rates in 3 groups: Pilot/aircrew related, ATC related, Aircraft Avionics/Contingencies, Weather/Turbulence, and TCAS related

# Background

- **Pacific RMAs and EMAs: JASMA, PARMO**
  - Traffic btw North America and Asia, or North America and South Pacific States
  - FIRs: Anchorage, Auckland, Fukuoka, Nadi, Oakland, and Tahiti)
- **Asia RMAs: AAMA, China RMA, MAAR, PARMO, JASMA**
- **Asia EMAs: AAMA, BOBASMA, PARMO, SEASMA, JASMA**
  - Traffic btw Asia and Middle East, Europe and South Pacific States
  - Bangkok, Beijing, Brisbane, Chennai, Colombo, Dhaka, Delhi, Guangzhou, Hanoi, Ho Chi Minh, Hong Kong, Honiara, Incheon, Jakarta, Karachi, Kathmandu, Kolkata, Kota Kinabalu, Kuala Lumpur, Kunming, Lahore, Lanzhou, Male, Manila, Melbourne, Mumbai, Nauru, Phnom Penh, Port Moresby, Pyongyang, Sanya, Shanghai, Shenyang, Singapore, Taipei, Ujung Pandang, Ulaanbaatar, Urumqi, Vientiane, Wuhan, and Yangon



# Asia: Vertical Airspace Risk Assessment (LHDs)

- Vertical Collision Risk Estimates: Target Level of Safety (TLS)  $5.0 \times 10^{-9}$  FAPFH**

2019 Asia Sub-Region	Vertical Risk Estimate	Remark
Vertical Technical Risk	$0.74 \times 10^{-9}$ FAPFH	Below Technical TLS
Vertical Operational Risk	$12.14 \times 10^{-9}$ FAPFH	
<b>Vertical Overall Risk</b>	<b><math>12.88 \times 10^{-9}</math> FAPFH</b>	<b>Above TLS</b>

<b>2018 Vertical Overall Risk</b>	<b><math>15.50 \times 10^{-9}</math> FAPFH</b>	<b>Above TLS</b>
<b>2017 Vertical Overall Risk</b>	<b><math>27.30 \times 10^{-9}</math> FAPFH</b>	<b>Above TLS</b>
<b>2016 Vertical Overall Risk</b>	<b><math>12.53 \times 10^{-9}</math> FAPFH</b>	<b>Above TLS</b>

**Number of annual flying hours: 12,324,4974 hours/year, 2019**



# Asia: Summary of LHDs in 2019

Attributions	Category Code	Description	Number of Occurrences	Duration (minute)	Number of Levels Crossed
Aircrew/ Pilot	A	Flight crew failing to climb/descend the aircraft as cleared	45	10.5	20
	B	Flight crew climbing/descending without ATC Clearance	34	5.73	28
	C	Incorrect operation or interpretation of airborne equipment	9	0	2
ATC	D	ATC system loop error	40	14.4	27.5
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	597	2,269.75	1
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	12	0	0
Aircraft/ Avionics/ Contingencies	G	Aircraft contingency event leading to sudden inability to maintain assigned flight level	2	0.5	1
	H	Airborne equipment failure leading to unintentional or undetected change of flight level	3	0	4



# Asia: Summary of LHDs in 2019 (continued)

Attributions	Category Code	Description	Number of Occurrences	Duration (minute)	Number of Levels Crossed
Weather/ Turbulence	I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	37	6	24
TCAS	J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	19	1	8
	K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory	0	0	0
Other	L	An aircraft being provided with RVSM separation is not RVSM approved	3	95	0
	M	Other	26	9.5	0.5
<b>Total</b>			<b>827</b>	<b>2,412.38</b>	<b>116</b>

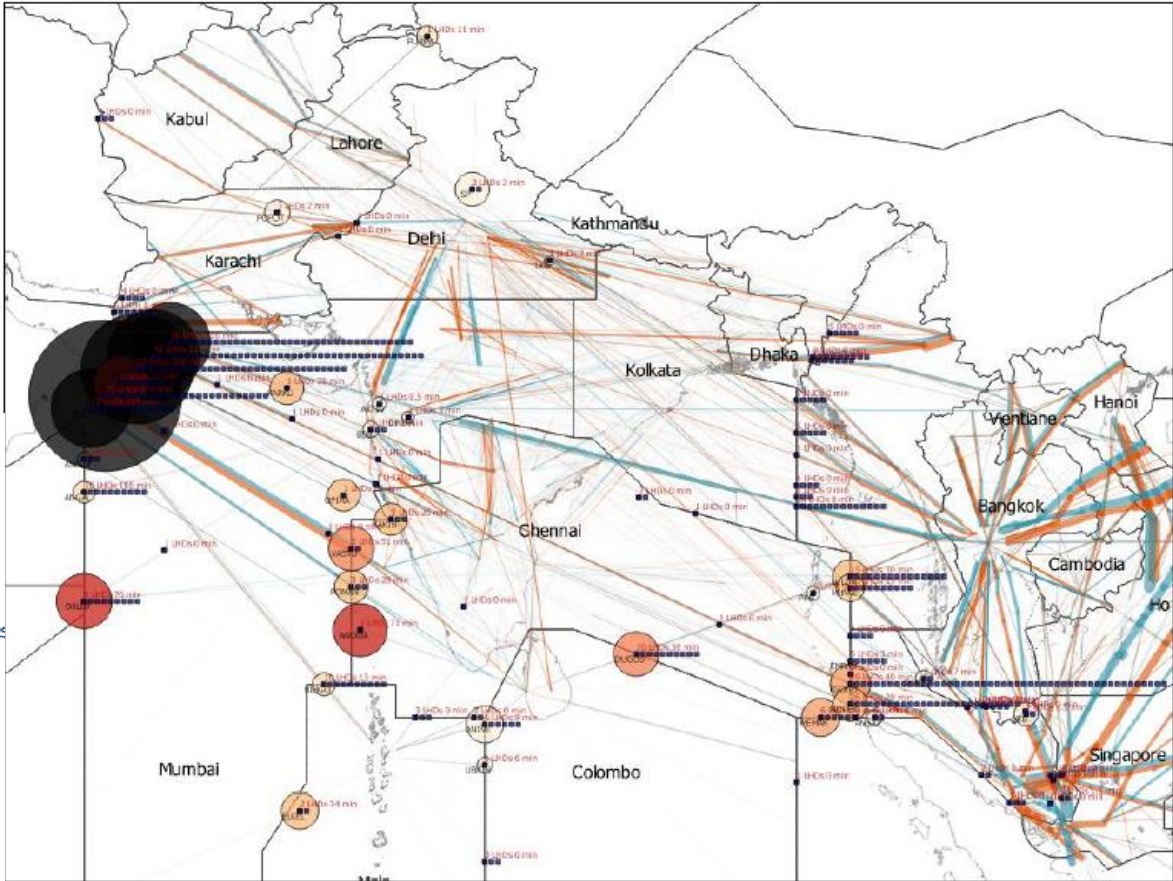
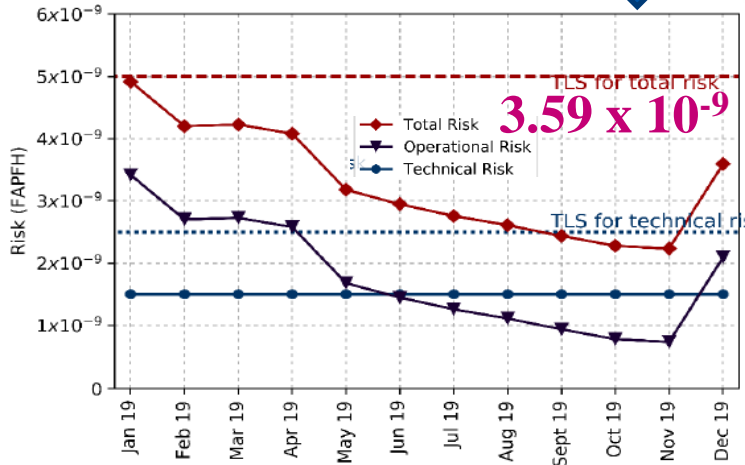


# Vertical Risk Assessment

## Asia: 2019 Geographical Locations of SAIO LHDs



## Vertical Risk Estimate for SEA airspace



# Asia: Summary of LHD Hot Spots

- **Hot Spots Deleted:**

- **Hot Spot C** (Hong Kong-Guangzhou), **E** (Lahore-Urumqi), **H** (Guangzhou-Wuhan), **I** (Karachi-Kabul), **K** (Jakarta-Ujung Pandang), **L** (Fukuoka-Khabarovsk), **M** (Colombo-Melbourne)

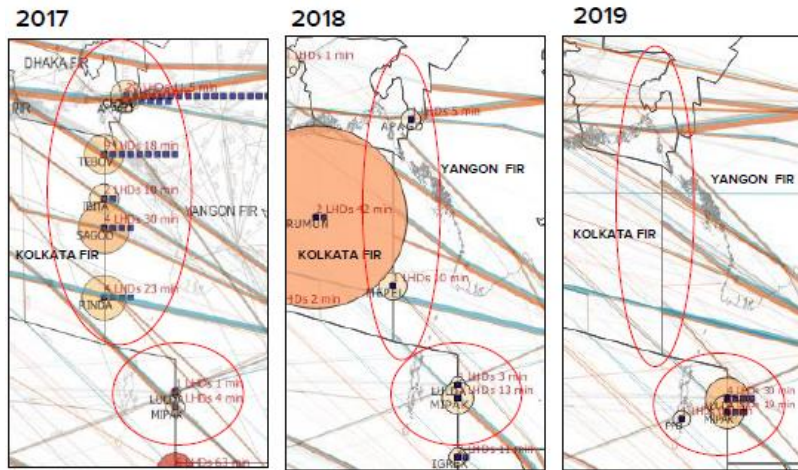
- **Remaining Hot Spots:**

ID	Involved FIRs	Identified	Remarks
A1	Kolkata/Chennai/Dhaka – Yangon	2015	Potential non-hot spot
A2	Chennai – Kuala Lumpur	2015	LHDs increased
B	Incheon	2015	AKARA Corridor
D	Manila – all adjacent FIRs	2015	LHDs reduction
F	Mogadishu – Mumbai	2015	LHDs reducing
G	Sana'a/Muscat – Mumbai	2015	Cat. E LHDs (Sana'a improved)
J	Jakarta – Singapore/Kota Kinabalu	2018	Minor, Cat. E LHDs
M	Colombo - Melbourne	2019	Potential non-hot spot
N	Oakland USA – Hawaii CEP	2019	Cat. E LHDs

## LHD Hot Spot A1\_Kolkata/Chennai/Dhaka - Yangon

- **Nature of Occurrences:** CAT E (Coordination errors as a result of human factors issues)
- **Contributing Factors:** The interfaces are oceanic airspace, which has some gaps in COM and SUR coverage
- **Trend:** significantly decreased from 2017 at 2019 in Kolkata/Dhaka and Yangon FIR, but increased at the interfaces btw Chennai and Yangon FIR
- **Mitigation:**
  - ADS-B data sharing btw Kolkata & Yangon FIR in 2018
  - LULDA-MIPAK: remaining non-zero-duration LHDs due to no data sharing
  - AIDC implementation and review of the procedure of handling aircraft on route L759 btw MIPAK & LIBDI where there is a brief crossing into Chennai FIR, might be beneficial

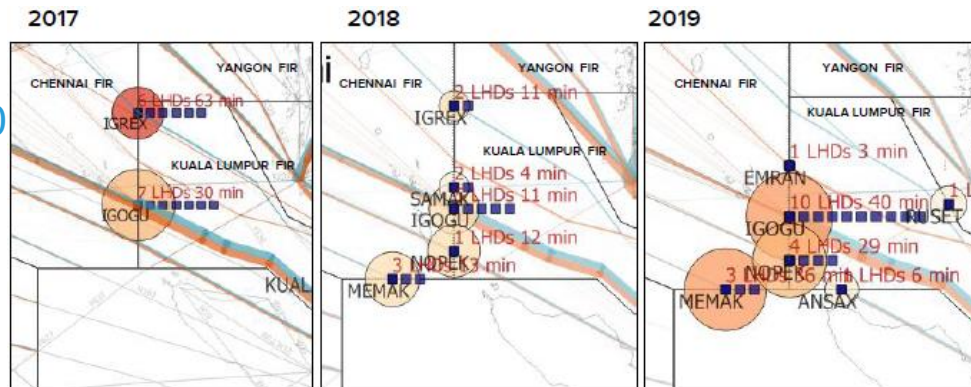
Operational risk (FAPFH)		
2017	2018	2019
$2.06 \times 10^{-9}$	$0.66 \times 10^{-9}$	$0.80 \times 10^{-9}$



# LHD Hot Spot A2\_Chennai – Kuala Lumpur

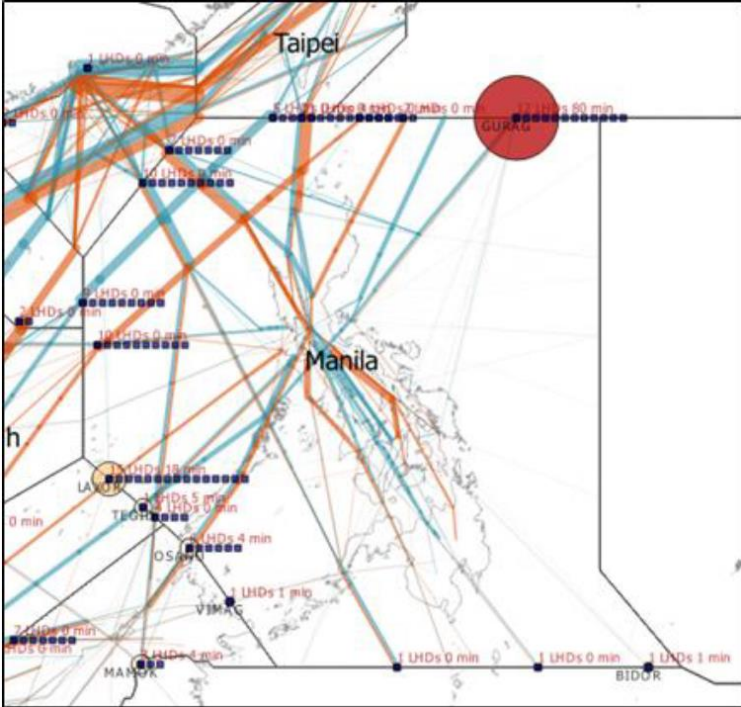
- **Nature of Occurrences:** CAT E (Coordination errors as a result of human factors issues)
- **Contributing Factors:** There are still some gaps in COM and SUR coverage
- **Trend:** The operational risk decreased by 1/3 from 2017 to 2018, but increased again in 2019
- **Mitigation:**
  - AIDC btw Chennai & Kuala Lumpur is fully operational from 1<sup>st</sup> April 2020
  - Surveillance data sharing planned for 2021

Operational risk (FAPFH)		
2017	2018	2019
0.91 x 10 <sup>-9</sup>	0.66 x 10 <sup>-9</sup>	1.14 x 10 <sup>-9</sup>



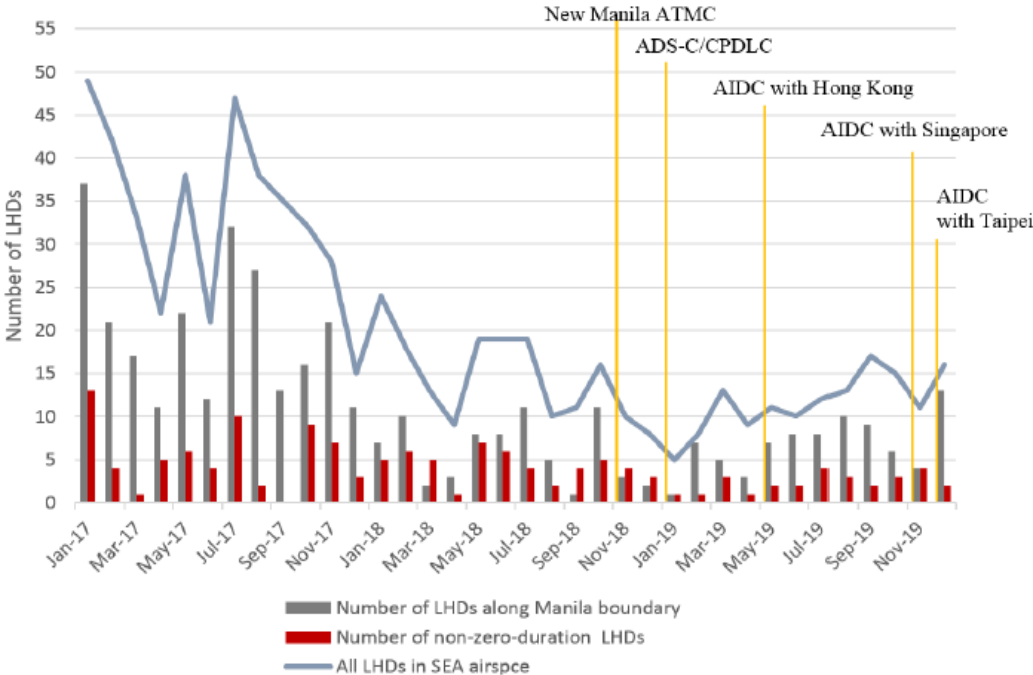
# LHD Hot Spot D\_Manila – Hong Kong/Singapore/Taipei

- **Nature of Occurrences:** CAT E (Coordination errors as a result of human factors issues)
- **Contributing Factors:** Even though Manila FIR now has much improved COM and SUR coverage, there are still some gaps.
- **Trend:** The operational risk slightly decreased in 2019. The most frequent LHDs were CAT E while a number of CAT F LHDs can be observed in 2020.



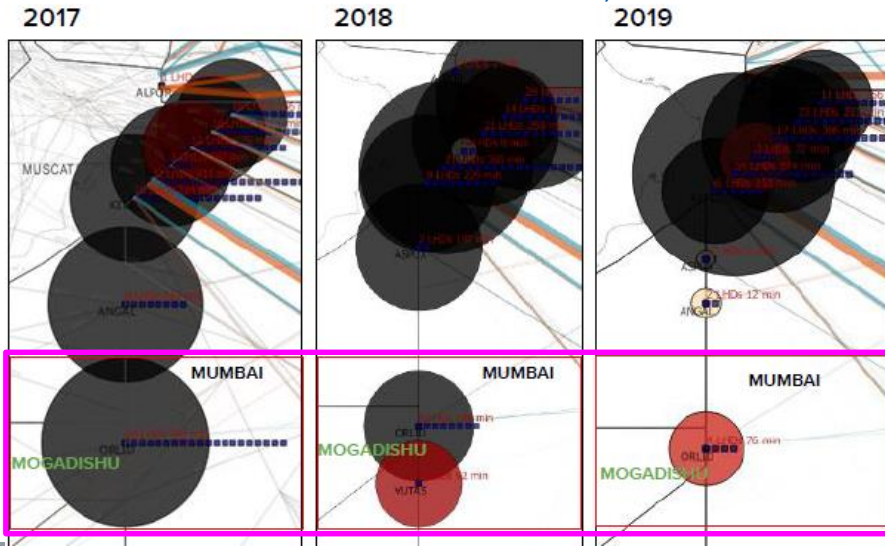
# LHD Hot Spot D\_Manila – Hong Kong/Singapore/Taipei

- Mitigation:**
  - In 2018, New ATC system (Manila ACC upgraded)
  - The enhanced capabilities of VHF radio, radar and ADS-B coverage, new sectors
  - In 2019, ADS-C/CPDLC in oceanic airspace, AIDC with Hong Kong, Singapore and Taipei FIRs were implemented
  - Further improvement are planned



# LHD Hot Spot F\_Mogadishu – Mumbai

- **Nature of Occurrences:** CAT E (Coordination errors as a result of human factors issues)
- **Contributing Factors:** oceanic airspace (Waypoint: ORLID, Route G450) with some poor COM and SUR coverage, mostly CAT E (negative transfer and incorrect FL information in transfer)
- **Trend:** The number of the LHDs and operational risk significantly decreased in 2018 and 2019.
- **Mitigation:**
  - AIDC implementation
  - Surveillance coverage enhancement are recommended to help reduce and mitigate the LHDs

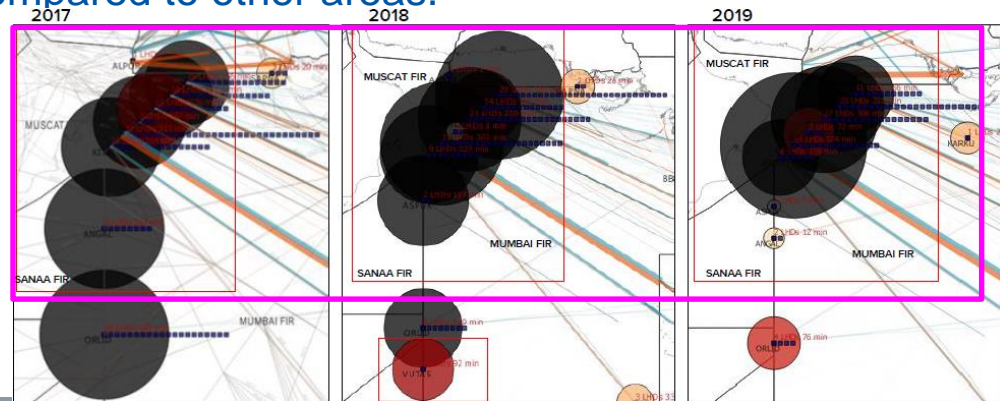


## LHD Hot Spot G\_Sanna/Muscat – Mumbai

- **Nature of Occurrences:** CAT E (Coordination errors as a result of human factors issues)
- **Contributing Factors:** oceanic airspace with poor COM and SUR coverage, so, long duration LHDs were still prevalent on these interfaces
  - ❖ *Note: There was an effect from the closure of Pakistan airspace during 27 Feb to 16 July 2019*
- **Trend:** The number of LHDs and the operational risk slightly decreased from 2018 to 2019, but still very high compared to other areas.

Interface	Operational Risk (x 10 <sup>-9</sup> FAPFH)		
	2017	2018	2019
Mumbai-Muscat	32.82	30.38	24.71
Mumbai-Sanaa	6.25	2.28	0.20
<b>Total</b>	<b>39.07</b>	<b>32.66</b>	<b>24.91</b>

- **Mitigation:**
  - AIDC trail in 2018, and Mumbai awaiting response from Muscat.
  - data-sharing and video conference btw Mumbai & Muscat ACC to reduce coordination errors being conducted
  - space-based ADS-B could help mitigate the duration of LLDs and LLEs.



# Asia: Horizontal Airspace Risk Assessment (LLDs & LLEs)

- Horizontal Collision Risk Estimates: Target Level of Safety (TLS)  $5.0 \times 10^{-9}$  FAPFH

2019 Asia Sub-Region	Horizontal Risk Estimate	Remark
30NM Lateral Risk	$0.0001 \times 10^{-9}$ FAPFH	Below TLS
50NM Longitudinal Risk	$0.25 \times 10^{-9}$ FAPFH	Below TLS
2018 Asia Sub-Region	Horizontal Risk Estimate	Remark
30NM Lateral Risk	$0.52 \times 10^{-9}$ FAPFH	Below TLS
50NM Longitudinal Risk	$3.91 \times 10^{-9}$ FAPFH	Below TLS

Number of annual flying hours: 12,324,497 hours/year, 2019



# Asia: Summary of LLDs & LLEs in 2019

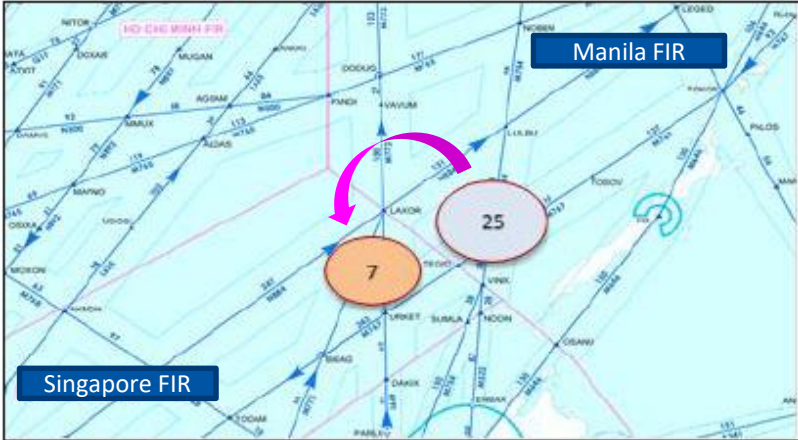
Attributions	Category Code	Description	Number of Occurrences	Duration (minute)	Number of Tracks /Routes Crossed	Horizontal Deviation (NM)
Aircrew/ Pilot	A	Flight crew deviate without ATC Clearance	1	0	0	50
	B	Incorrect estimate or route provided due to incorrect operation or interpretation of airborne equipment	1	3	0	0
	C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position	0	0	0	0
ATC	D	ATC system loop error	0	0	0	0
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	10	0	0	503
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	4	2	0	0

**Asia: Summary of LLDs & LLEs in 2019 (continued)**

Attributions	Category Code	Description	Number of Occurrences	Duration (minute)	Number of Tracks /Routes Crossed	Horizontal Deviation (NM)
Aircraft/ Avionics/ Contingencies	G	Navigation errors due to airborne equipment failure	0	0	0	0
Weather/ Turbulence	H	Turbulence or other weather related causes leading to a deviation in the horizontal dimension	0	0	0	0
Other	I	An aircraft was provided with reduced horizontal separation minima but did not meet the RNP/RSP/RCP specification;	1	0	0	10
	J	Other	0	0	0	0
<b>Total</b>			<b>17</b>	<b>5</b>	<b>0</b>	<b>563</b>

## SEA (South East Asia) Airspace\_Singapore & Manila

- **Nature of Occurrences:** CAT B and CAT F
- **Contributing Factors:** Inaccurate pilots' estimate, negative flight plans leading to AIDC non transfer
- **Trend:** First identified as a hot spot in 2014, improved by 72% compared to 2018
- **Mitigation:**
  - continual proactive safety awareness and lesson sharing
  - focused on types of AIDC failures (CAT F)
  - use of Improved system estimates generated from multiple surveillance sources (CAT B)



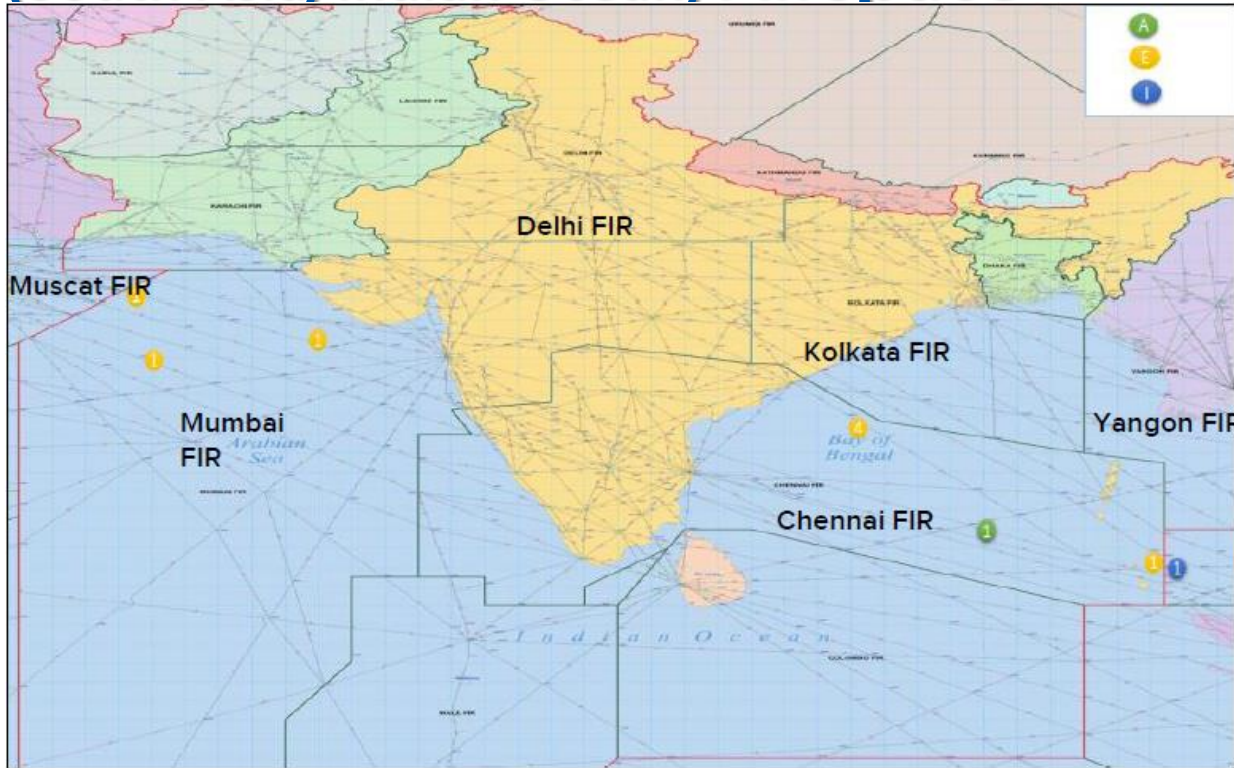
The number of LLDs and LLEs in 2019  
 The number of LLDs and LLEs in 2018

Note:

**CAT B:** Incorrect estimate or route provided due to incorrect operation or interpretation of airborne equipment

**CAT F:** Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues

## SAIO(South Asia/Indian Ocean) Airspace

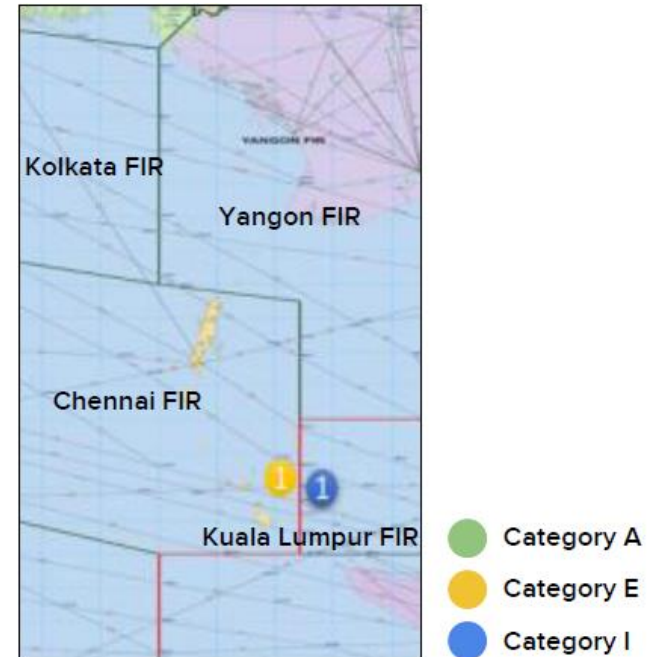


Note:  
**CAT A:** Flight crew deviate without ATC Clearance  
**CAT E:** Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues  
**CAT I:** An aircraft was provided with reduced horizontal separation minima but did not meet the RNP/RSP/RCP specification

- Kuala Lumpur FIR
- Category A
  - Category E
  - Category I

# SAIO Airspace\_Chennai & Kuala Lumpur Boundary

- **Nature of Occurrences:** CAT E
- **Contributing Factors:** Bad weather resulting in aircraft deviation that was not communicated by transferring unit to receiving unit
- **Mitigation:**
  - AIDC trails operations since 2017
  - MOU signed for operationalization of AIDC from 1<sup>st</sup> April 2020 and now fully operational
  - space-based ADS-B could help mitigate the duration of LLDs and LLEs.

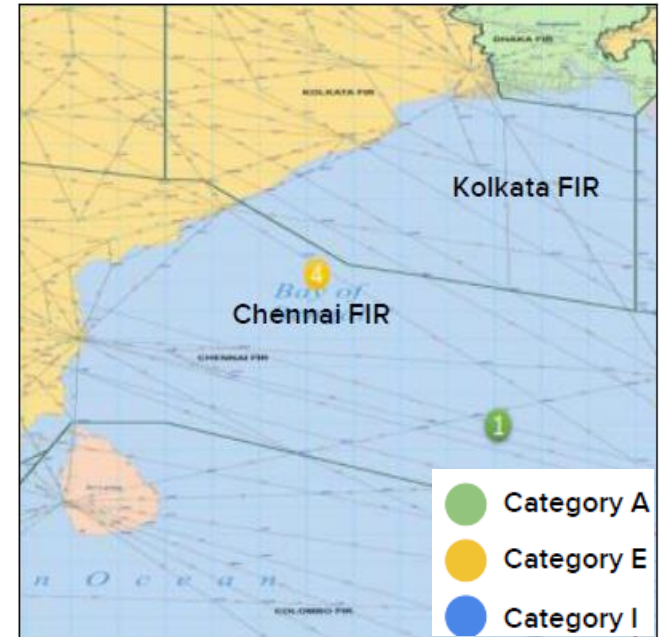


Note: **CAT E:** Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues

**CAT I:** An aircraft was provided with reduced horizontal separation minima but did not meet the RNP/RSP/RCP specification

# SAIO Airspace\_Chennai & Kolkata Boundary

- **Nature of Occurrences:** CAT E
- **Contributing Factors:** Bad weather resulting in aircraft deviation that was not communicated by transferring unit to receiving unit (occurred in 1 day)
- **Mitigation:**
  - AIDC trials operations since Nov. 2019
  - Phase 2 AIDC trials btw Chennai OCC & Kolkata postponed and will be commence shortly



Note: **CAT A:** Flight crew deviate without ATC Clearance

**CAT E:** Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues





# APAC Consolidated LTHM Estimate

- **Decreased remaining monitoring burden:**
  - China RMA (22%, 82 aircraft), JASMA (2%, 9 aircraft), PARMO (3%)
- **Increased remaining monitoring burden:**
  - **MAAR (54%, 206 aircraft remaining to be monitored), AAMA (19%, 71 aircraft)**
  - Mainly due to aircraft being unable to be monitored using Enhanced Global Navigation Satellite System Monitoring Units (EGMUs) during the COVID19 pandemic
- In 2019, the total number of aircraft remaining to be monitored in the APAC Region had **risen by 20% to 379** from 2018.

State	2017%	2018%	MMR	Burden	2019%
Afghanistan (MAAR)	38%	36%	13	11	85%
Pakistan (MAAR)	69%	56%	28	13	46%
India (MAAR)	30%	25%	245	106	46%
Nepal (MAAR)	0%	0%	11	5	45%
Philippines (MAAR)	30%	26%	70	30	43%
Indonesia (AAMA)	42%	21%	57	24	42%
Bhutan (MAAR)	0%	0%	5	2	40%
Malaysia (MAAR)	38%	40%	72	19	26%
Myanmar (MAAR)	36%	0%	6	1	17%
Bangladesh (MAAR)	44%	14%	14	2	14%

States with Remaining Monitoring Burdens over 30% (red = liable for APANPIRG Deficiency)

## Reporting Rate of LHDs/LLDs/LLEs

- Reporting rate is improving in general.
- DPRK reported none for the last 4 years
- Mongolia's reporting rate in 2019 was significantly lower than others.
- ROK, Pacific, and South West Pacific have significantly improved their reporting rates in 2019

Airspace	# Reports				1 Report : Flying Hrs			
	2016	2017	2018	2019	2016	2017	2018	2019
DPRK	0	0	0	0	-	-	-	-
Mongolia	0	4	1	2	-	1: 37,771	1: 158,891	1: 82,138
Indonesia	32	34	23	37	1: 11,520	1: 10,842	1: 53,603	1: 33,321
China	117	134	110	79	1: 20,413	1: 18,248	1: 22,229	1: 31,119
SEA	426	474	205	152	1: 5,884	1: 6,548	1: 17,757	1: 22,275
Japan	43	71	76	77	1: 33,834	1: 21,510	1: 20,632	1: 20,762
ROK	6	5	12	34	1: 93,291	1: 117,090	1: 28,365	1: 18,959
Pacific	33	42	43	173	1: 63,500	1: 54,191	1: 45,064	1: 10,139
SW Pacific	52	51	53	101	1: 16,639	1: 17,572	1: 17,817	1: 9,335
SA/IO	778	935	681	439	1: 3,689	1: 3,166	1: 3,783	1: 7,955
<b>Total</b>	<b>1,487</b>	<b>1,750</b>	<b>1,204</b>	<b>1,094</b>	<b>1: 8,905</b>	<b>1: 8,180</b>	<b>1: 12,332</b>	<b>1: 14,330</b>

Notes: - **Indonesia** resolved the issues with TSD collection in 2018. The flying hours and, hence, the reporting rate significantly changed in 2018.



# Reporting Culture\_ ‘Aviation Culture’

- **For effective analysis of Monitoring Agencies, safety data and reports are crucial.**
- **RASMAG/25 had noted that the following States have the potential reporting issues:**
  - Afghanistan, which did not report any LHDs during 2020;
  - China, which had reported an implausibly low percentage of Category E event (73% during 2018 and 7% in 2019);
  - India – Delhi and Kolkata FIRs (although Mumbai and Chennai had made distinct improvements); and
  - Mongolia had a rate of reported LHDs per hour that was very low, many factors less than that expected.
- **Some good signs of reporting culture improvement:**
  - LHD reports by the ACCs that had made the error: Singapore, Manila, Kota Kinabalu and Kuala Lumpur
  - Nil Reports: Phnom Penh, Hong Kong, Taipei, Hanoi, Ho Chi Minh, Dhaka, Karachi and Ulaanbaatar

# Reporting Culture\_ ‘Aviation Culture’

- In order to be more proactive, ICAO recommended that RMAs and EMAs better analyse safety data to identify potential under-reporting and undertake safety culture surveys and audits to monitor safety reporting culture.

➤ **Decision RASMAG/25-4: Safety Reporting Assessments**

- That, RMAs and EMAs will include within their vertical and horizontal safety reports to RASMAG an **assessment of the safety reporting culture of the States concerned (incl. ‘Just Culture’)**, specifically, whether safety reports for events such as LHDDs were consistently being made by pilots and ATC.



*Optimal Aviation Culture Factors (from APAC Seamless ANS Plan 3.0)*



# RASMAG/25 Conclusions/Decisions

- **Conclusion RASMAG/25-1: Revised PBCS Non-Compliance Report Form Template**
  - That, the PBCS Non-Compliance Report Form Template at Appendix C to the Report be uploaded to the Asia/Pacific Regional Office website, to replace the previous template.
- **Conclusion RASMAG/25-2: RVSM MMR Update**
  - That, the Reduced Vertical Separation Minimum (RVSM) Minimum Monitoring Requirement (MMR) update at Appendix D to the Report be utilized by Regional Monitoring Agencies (RMAs) and States as appropriate.



# RASMAG/25 Conclusions/Decisions

- **Draft Conclusion RASMAG/25-3: Alphanumeric Call Sign Initiative**
  - That, leading ANSPs and aerodrome operators, in coordination with CANSO and ACI, were urged to consider a trail to identify and overcome any barriers for the implementation of alphanumeric call signs, with a view to developing a project for the Asia/Pacific Region.
- **Decision RASMAG/25-5: Rotation Responsibility for the Production of the Combined PBCS Monitoring Report**
  - That, FIT-Asia will produce an annual Combined PBCS Monitoring Report, i.e. responsibility for the report production will rotate biennially amongst volunteer States

# Summary

- **Vertical TLS Compliance for 2019 APAC**
  - Vertical overall risk is 12.88 x 10<sup>-9</sup> FAPFH (above the TLS) with a **decreasing trend** since 2017 from various safety improvement initiatives.
  - For **Pacific**, vertical overall risk is **30.21 x 10<sup>-9</sup>** FAPFH (above the TLS) with an **increasing trend** since 2016 from improved reporting culture.
- **Horizontal TLS Compliance for 2019 APAC**
  - 10MIN longitudinal risk estimate of Japan airspace is 20.1 x 10<sup>-9</sup> FAPFH (above the TLS). However, this is due to a technical issue in the computation
  - All else are below the TLS
- **LHD Hot Spot Deletion proposed:** C (Hong Kong -Guangzhou), E (Lahore -Urumqi), H (Guangzhou -Wuhan), I (Karachi -Kabul), K (Jakarta -Ujung Pandang), and L (Fukuoka – Khabarovsk), M (Colombo-Melbourne)



# Action by the Meeting

- **The meeting is invited to:**
  - Note the information contained in this paper;
  - Note the PBCS-related and RASMAG Decisions;
  - Discuss the elevated vertical safety risks in APAC Region;
  - Discuss the safety reporting issues identified by RASMAG as appropriate; and
  - Discuss any other matters as appropriate.



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THANK YOU