POST OPERATIONS ANALYSIS REPORT

July, 2024

CENTRAL COMMAND CENTER, C-ATFM, DELHI

Contents

List of Figures

A. Executive Summary

Average Domestic air traffic has recorded a decrease of 1.7% whereas the average international air traffic has increased by 0.68 % in the month of July '24 as compared to June '24.

On average, the Indian Airports in the ATFCM area saw 4402 IFR flights per day in the month of July 2024. The peak day was on 05th July 2024 (4526 IFR flights). Thursday's were the busiest days throughout this month with an average of 4468 IFR flights per day.

Total Forty (70) ATFM measures were applied this month during periods of congestion at Delhi, Chennai and Mumbai Airport.
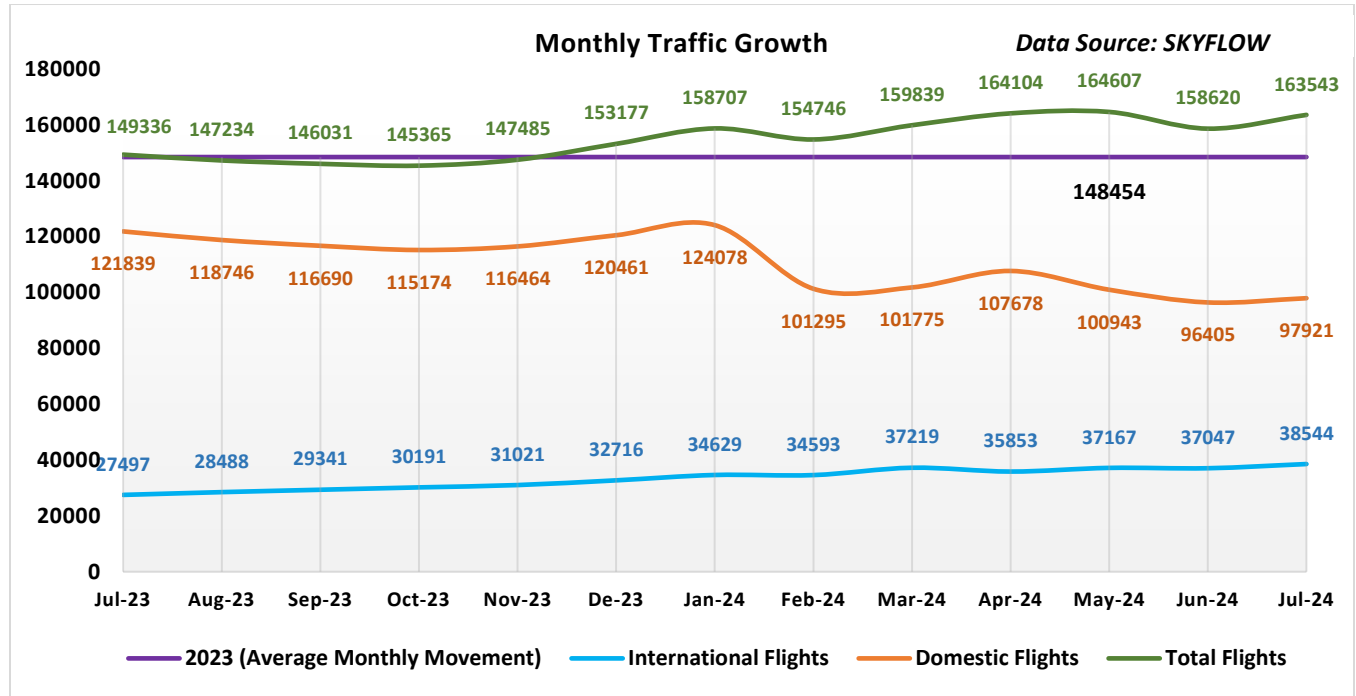
Figure 1: Monthly Traffic Growth

The graph above depicts the Domestic, International and Overflying Air traffic in Indian ATFCM Area during the last 13 months (July'23 to July'24).

B. Traffic Analysis

I. Air Traffic Movement at Major Airports in India
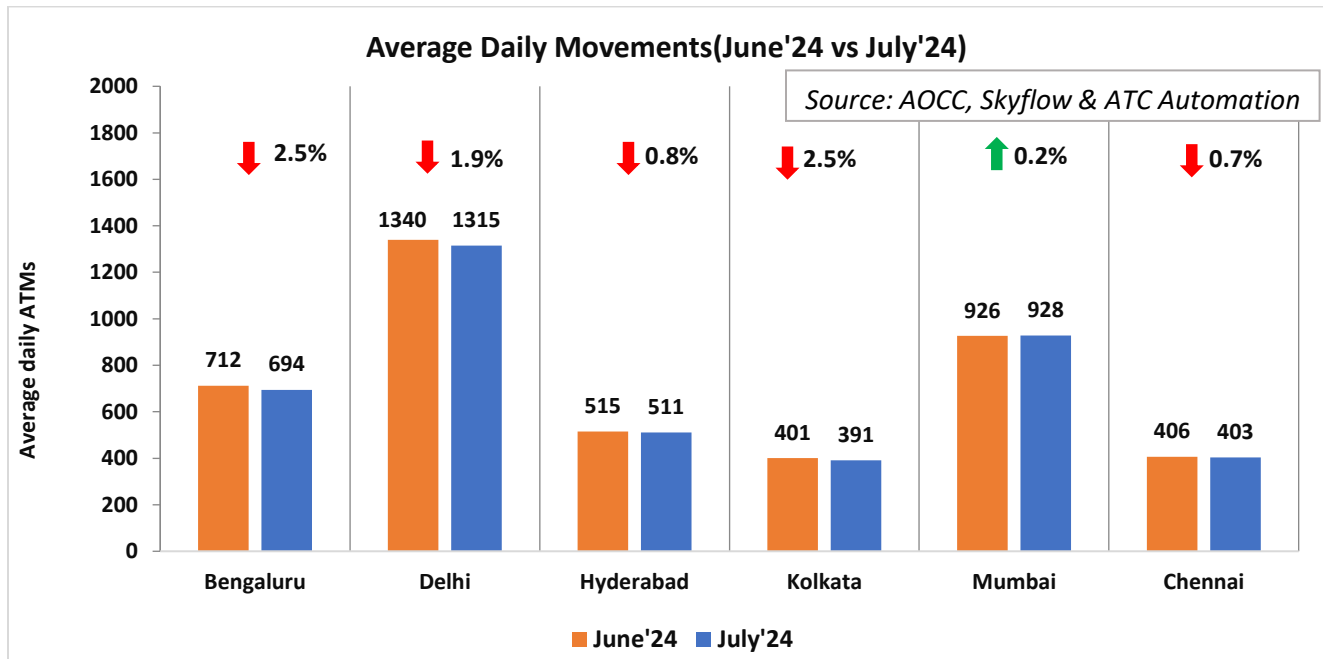
Figure 2: Average Daily Movements (June '24 vs July '24)

The above chart depicts the percentage change in average daily ATMs at six major Airports in July'24 as compared to the previous month June '24.

Airports\Year	Avg. Daily ATMs (YoY) for six major airports				
	July'20	July'21	July'22	July'23	July'24
Bengaluru	188	314	525	636	694
Delhi	457	728	1171	1231	1315
Hyderabad	174	265	405	451	511
Kolkata	120	203	356	376	391
Mumbai	180	395	712	886	928
Chennai	103	200	353	383	403

Air Traffic Movement for each day in July'24 is plotted for Delhi, Mumbai, Bengaluru and Hyderabad Airport along with the percentage change w.r.t. Avg. Daily Movements for the same month.
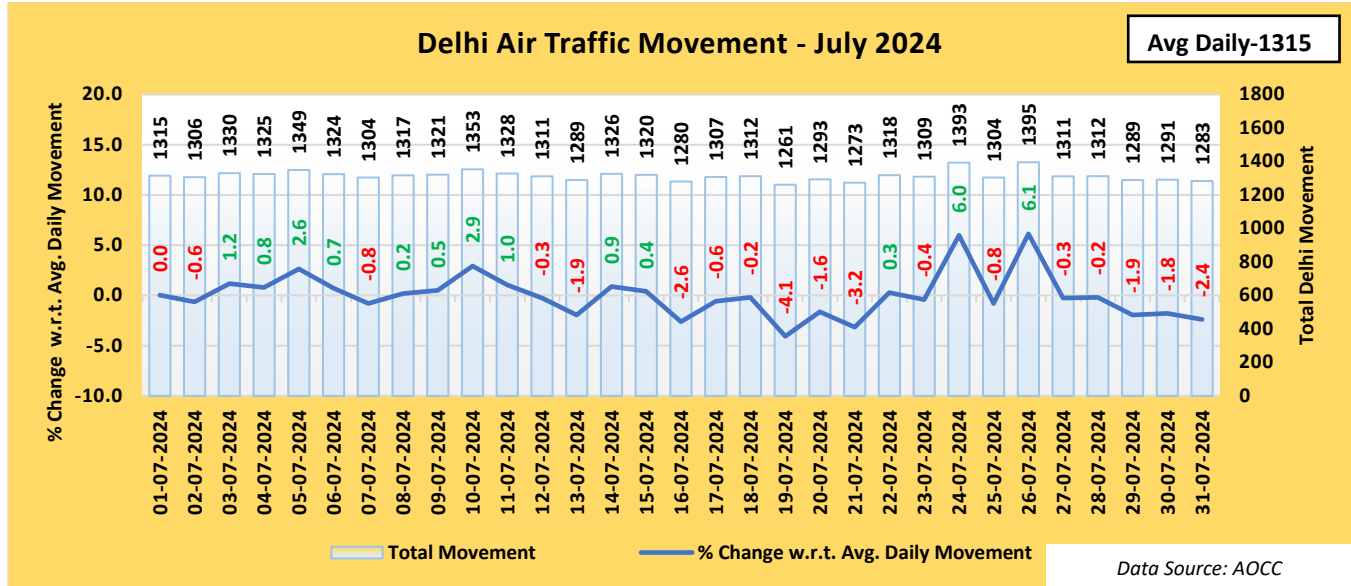
Figure 3: Air Traffic Movement for Delhi –July 2024
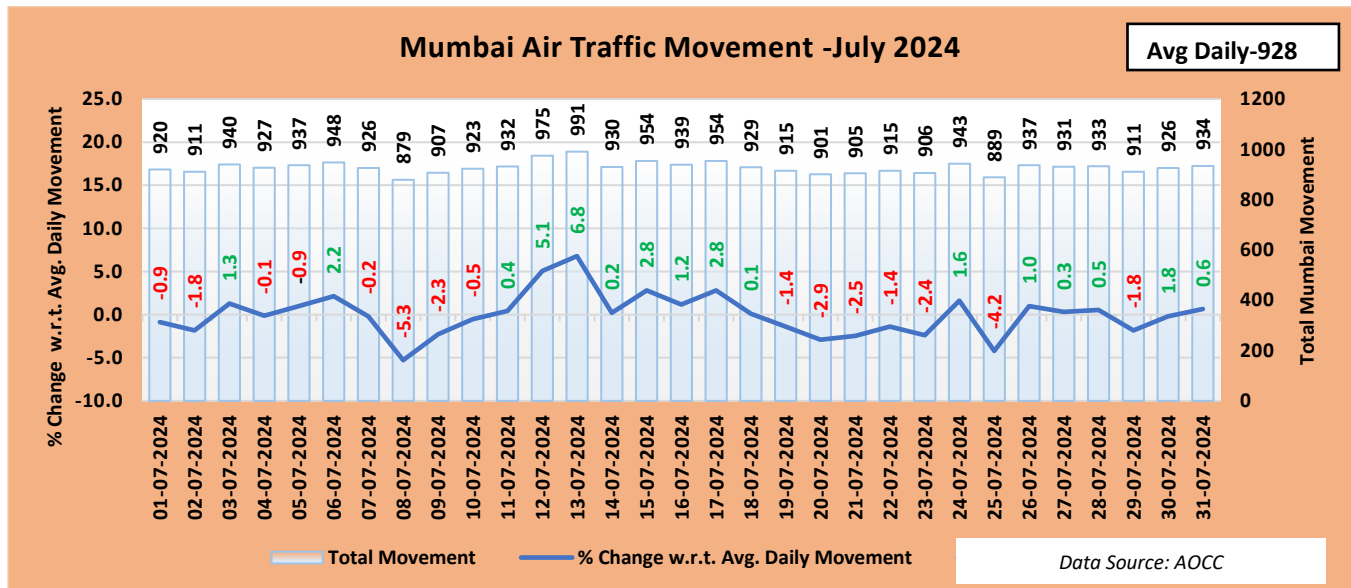
Figure 4: Air Traffic Movement for Mumbai - July 2024

Bengaluru Air Traffic Movement - July 2024

Avg Daily-694

Data Source: AOCC & ATC Automation
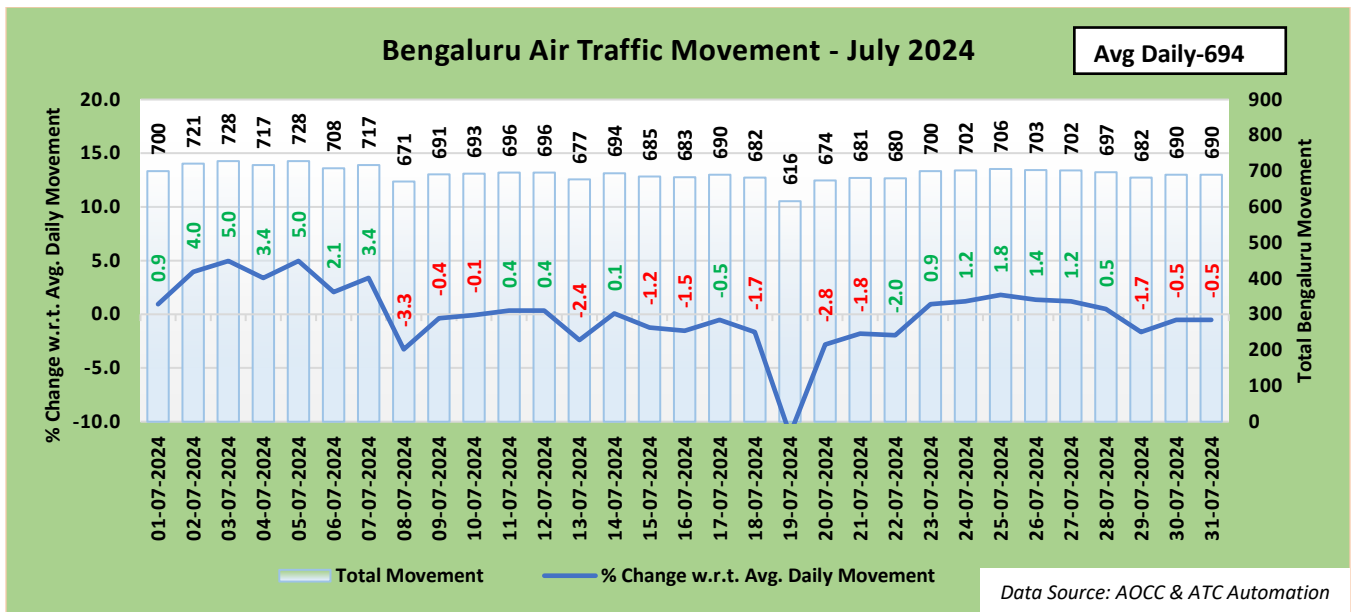
Figure 5: Air Traffic Movement for Bengaluru – July 2024

Hyderabad Air Traffic Movement - July 2024

Avg Daily-511

Data Source: AOCC
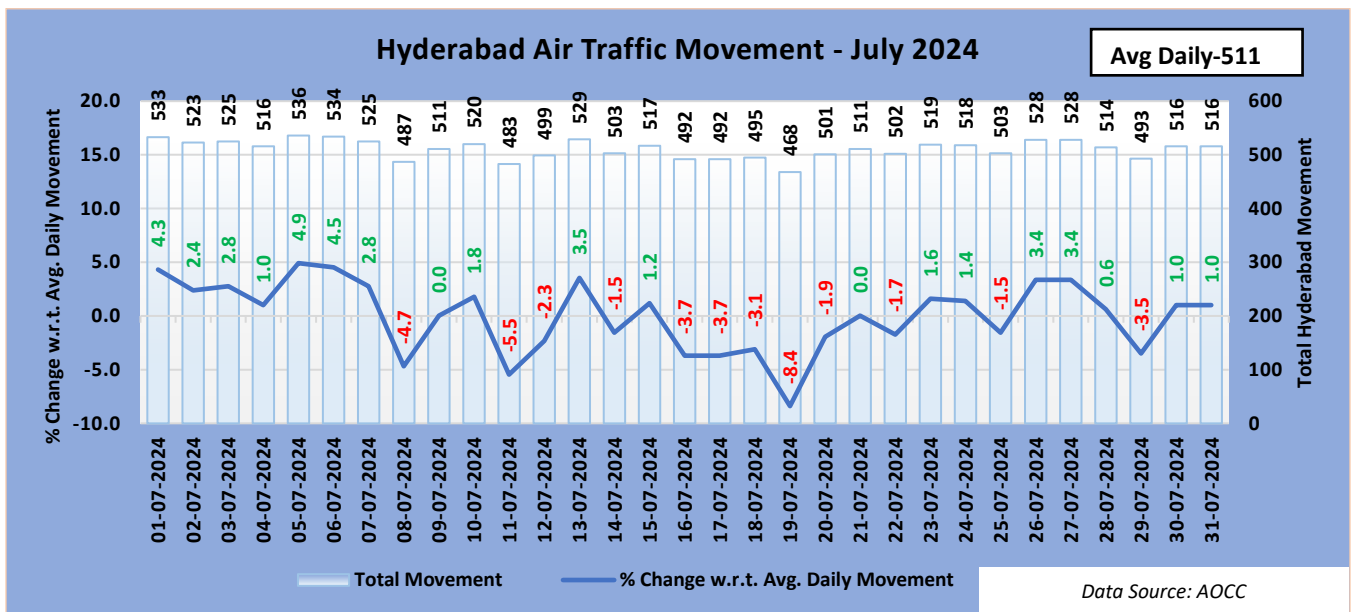
Figure 6: Air Traffic Movement for Hyderabad – July 2024

It can be concluded from the above charts that on 31st July 2024 (month end), the ATM at Mumbai and Hyderabad saw an increase of 0.6% and 1.0% respectively whereas the ATM at Delhi and Bengaluru saw a decline of 2.5% and 0.5% respectively in comparison to the average daily movement for July'24.

II.   Comparison of total ATMs (YoY) and Monthwise

The total Air traffic movement(ATMs) including Passenger and other flights such as Cargo flights, International scheduled, International non-scheduled, Domestic scheduled, Domestic non-scheduled, Air taxi & commercial business flights at six major Indian Airports namely Delhi, Mumbai, Bengaluru, Hyderabad, Kolkata and Chennai is plotted for the month of July for two consecutive years 2023 and 2024 respectively. Air Traffic movement is also plotted Airline wise for the last six months for the major Scheduled Operators.
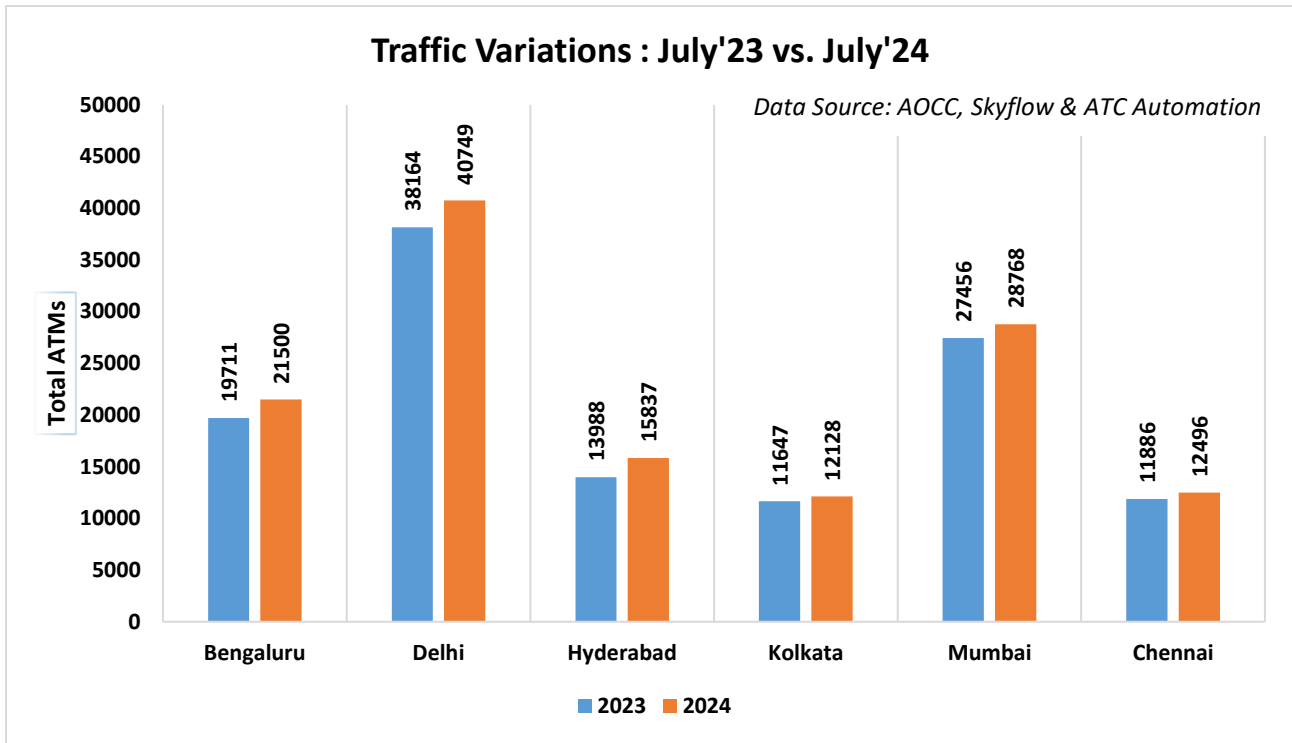
Figure 7: Traffic Variation (YoY)

III.   Flight Operations – Airlinewise
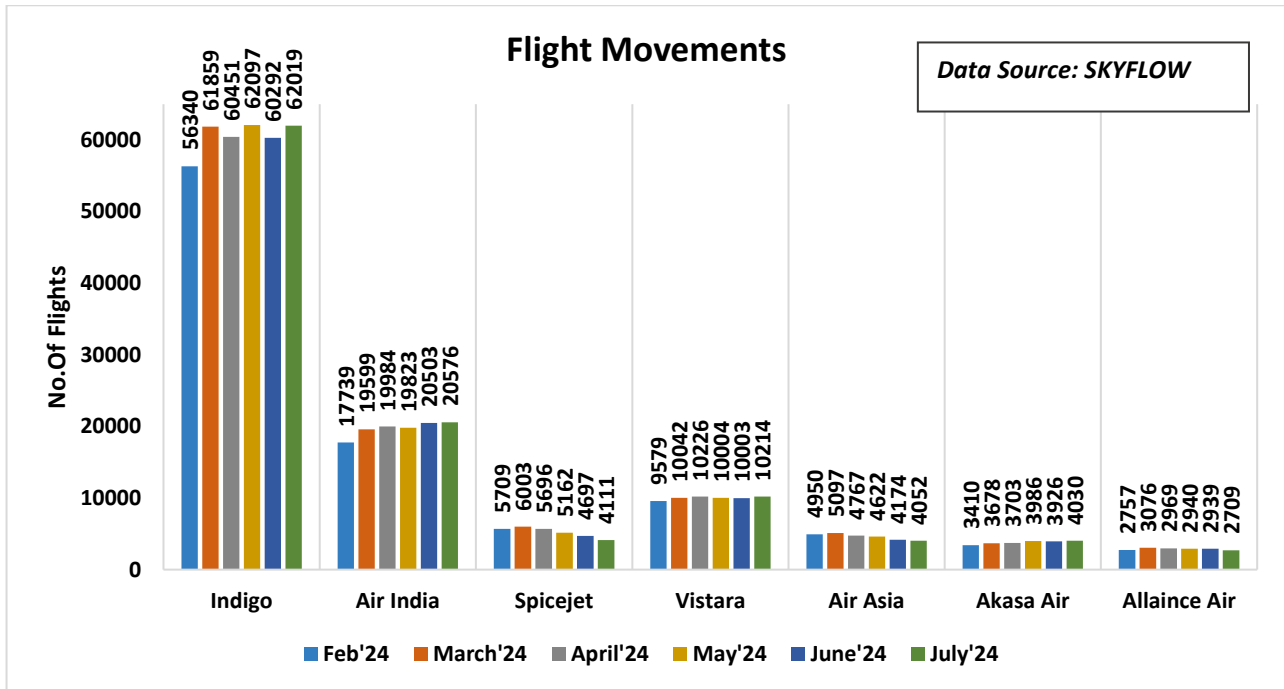
Figure 8: Flight Movements –Airlinewise

 Inference:

1. Indigo,Air India, Vistara and Akasa airlines have recorded an increase in the monthly average(31 days) Flight movement in July'24 as compared to June '24 while Spicejet, Alliance air and Air Asia airlines have recorded a decline during the same period.

C.   ATFM Post Operations – CDM Analysis

I.   Introduction

Analysis Period   **1st – 31st July 24**

Back Ground   During the above mentioned period, **Thirteen (13)** ATFM measures were applied **for Delhi Airport, Fifty four (54)** ATFM measures were applied **for Mumbai Airport and Three (03)** ATFM measure was applied **for Chennai Airport** due to the following reasons as illustrated in the bar chart below:–
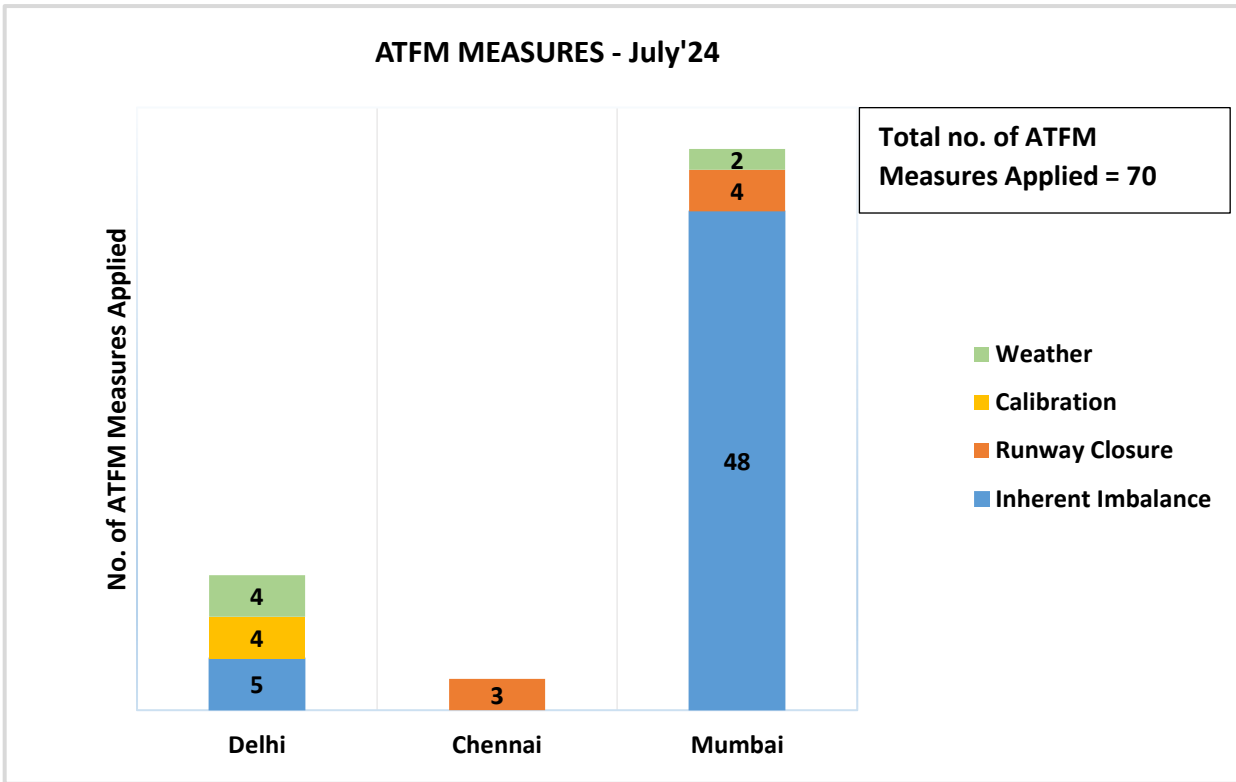
Figure 9: ATFM Measures –July '24

II. ATFM Measures Overview

Constrained Airport	Delhi	Mumbai	Chennai
Number of ATFM measures applied	13	54	3
Average ATFM Ground delay(in min) due to measures*	26.1	34.5	21.4
Maximum ATFM Ground delay(in min) due to measures	73	92	37
% Compliance	76.5	80.5	87.5

Note: $* \; Average \; ATFM \; Delay = \dfrac{Total \; ATFM \; Delay}{Total \; Domestic \; Arrivals}$

Total Arrivals	5416
Total International Arrivals(exempted)	1232
Total affected flights in scenario (Domestic Arrivals)	4184
Total Domestic Arrivals with zero ATFM delay	166
Total Domestic Arrivals with ATFM delay	4018

Affected Flight Statistics

4%
96%

☐ Delayed flights   ☐ Non-delayed flights
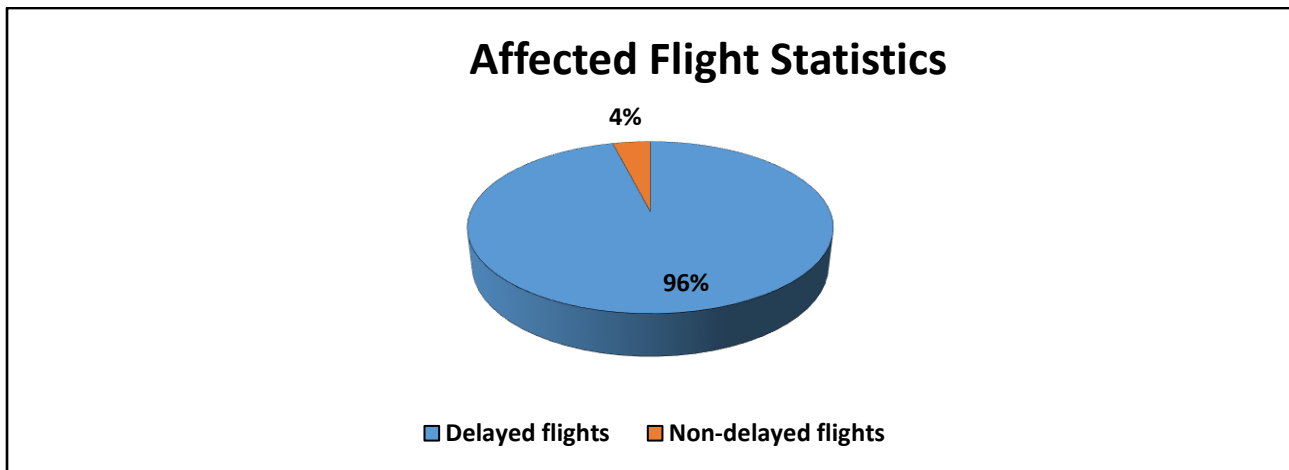
Figure 10: Affected Flight Statistics –July'24

III. Overall Compliance

Total arrivals	5416
Domestic arrivals	4184
Flights with complete data (ATOT)	4040
Flights with incomplete data	22
Flights Not Operated	122
Compliant*	3211
Non-Compliant	829

*Total No. of Revised CTOTs issued = 1543 (Compliance calculation for flights which were issued revised CTOT is w.r.t. new CTOT issued)
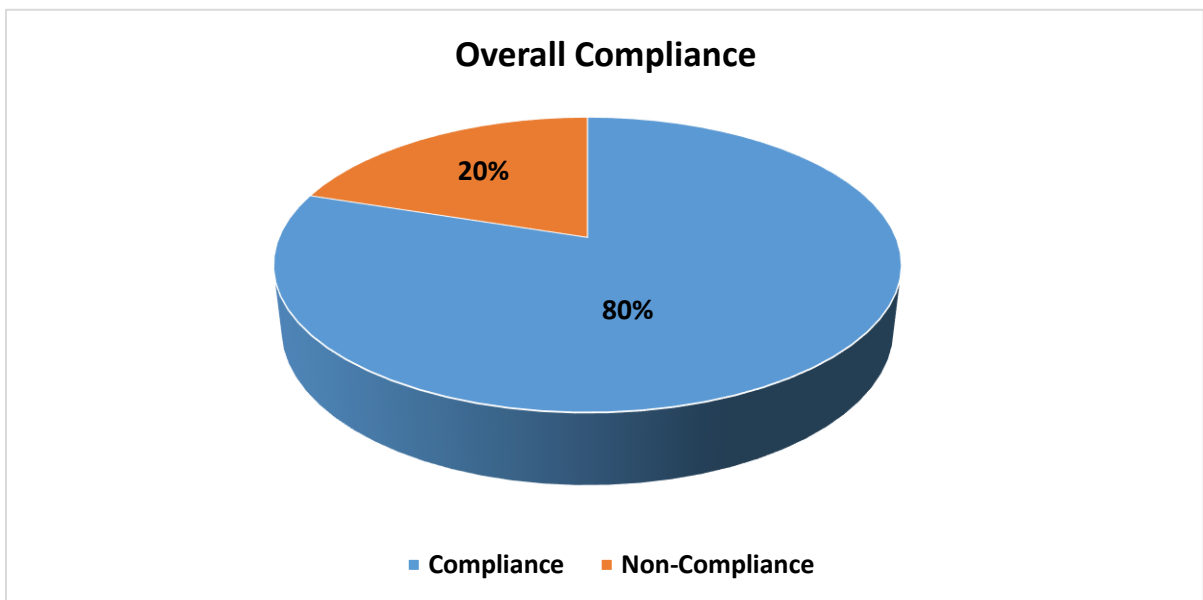
Figure 11: **Overall Compliance – July'24**

NOTE: Flights with required data (i.e. ATOT) are only considered for compliance measurement
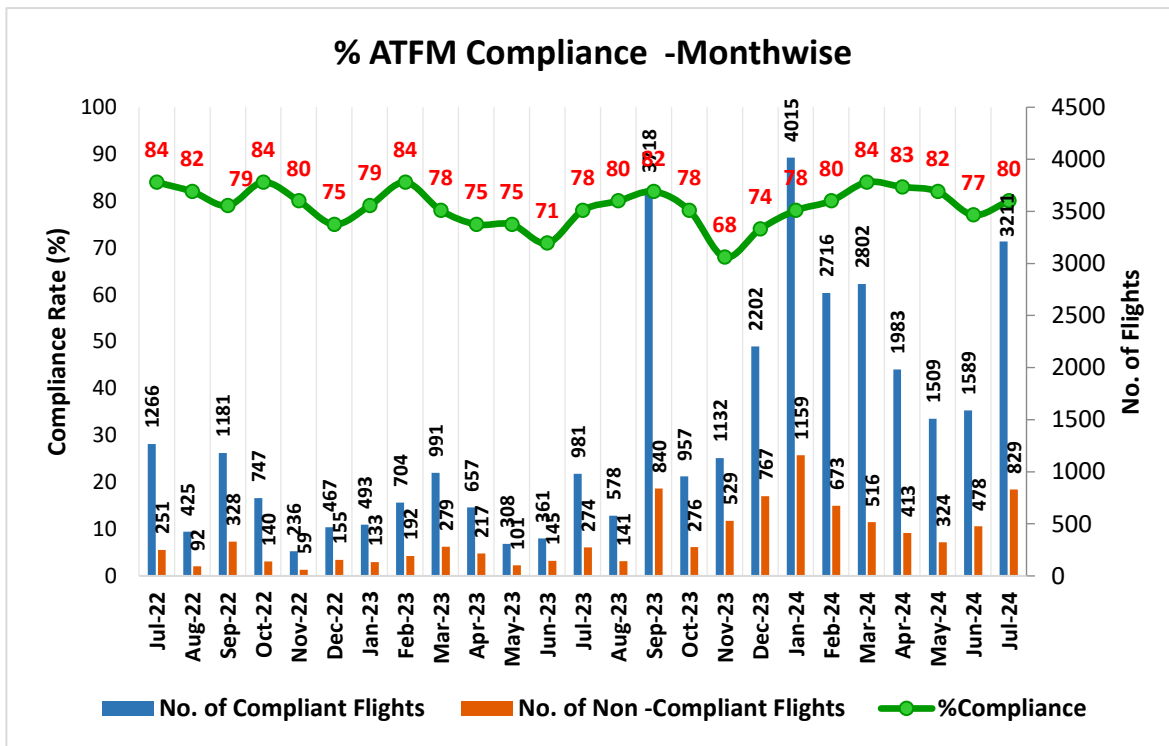
Figure 12: Compliance(Monthwise)

Inference

1. Out of the total arrivals captured(5416 flights) during the CDM scenario for the constrained Airports, 77.3% of flights i.e. domestic arrivals(4184 flights) were candidates for ground delay(participating).
2. Out of these Domestic Arrivals(4184), 96% (4018 flights) are assigned ATFM ground delay.
3. Out of the total arrivals captured(5416 flights) to the constrained Airport during the ATFM scenario, only 74.2% of flights(4018 flights) were assigned ATFM Ground Delay.

IV. CTOT Compliance rate – Airportwise

MUMBAI FIR (76%)*	Compliant	Non Compliant	% Compliant
Ahmedabad	125	25	83%
Aurangabad	28	4	88%
Mumbai	92	33	74%
Vadodara	28	5	85%
Bhopal	37	11	77%
Diu	2	1	67%
Hirasar, Rajkot	21	10	68%
Indore	63	30	68%
Jabalpur	7	4	64%
Jalgaon	6	1	86%
Jamnagar	14	4	78%
Kandla	6	2	75%
Kolhapur	6	0	100%
Ozar	1	0	100%
Nagpur	60	23	72%
Nasik	0	2	0%
Pune	31	15	67%
Shirdi	2	2	50%
Surat	12	1	92%
Udaipur	30	12	71%
KOLKATA FIR (81%)*	Compliant	Non Compliant	% Compliant
Prayagraj	11	13	46%
Varanasi	1	1	50%
Bhubneshwar	20	9	69%
Shillong	38	4	90%
Kolkatta	48	19	72%
Bhubaneswar	68	12	85%
Bilaspur	1	0	100%
Kolkata	164	29	85%
Chakeri	4	3	57%
Durgapur	4	0	100%
Darbhanga	4	3	57%

	Compliant	Non Compliant	% Compliant
Deoghar	1	1	50%
Jagdalpur	9	2	82%
Guwahati	40	16	71%
Gaya	5	0	100%
Raipur	1	0	100%
Imphal	2	0	100%
Jharsuguda	2	0	100%
Khajuraho	4	0	100%
Aizawl	1	0	100%
Dibrugarh	6	0	100%
Dimapur	2	0	100%
Patna	73	8	90%
Ranchi	19	13	59%
Gaggal	51	6	89%
DELHI FIR (74%)*	**Compliant**	**Non Compliant**	**% Compliant**
Agra	1	2	33%
Ambala	0	1	0%
Amritsar	12	7	63%
Bhuntar	4	0	100%
Bathinda	1	2	33%
Kishangarh	2	6	25%
Chandigarh	42	18	70%
Dehradun	24	16	60%
Delhi	411	84	83%
Hindon	1	0	100%
Baldota Koppal	6	2	75%
Gwalior	5	7	42%
Jodhpur	10	4	71%
Jaipur	63	22	74%
Jammu	16	8	67%
Vijaywada	18	14	56%
Lucknow	78	16	83%
Pantnagar	4	2	67%
Shimla	1	0	100%
Sarsawa Air Force Station	0	1	0%
Begumpet, Hyderabad	71	54	57%
Sirsa	0	1	0%
Uttar Lai	0	1	0%

CHENNAI FIR (84%)*	Compliant	Non Compliant	% Compliant
Hal Bangalore	4	3	57%
Shashabad Hyderabad	0	1	0%
Bangalore	342	39	90%
Belgaum	2	3	40%
Vijayawada	17	2	89%
Coimbatore	79	5	94%
Mangaluru	101	16	86%
Calicut	4	0	100%
MOPA Goa	80	20	80%
Goa	115	57	67%
Hubli	3	3	50%
Shamsabad, Hyderabad	227	39	85%
Begumpet Hyderabad	4	1	80%
Vijaynagar	1	0	100%
Kannur	7	1	88%
Madurai	11	2	85%
Mangalore	32	5	86%
Chennai	185	29	86%
Port Blair	3	1	75%
Rajahmundry	2	0	100%
Sindhudurg	2	1	67%
Tiruchirappally	3	1	75%
Thiruvananthapuram	52	4	93%
Visakhapatnam	15	4	79%

*FIR wise compliance rate

Note: The above list contains only those airports which had flights to the Constrained Airport and are affected by ATFM measures.

Airports with % compliance less than the average compliance(80%) for the month are highlighted in red.

V. CTOT Compliance rate – Airlinewise

Overall Compliance Chart of Airline Operators - July'24
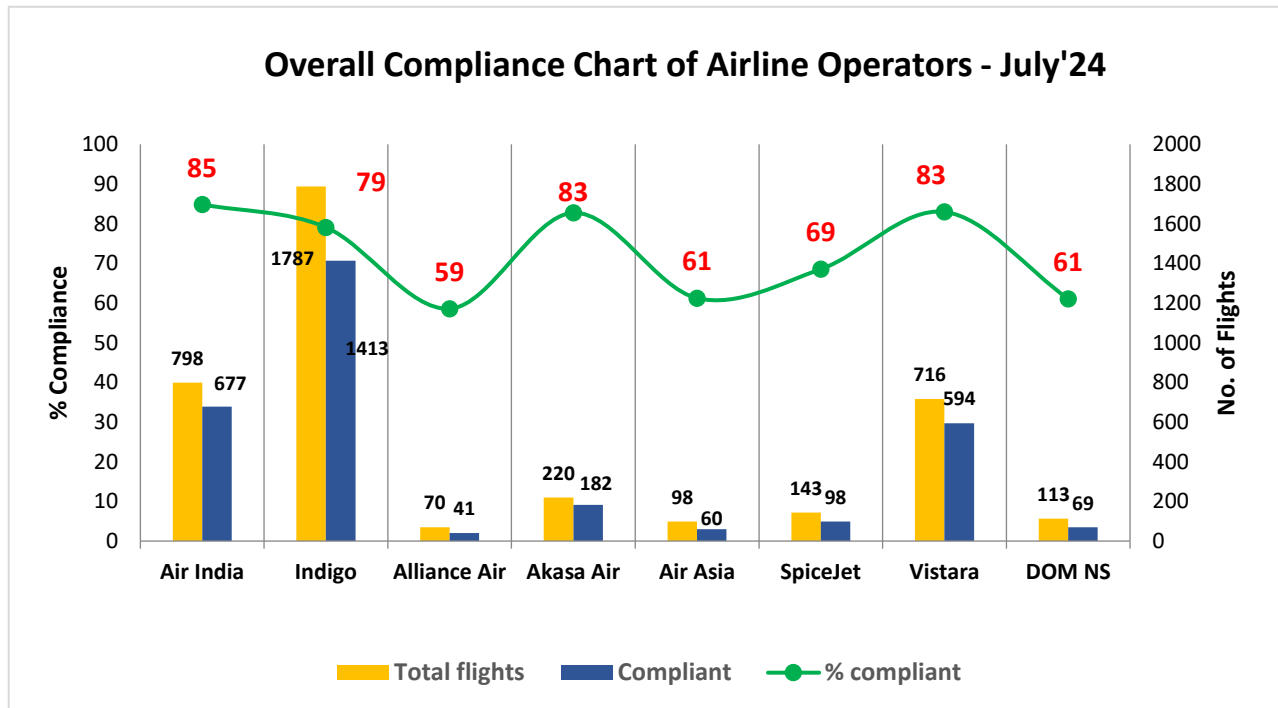
Figure 13: Airline wise Compliance –July'24

Inference

1. Out of the total domestic arrivals with complete data in the CDM scenario, 80% arrivals are compliant.
2. Chennai region record the highest compliance of 84% whereas Delhi region has the lowest percentage compliance of 74%.
3. Air India, Akasa and Vistara Airlines have a CTOT compliance higher than the average recorded compliance for the month of July'24.

VI. Reason For Non Compliance
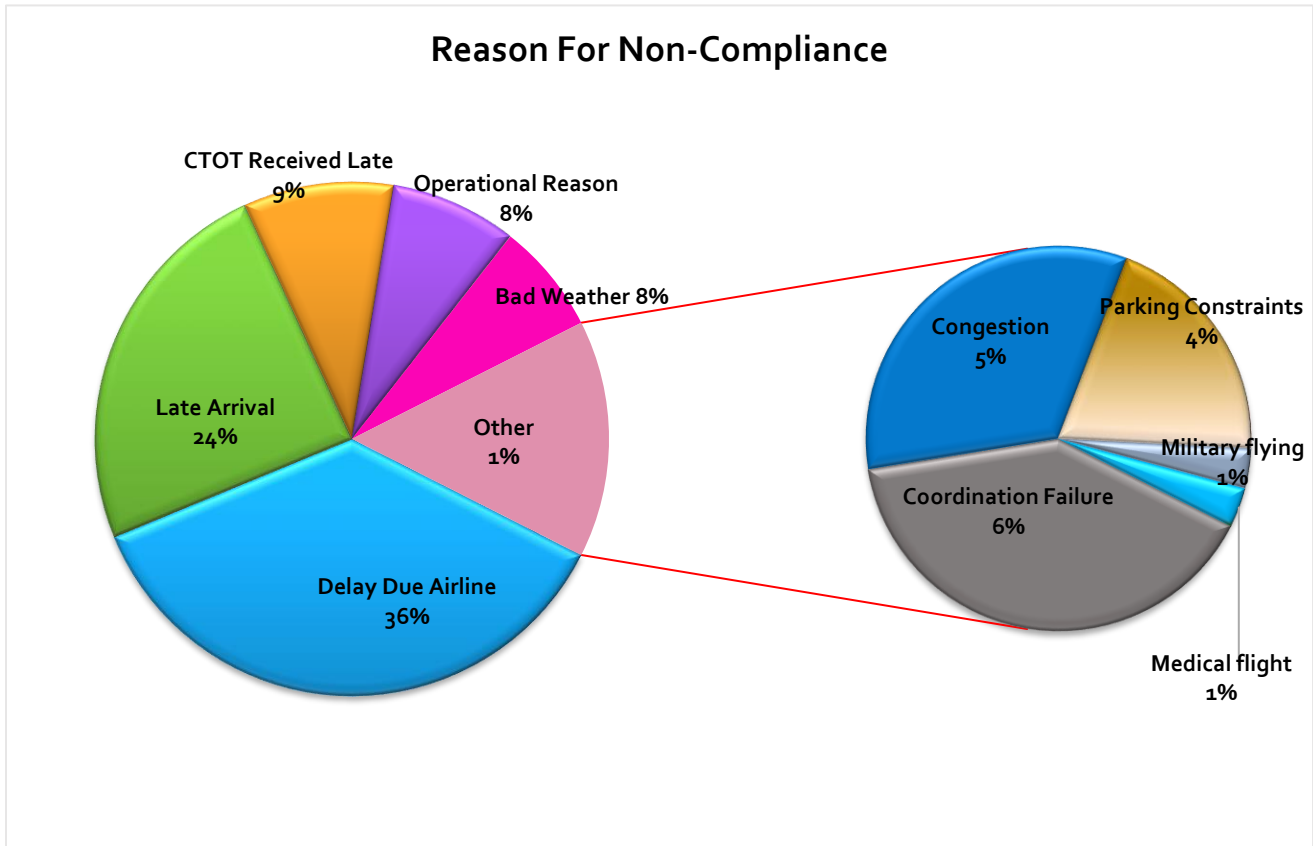
Figure 14: Reason for Non-Compliance as provided by FMPs

Inference:

1. 36 % of CTOT Non- Compliance was reported by concerned FMPs to be due to delay by Airlines.
2. 24 % of the CTOT Non- compliance was reported to be due to late arrival from previous station. Updated EOBTs of such flights was not available to ATFM unit leading to wastage of unused slots.
3. 9 % of the CTOT Non- compliance was reported by concerned FMPs to be due to late receipt of CTOTs and by the time the aircraft had already initiated pushed back or startup.

VII. Air Delay during the CDM Scenario period

Average Air Delay to domestic arrivals* within the CDM Scenario period for Delhi, Mumbai and Chennai was 9.4,16.6 and 9.1 minutes respectively.

*Note: Only calculated for domestic arrivals with both ATOT and ALDT information
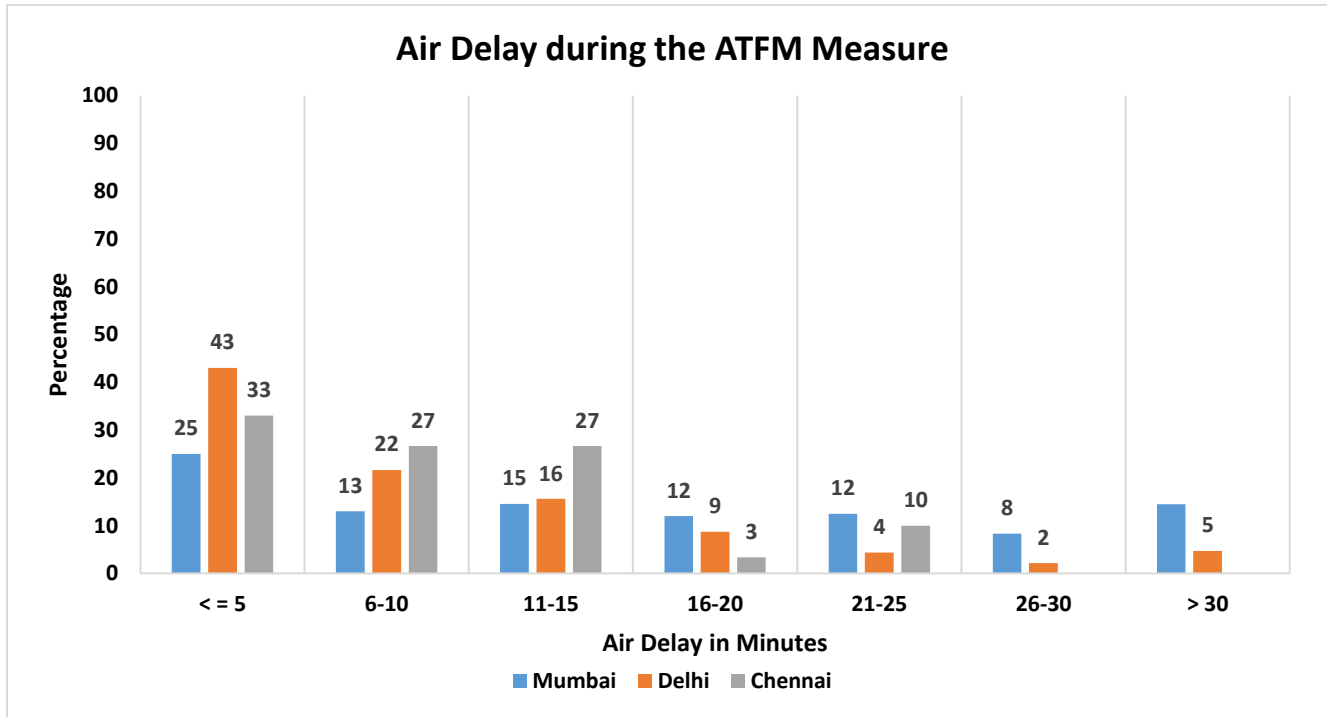
Figure 15: Air Delay distribution during the CDM period

Inference

1. 38% of domestic arriving flights to Mumbai had an Air delay of equal to or less than 10 minutes during the CDM period.
2. 65% of domestic arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period.
3. 60% of domestic arriving flights to Chennai had an Air delay of equal to or less than 10 minutes during the CDM period.

VIII.   Tangible Benefits due to ATFM Measures

A modest attempt is made to find out the tangible benefit of ATFM measures applied.

Assumptions:

•When ATFM measures are not in force, all flights take off at their ETOT where Estimated take off time(ETOT)= Estimated off block time(EOBT) + default taxi time

•All flights have an Estimated elapsed time(EET) as calculated by SKYFLOW using the Flight Plan information and Basic Aircraft data.

Methodology:

Air delay (with ATFM measures in force) is calculated during the period when ATFM measures are in force by summing the air delay for all the flights landing at constrained Airport.

i.e. **Total Air Delay = ∑ (Actual Flying time – SKYFLOW calculated EET)**

Air delay (with no ATFM measures) is calculated as the sum of Air delay for all the flights during the above said period with no ATFM measures in place and the air delay for each flight is the difference in its ideal landing time and its ideal estimated landing time.

Total Air Delay (with no ATFM measures) = ∑ (Ideal LDT - Ideal ELDT)

*Ideal LDT is taken by assuming every flight is landing at a specified interval based on the Arrival acceptance rate(AAR) defined,

*Ideal ELDT = ETOT + SKYFLOW calculated Flying time

Fuel Saving Calculation :

Great Circle Distance(GCD)* was calculated for all the arrivals during the ATFM Measure from the point of origin to destination. Assuming Airbus 320 as reference aircraft for flights (flight distance equal to or less than 3000 nm) and B777 for international flights (flight distance more than 3000nm):

Fuel consumption (Kgs / nm) for each affected flight in the scenario was then calculated using the Reference document: ICAO Carbon emissions calculator methodology, version10, Appendix C: ICAO Fuel Consumption Table.

The Fuel consumed per minute(Kg/min) was calculated for each affected flight.

Total Air Delay(with ATFM Measures)= 71485 mins

Total Air Delay (with no ATFM measures) = 117073 mins

Reduction in Air delay due to ATFM measures= (117073-71485) = **45588 mins**

Fuel Saving Calculation:

Total Fuel saved during the ATFM Measure: ***30,45,064.079 Kg***

Total reduction in CO_2 emission : 3.16(KgCO_2/kg fuel)* 30,45,064.079 Kg = 96,22,402.49 Kg

*GCD (Great Circle Distance): The distance between origin and destination airports is derived from latitude and longitude coordinates originally obtained from ICAO Location Indicators database.

3.16 = constant representing the number of tonnes of CO2 produced by burning a tonne of aviation fuel.

D. Glossary

ATFM Parameters	**Definition**
Affected Flight statistics	An insight of participating traffic in the scenario i.e. ratio of the domestic arrivals to the constrained airport affected by ATFM measures (assigned delay by the Ground Delay Program) to the domestic arrivals not affected by ATFM measures (not assigned any delay) within the CDM scenario.
ATFM Ground delay	ATFM ground delay defined as CTOT-ETOT (Calculated take off time – Estimated take off time)
Average ATFM delay	$$\frac{\textit{Total monthly ATFM delay (in minutes)}}{\textit{Total Domestic Arrivals}}$$
Maximum ATFM delay	Maximum ATFM delay (in minutes) assigned in the month
Overall compliance rate	Defined as monthly ATFM departure slot adherence rate of regulated flights. Flights having ATOT within theATFM Slot Tolerance Window (STW) of minus 5 to plus 10 minutes of CTOTs, are considered as compliant flights
CTOT Compliance rate of Airline operators	An overview of CTOT compliance rate of various Airline operators
CTOT Compliance rate of Airports within different Regions	An overview of CTOT compliance rate of Airports within 4 FIRs
Air delay statistics	Air delay defined as difference between AET & EET, whereAET(actual elapsed time) can be obtained from (ALDT-ATOT) and estimated elapsed time(EET)can be obtained from FPL/RPL or (CLDT-CTOT). **Therefore, Air delay = AET-EET** Average Air Delay is calculated as: $$\textit{Average Air Delay} = \frac{\textit{Total Air Delay to domestic arrivals (with values greater than zero)}}{\textit{Total Domestic Arrivals}}$$ *CLDT: Calculated Landing Time* *CTOT: Calculated Take off Time* *ALDT: Actual Landing Time* *ATOT: Actual Take off Time*

Annexure-A

Compliance by Airlines with Flight Planning Requirements of Common Business rules(CBR)- July 2024.

I. Introduction:

Accurate and timely input in respect of flight intent is paramount to the correct traffic demand projection and eventually effective ATFM implementation. FPLs remain the main source of tactical demand prediction for ATFM systems. Early filing of error free FPL helps in improving the lead time required for ATFM measures and reduces the number of unexpected flights(pop-up). This in turn helps in improving the accuracy of demand-capacity imbalance prediction and optimizes slot utilization.
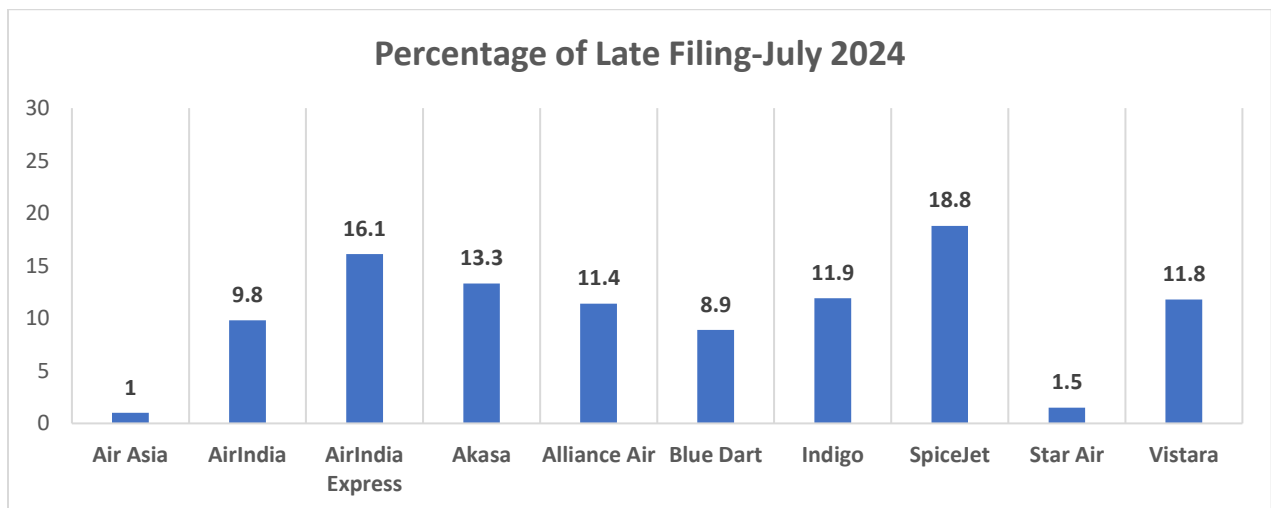
AIP India, ENR 1.9 section 4 on Flight Planning in the context of ATFM recommends Flight Planning requirements for all Airline Operators –

a) Flight plans shall be submitted at least 3 hours before the estimated off block time (EOBT);
b) The window for filing FPL is between 3 Hours and 120 Hours (Five days) before the EOBT. Earlier filing of FPL will give a realistic demand data to the CCC and hence the requirement of ATFM measures can be identified early for better planning. Late filing of a flight plan will lead to inaccuracies in predicting the demand and may lead to undesirable delay;"

II. Analysis

A. An analysis has been conducted to find out the difference between the flight plan filing time and filed EOBT for all the FPLs received at ATFM system from 1st July 2024 to 31st July 2024.
The purpose of the analysis is to monitor the compliance with provisions of AIP India, section 4, ENR 1.9 regarding Flight Planning requirements in context of the ATFM.

This flight plan filing requirement has been reiterated through the recently agreed ATFM common business rules (CBR) document and is recognized as a metrics to be monitored regularly for any improvement.

Percentage of Late Filing-July 2024

| Airline	Percentage
Air Asia	1
AirIndia	9.8
AirIndia Express	16.1
Akasa	13.3
Alliance Air	11.4
Blue Dart	8.9
Indigo	11.9
SpiceJet	18.8
Star Air	1.5
Vistara	11.8

The table below lists number of filed flight plans (FPLs) with less than 3 Hours prior to EOBT:

Name of Airline	Late Filed FPL	Total No. Of FPL	% Delayed Filing
Air Asia	43	4138	1
AirIndia	1474	14942	9.8
AirIndia Express	1089	6745	16.1
Akasa	539	4047	13.3
Alliance Air	331	2894	11.4
Blue Dart	63	702	8.9
Indigo	7528	63002	11.9
SpiceJet	828	4392	18.8
Star Air	20	1300	1.5
Vistara	1220	10293	11.8
Total no. of FPLs for Scheduled Airlines	**13135**	**112455**	**11.6**

B. For the analysis of non-receipt of DLA (Delay) messages for flight plans filed, the EOBT of FPL received has been compared with Actual Take off time (ATOT)received through DEP(Departure)messages.
Thus, only those FPLs were considered for analysis for which DEP messages were available and no associated DLA messages was received.

The Table below lists number of flights for which no DLA message was received in July 2024. **{(EOBT of original FPL)- (ATOT received)} > 30 minutes)**

Name of Airline	DLA Message not received	Total No. of flights considered for analysis	% of flights for which no DLA message was received
Air India	4782	12356	38.7
Akasa Air	1021	3498	29.1
Express India	1445	4792	30.1
Blue dart	125	611	20.4
Air Asia	644	3345	19.2
Indigo	14398	50619	28.4
Alliance Air	350	1719	20.3
Star Air	79	521	15.1
Spice Jet	1474	3338	44.1
Vistara	3418	8901	38.4

Percentage of DLA Msg not received-July 2024
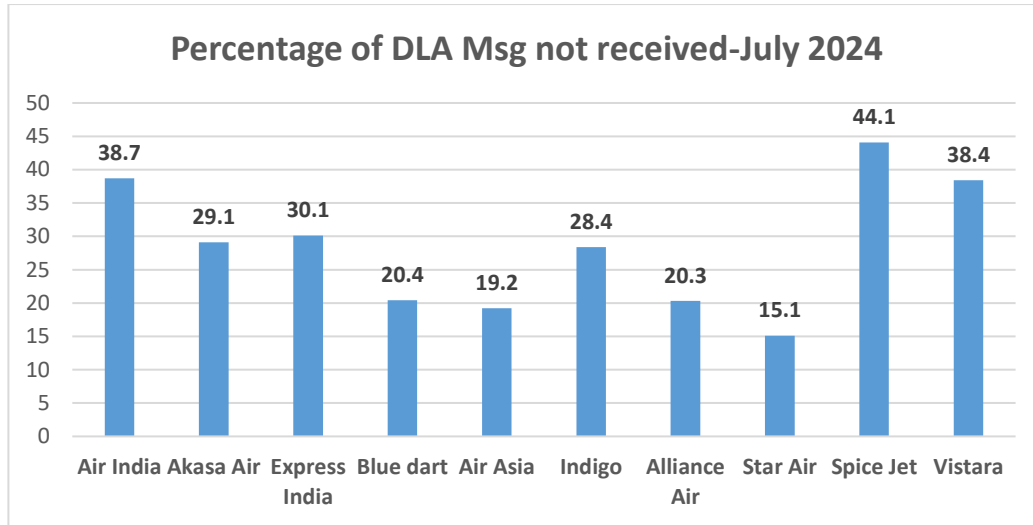
C. For analysis of non-receipt of CNL (cancel) messages for July 2024, annulled FPLs were considered for which no CNL/DEP/DLA messages were received. A FPL gets annulled in SKYFLOW system, if it doesn't get activated through Dep message /surveillance data/ manual activation by FMP within a defined system parameter.

The table below lists the number of Flights for which no CNL Msg. was received in July 2024:

Name of Airline	CNL message not received	No. of flights annulled
Air India	107	122
Akasa Air	36	36
Express India	120	137
Blue dart	14	15
Air Asia	55	59
Indigo	396	410
Alliance Air	349	350
Star Air	27	28
Spice Jet	256	258
Vistara	120	123

-End of Report-