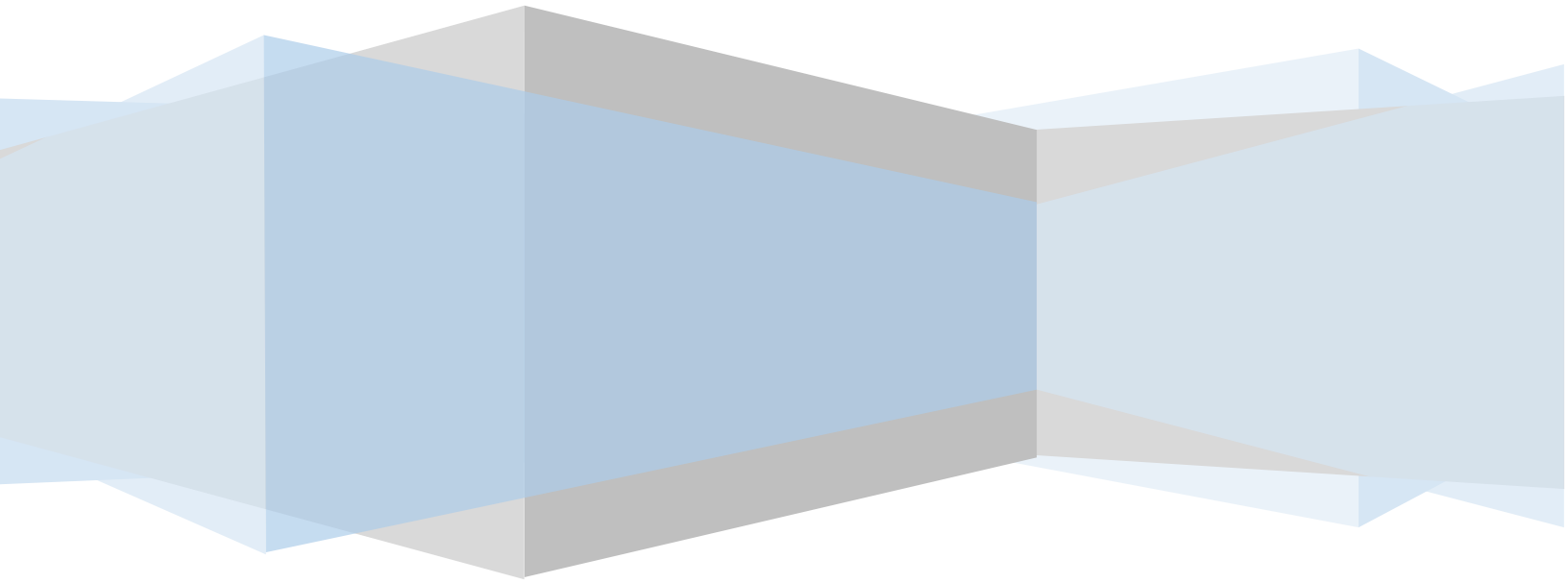
POST OPERATIONS ANALYSIS REPORT

January, 2021

CENTRAL COMMAND CENTER, C-ATFM, DELHI



Contents

List of Figures

A. Executive Summary

Scheduled domestic flights in India were completely suspended for a period of two months between March 25 and May 24, 2020, due to the coronavirus-induced lockdown. Currently, Indian Domestic carriers are permitted to operate maximum 80 percent of their Pre-Covid schedule.

Scheduled international flights continue to remain suspended in India till 1829 UTC of 28th Feb'21(NOTAM G0067/21 replacing NOTAM G1365/20). However, special international flights have been permitted since May last year under the Vande Bharat Mission and under air bubble arrangements formed with around 24 countries since July'20. Under a bilateral air bubble arrangement, airlines of the two countries can operate flights between their territories with certain restrictions.

Total ten (10) number of times ATFM measures were applied to resolve Demand Capacity imbalance in Jan'21. Most Ground delay measures were applied to cater to traffic congestion after the Airspace/Airport closure during the Republic Day Celebrations at Delhi and Scheduled Runway Maintenance & Aero India Show at Bengaluru. The average CTOT Compliance has been 75 percent for the month.

Traffic Analysis

Experts believe that the key factors that will determine the pace of recovery in the domestic market are development and availability of vaccines, people's willingness to undertake leisure travel and recovery in macroeconomic growth.

The total Air traffic movement including Passenger and Combination of other flights i.e. All-Cargo flights, International scheduled, International non-scheduled, Domestic scheduled, Domestic non-scheduled, Air taxi & commercial business flights and all other aircraft movements at six major Indian Airports namely Delhi, Mumbai, Bengaluru, Hyderabad, Kolkata and Chennai is plotted for each day of the month of Jan'21.

The data used is the movement data received from Delhi, Mumbai, Bengaluru and Hyderabad Airport. AIMS (Airport Information Management System) data is used for Kolkata and Chennai Airport. Air Traffic movement is also plotted Airline wise for the month for the major Scheduled Operators.

I. Comparison of total ATMs (YoY) and Month wise

The graph below depicts the change in total ATMs in the month of Jan'21 in comparison to the total ATMs in Jan'20 for six major airports in India. Bengaluru is showing the most recovery among the six airports i.e. the traffic at Bengaluru in Jan'21 is only 27.6% less than the traffic handled in Jan'20 whereas the traffic handled in Delhi, Hyderabad, Kolkata, Mumbai and Chennai are 32.4%, 33.3%, 36.8%, 37.9% and 40.3% respectively less than the traffic handled in Jan'20.

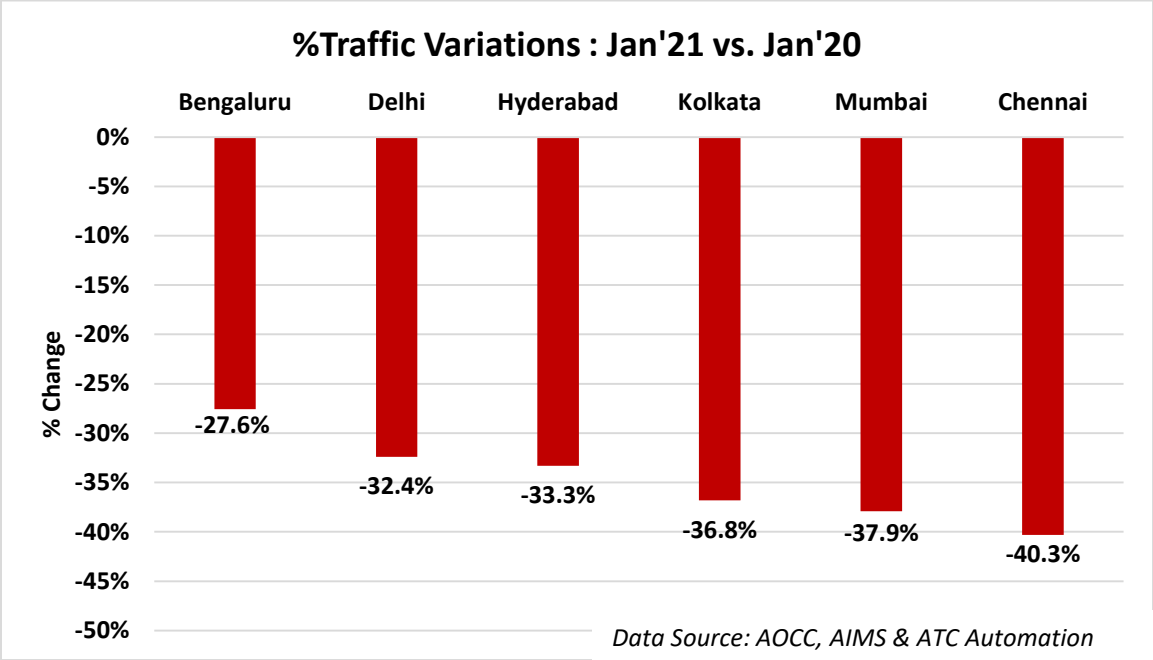
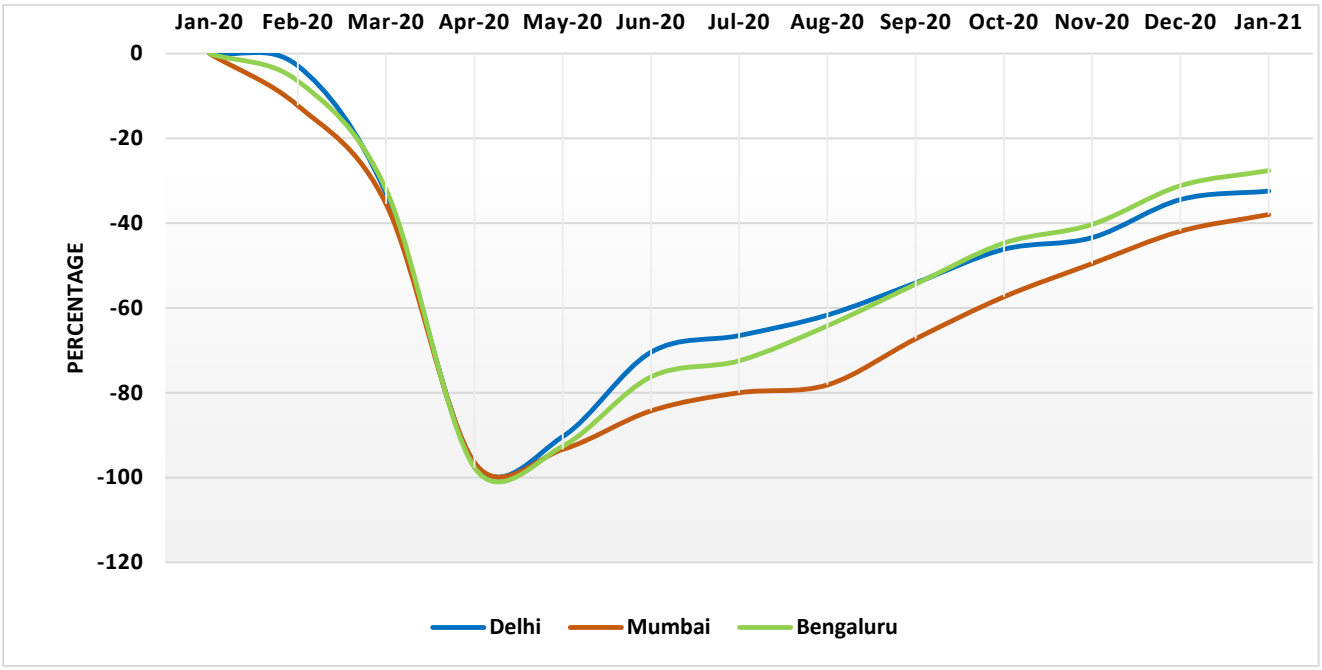


Figure 1: Percentage Traffic Variation (YoY)

	Total ATMs (YoY) for six major airports	
Airports\Year	**Jan'21**	**Jan'20**
Bengaluru	15294	21115
Delhi	28552	42261
Hyderabad	11285	16922
Kolkata	9775	15473
Mumbai	17300	27873
Chennai	9343	15672

The graphs below depict the percentage change in ATMs month wise taking Jan'20 as the reference value for the six metro Airports.



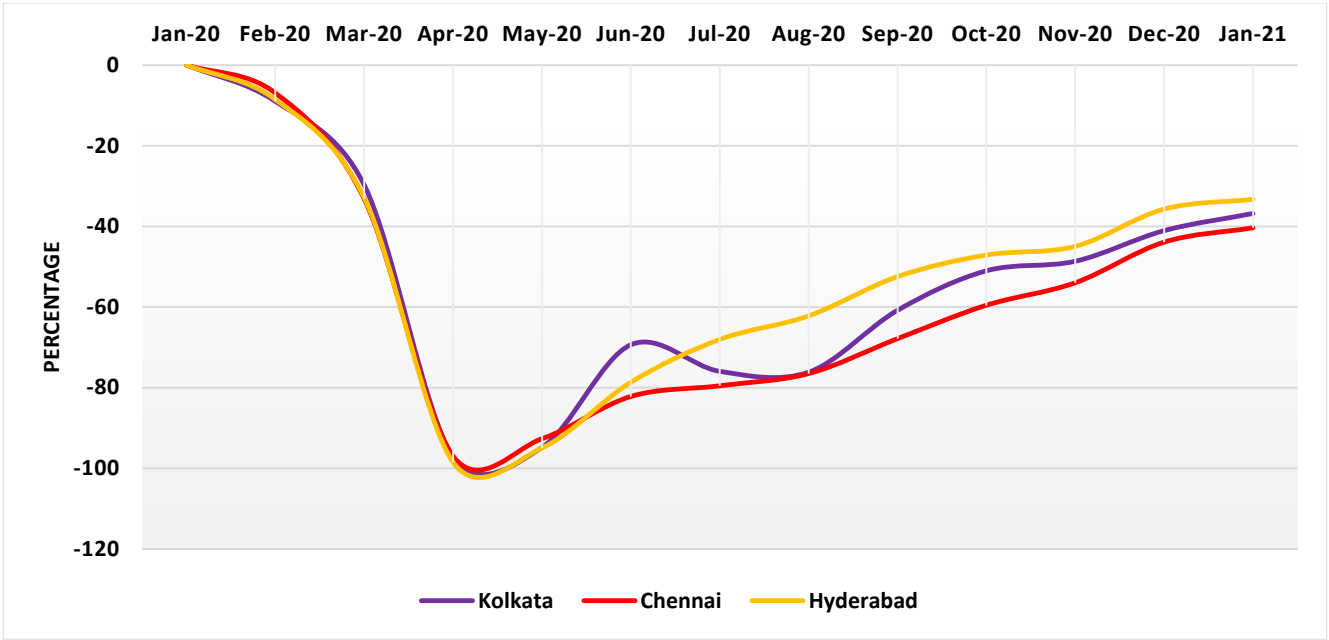


Figure 2: Percentage Traffic Variation

II. Air-Traffic Growth (Post COVID Lockdown period)

The graph below plots the percentage change per month in Air traffic (domestic and international) post Covid Lockdown and resumption of flight operations from May'20. The Indian aviation industry witnessed continued recovery in domestic passenger traffic in January'21, with a steady growth over December'20 by 5.7%.

The recovery to Pre-Covid levels as per the data available with ATFM (Average monthly Air traffic movement for the year 2019) is by Feb'21 by an optimistic estimate and by April'21 by a conservative estimate. The current trend is towards the conservative estimate as is visible from the graph below.

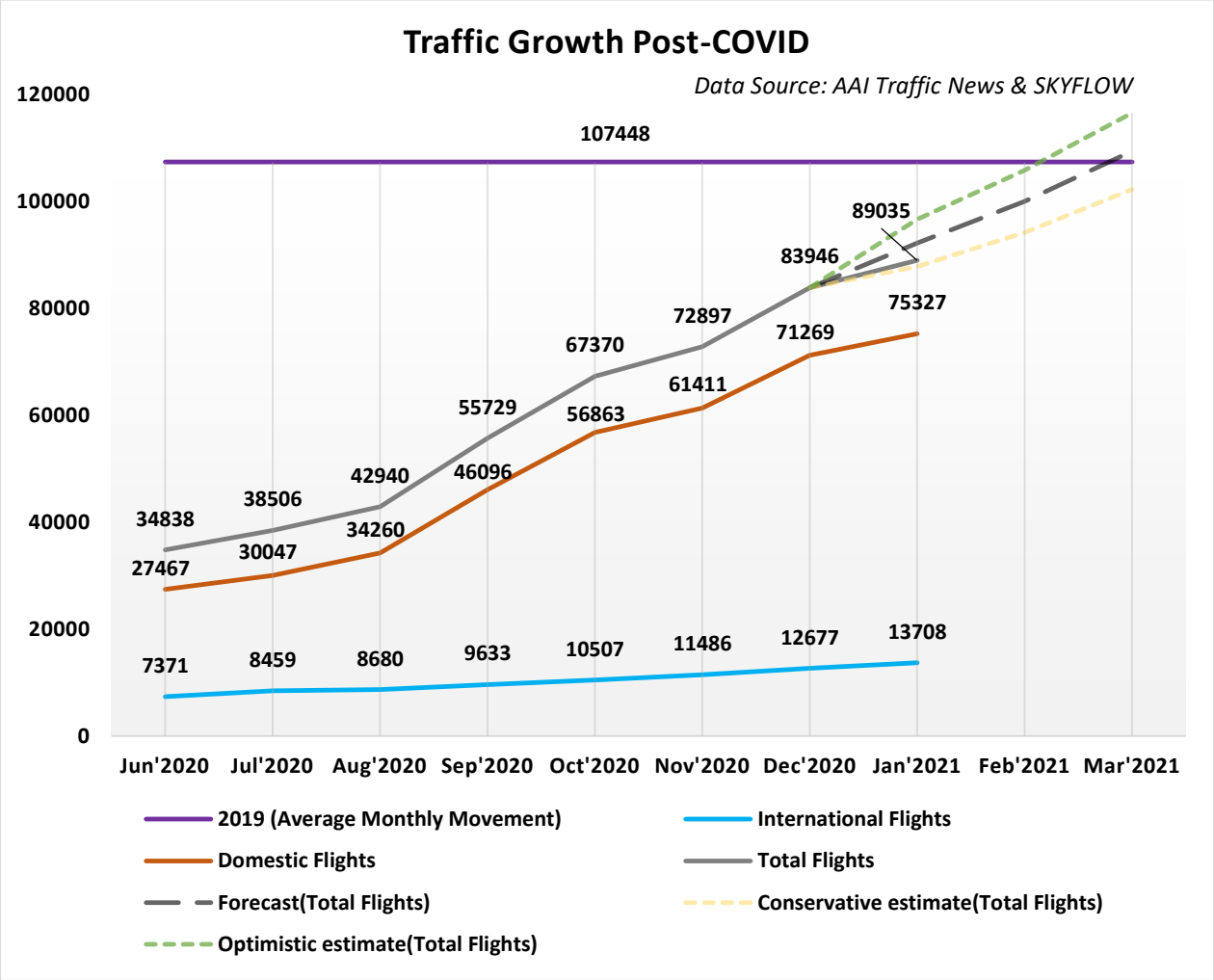


Figure 3: Traffic Growth - Post COVID

III. Flight Operations – Airline wise

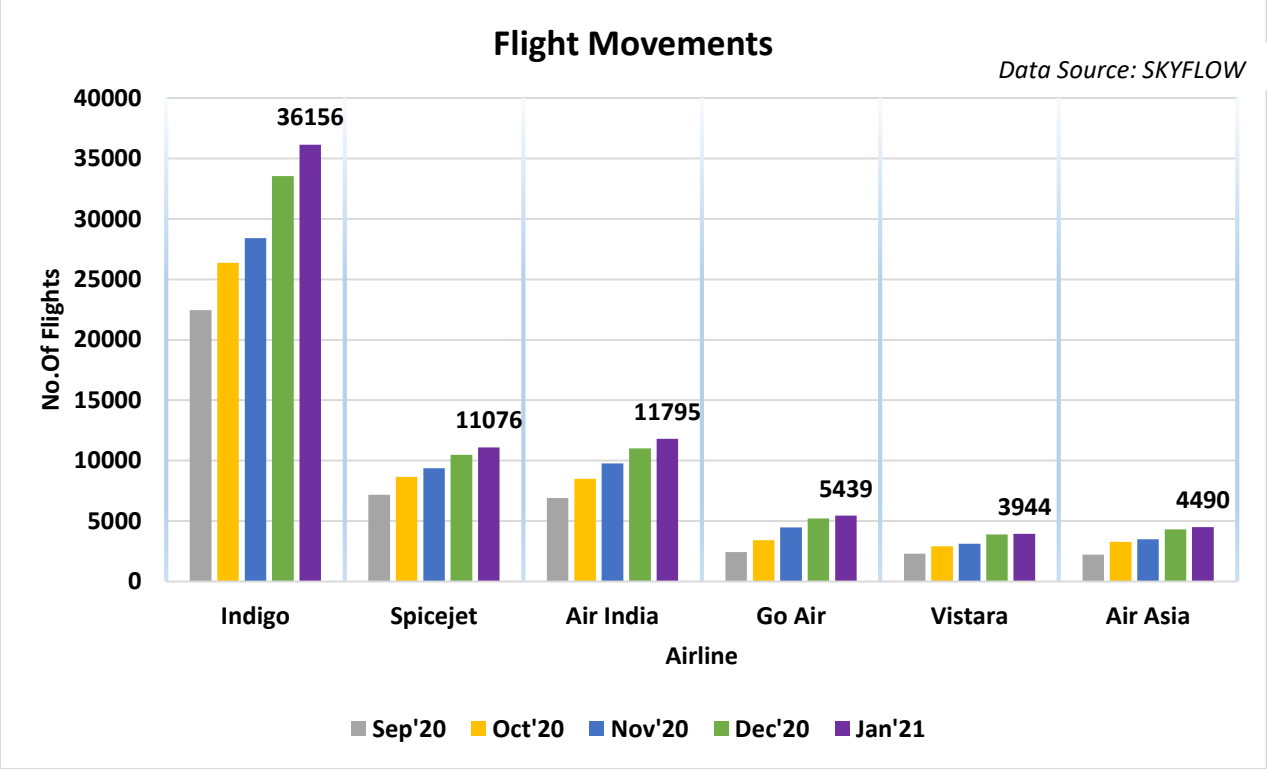


Figure 4: Flight Movements – Airline wise

B. ATFM Post Operations – CDM Analysis

I. Introduction

Analysis Period 1st – 31st January'21

Back Ground During the above mentioned period, ATFM measures were applied **four (4) times for Bengaluru Airport and six (6) times for Delhi Airport** due to the following reasons as illustrated in the bar chart below: –

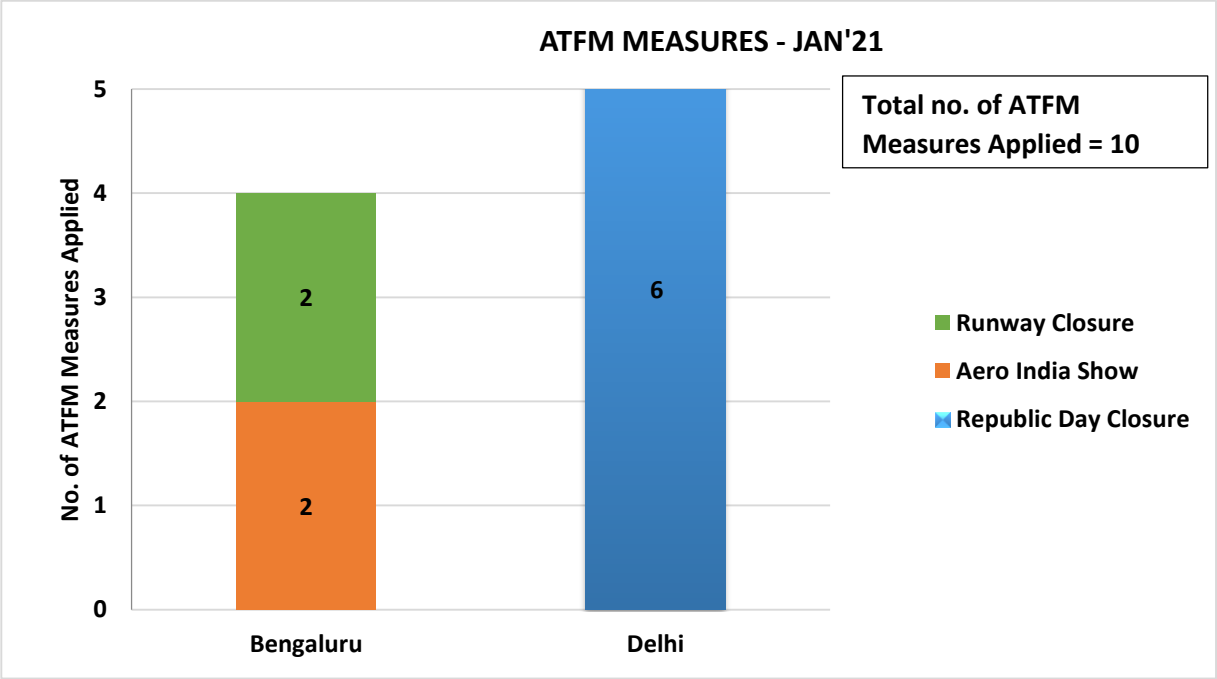


Figure 5: ATFM Measures – Jan'21

II. ATFM Measures Overview

	Delhi Airport	Bengaluru Airport
Number of ATFM measures applied	6	4
Average ATFM Ground delay due to measures	9 min	15 min
Maximum ATFM Ground delay due to measures	38 min	33 min
% Compliance	75	74

Note: $\boldsymbol{Average\ ATFM\ Delay = \frac{Total\ ATFM\ Delay}{Total\ Domestic\ Arrivals}}$

Total affected flights in scenario (Domestic Arrivals)	402
Total Domestic Arrivals with zero ATFM delay	87
Total Domestic Arrivals with ATFM delay	315

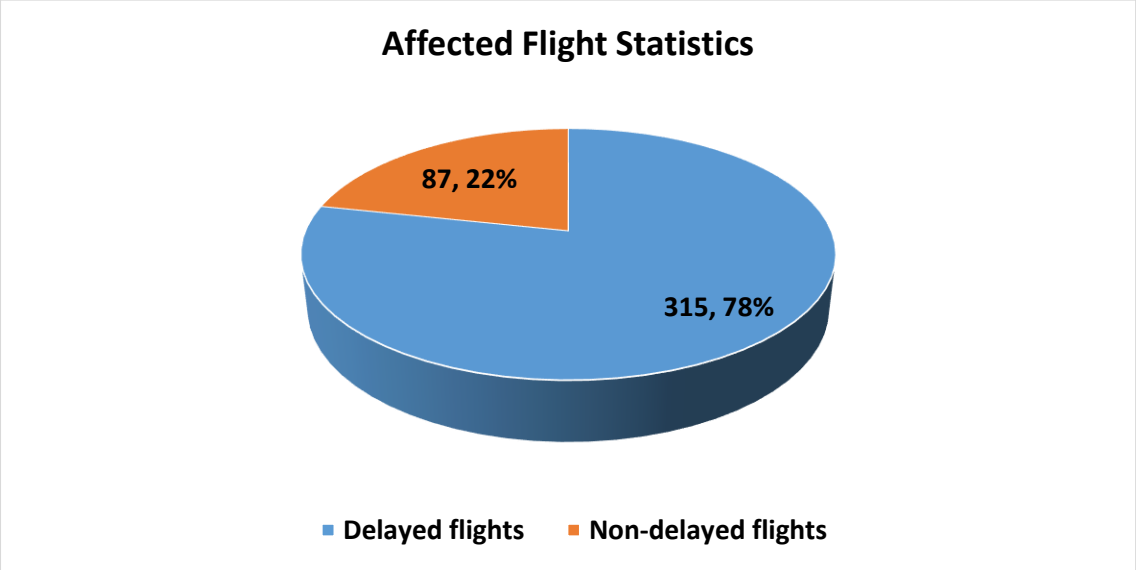


Figure 6: Affected Flight Statistics – Jan'21

III. Overall Compliance

Total Arrivals	471
Domestic arrivals	402
Flights with complete data (ATOT)	383
Flights with incomplete data	5
Flights Not Operated	14
Compliant*	286
Non-Compliant	97

Total No. of Revised CTOTs issued = 41 (Compliance calculation for flights which were issued revised CTOT is w.r.t. new CTOT issued)

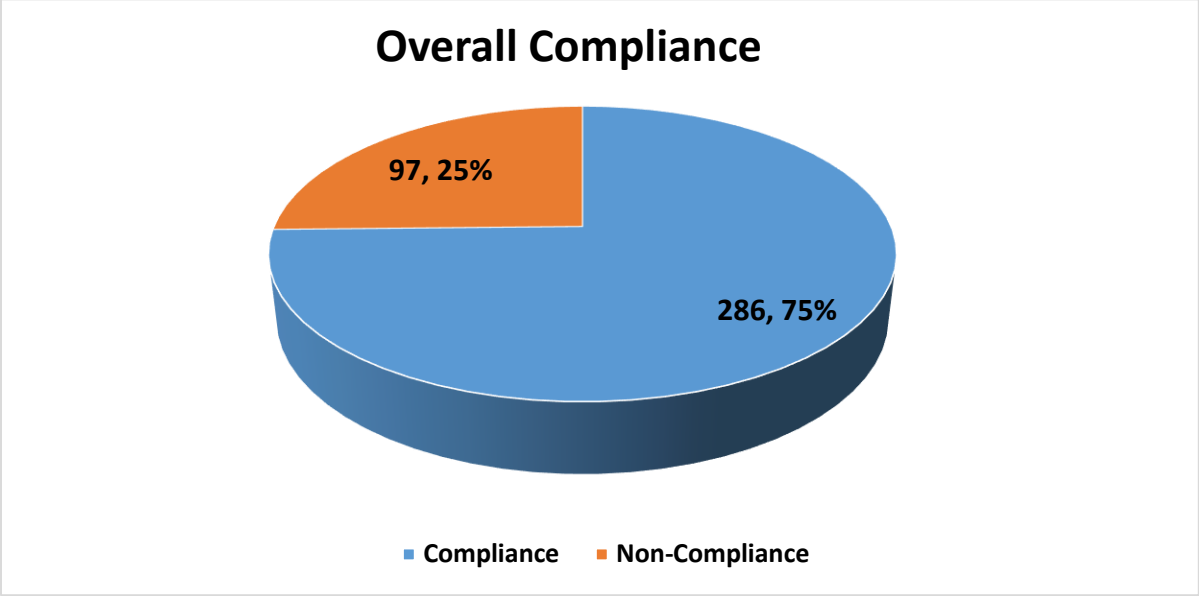


Figure 7: Overall Compliance – Jan'21

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

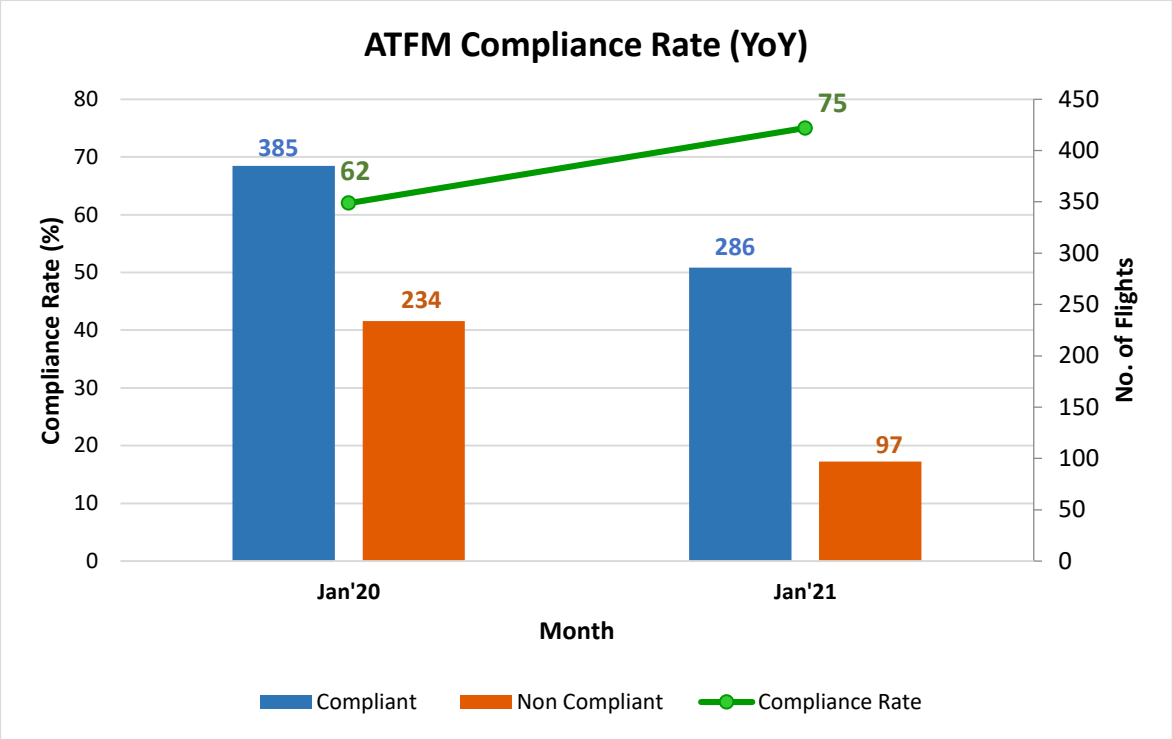


Figure 8: ATFM Compliance(YoY)

Inference

1. Out of the total arrivals captured for the constrained Airports during the CDM scenario, 85% of flights i.e. Domestic arrivals, are participating.

2. Out of these Domestic Arrivals, 78% of arrivals are assigned ATFM ground delay & 22% of flights are without any ATFM ground delay.

3. Out of the total arrivals captured to the constrained Airport during the ATFM scenario, 67% of flights are assigned ATFM Ground Delay.

4. CTOT Compliance is much higher in Jan'21 as compared to Jan'20.

IV. CTOT Compliance rate – Airport wise

MUMBAI FIR (88%)*	Compliant	Non Compliant	%Compliant
Mumbai	13	2	87
Pune	19	3	86
Aurangabad	6	0	100
Bhopal	8	0	100
Ahmedabad	9	0	100
KOLKATA FIR (76%)*			
Bagdogra	11	8	58
Gorakhpur	6	7	46
Kolkata	11	2	85
Ranchi	14	0	100
Varanasi	11	2	85
DELHI FIR (58%)*			
Delhi	8	4	67
Chandigarh	8	9	47
Leh	13	10	57
Dehradun	6	4	60
Srinagar	8	7	53
CHENNAI FIR (79%)*			
Chennai	8	2	80
Coimbatore	6	0	100
Hyderabad	22	3	88
Vishakhapatnam	7	2	78
Cochin	8	2	80

**FIR wise compliance rate*

V. CTOT Compliance rate – Airline wise

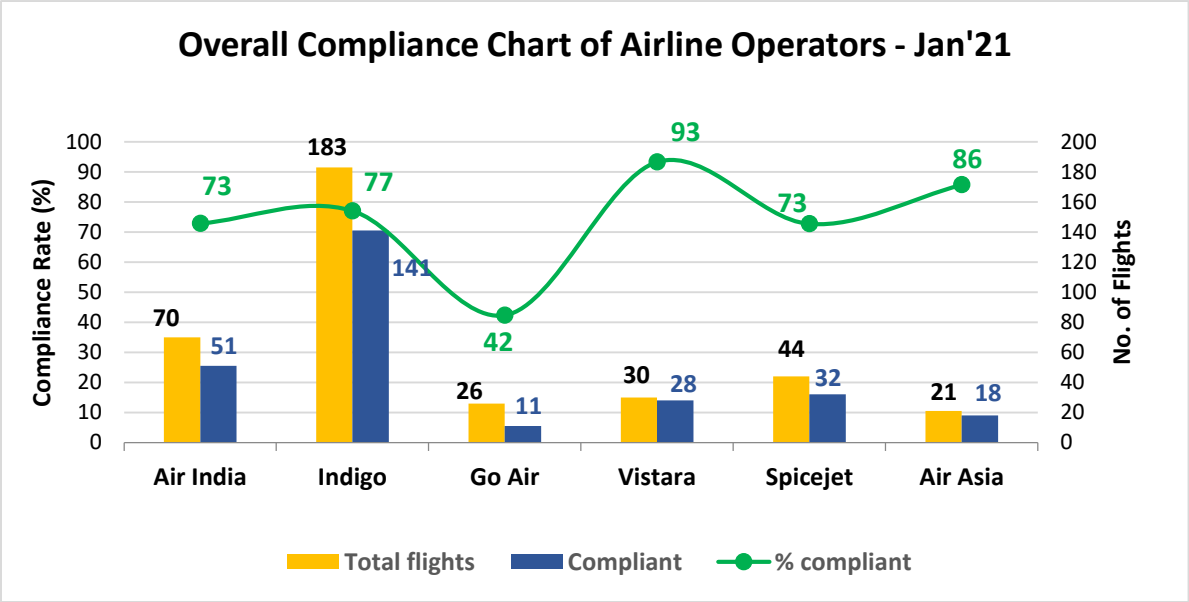


Figure 9: Airlines Overall Compliance – Jan'21

Inference

1. Out of the total domestic arrivals with complete data in the CDM scenario, 75% arrivals are compliant.
2. Mumbai region has the highest compliance rate of 88% whereas Delhi region has the lowest compliance rate of 58%.
3. Indigo, Vistara and Air Asia Airlines have a compliance rate above the average recorded 75% compliance.

VI. Air Delay during the CDM Scenario period

Average Air Delay to domestic arrivals* within the CDM Scenario period for Bengaluru is 11 minutes and Delhi is 3 minutes.

**Note: Only calculated for domestic arrivals with both ATOT and ALDT information*

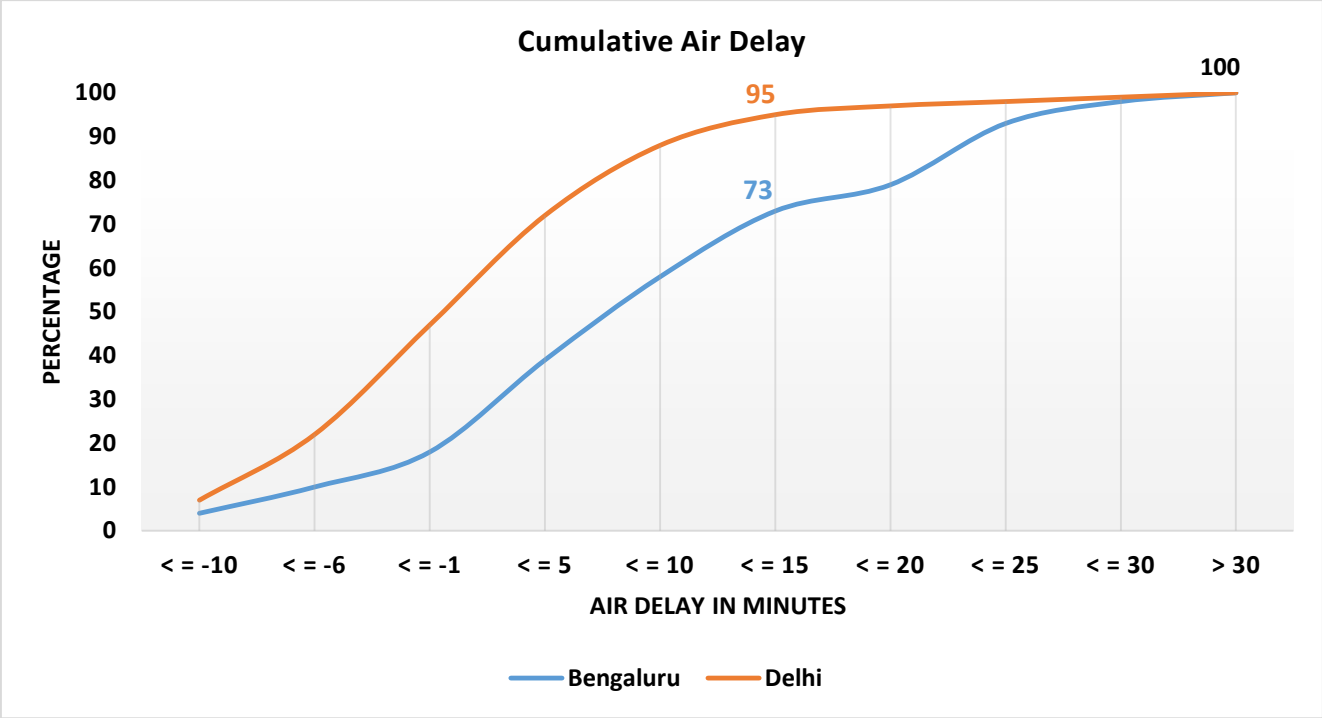


Figure 10: Cumulative Air Delay during CDM period

Inference

1. 95% of arriving flights to Delhi had an Air delay of equal to or less than 15 minutes during the CDM period.
2. 73% of arriving flights to Bengaluru had an Air delay of equal to or less than 15 minutes during the CDM period.

C. 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	$\frac{\boldsymbol{Total\ monthly\ ATFM\ delay\ (in\ minutes)}}{\boldsymbol{Total\ Domestic\ Arrivals}}$
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 the ATFM 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, where AET(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: $\boldsymbol{Average\ Air\ Delay} = \frac{\boldsymbol{Total\ Air\ Delay\ to\ domestic\ arrivals\ (with\ values\ greater\ than\ zero)}}{\boldsymbol{Total\ Domestic\ Arrivals}}$ *CLDT: Calculated Landing Time* *CTOT: Calculated Take off Time* *ALDT: Actual Landing Time* *ATOT: Actual Take off Time*

ANNEXURE-I

CASE STUDY

Republic Day Airspace Closure(2021)

A. Introduction:

Due to Republic day celebrations, Delhi Airport/Airspace was closed from 0505 to 0645 UTC on 20th – 24th and 26th Jan '21 vide NOTAM no. A0038/21 & A0041/21

(A0041/21 NOTAMN

Q) VIDF/QFAXX/IV/BO/A/000/999/

A) VIDP B) 2101200505 C) 2101260645

D) 20 21 22 23 24 26 0505-0645

E) NO LDG AND TKOF PERMITTED AT IGI AIRPORT, NEW DELHI (VIDP) DUE REPUBLIC DAY CELEBRATIONS.)

(A0038/21 NOTAMN

Q) VIDF/QRACA/IV/NBO/W/000/200/

A) VIDF B) 2101200515 C) 2101260645

D) 20 21 22 23 24 26 0515-0645

E) AIRSPACE WI A RADIUS OF 50NM AROUND DELHI VOR (DPN), EXCLUDING

AREAS OF 10NM RADIUS AROUND SIKANDRABAD VOR (SSB) AND 10NM AROUND

SAKRAS VOR (SKA), NOT AVBL DUE REPUBLIC DAY CELEBRATIONS.

F) GND G) FL200)

B. Executive Summary

A virtual meeting was conducted on 18th Jan'21 with all stakeholders' including senior officers from Delhi ATC to discuss the modalities for the upcoming Delhi Airspace/Airport closure and review last year's Airspace closure to identify bottlenecks and resolve them and incorporate best practices.

It was agreed that no ATFM measure would be applied pre Closure and Delhi ATC will be able to tactically manage the traffic effectively. Revised schedule approved by DIAL was already available with ATFM team.

A representative from Air India, Alliance Air, Air Asia & Indigo Airlines and an officer from Indian Meteorological Department(IMD) were present in CCC for all days of the Republic Day Airspace closure. Their presence helped in timely and effective coordination. All ATS in-charges/FMPs were informed to be abreast with the latest NOTAM w.r.t. republic day celebration and ensure that FMP position was manned by SKYFLOW trained staff.

C. Challenges:

1. Non-compliance of CTOT was observed from Bagdogra, Gorakhpur, Srinagar, Leh stations on 20th Jan'21. It was followed up by CCC officers.
2. Few flights which were scheduled to operate pre -closure were observed to be operating after the Airspace closure and had to be manually allotted a CTOT. No 'DLA' message was transmitted to VIDPCTFM by the airlines in such cases.
3. CTOT could not be applied through the SKYFLOW system on 22nd and 23 Jan'21 due technical glitches. The portal and the Air situation display was also not available/intermittent during the said period. The CTOTs were manually downloaded and passed to all concerned through emails, WhatsApp and telephone. It was also uploaded on the portal when it became functional.
4. CTOT dissemination to satellite remote stations still remains a challenge. Airlines are also faltering in their responsibility of apprising Air Crew about CTOT through their respective Operation Control Center.

D. Highlights:

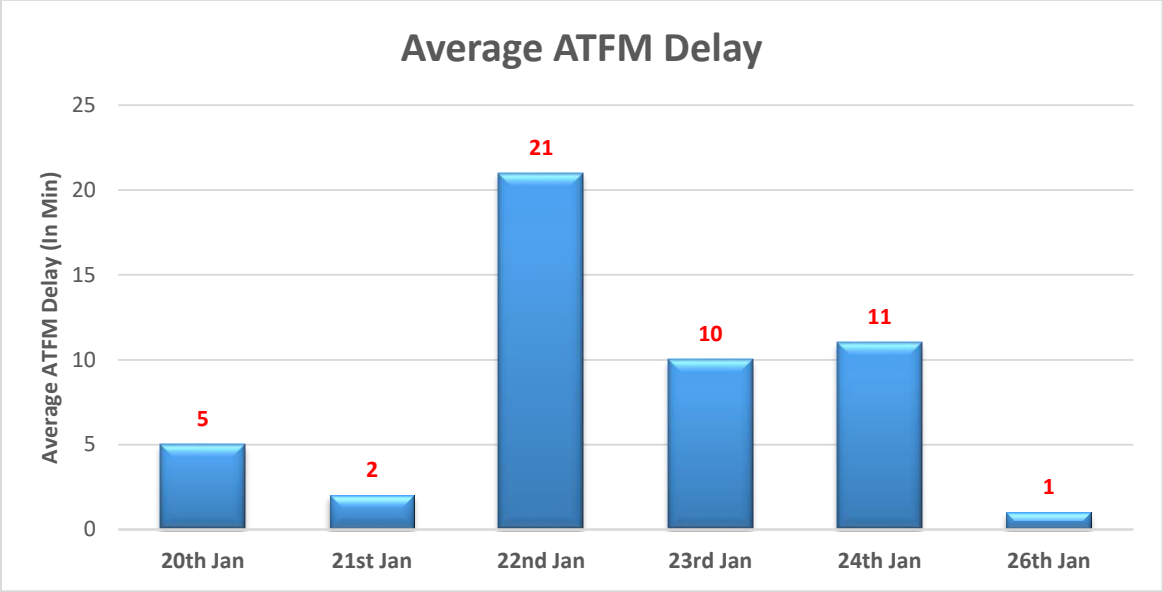
- Stakeholder's meeting prior to the closure helped in raising awareness about the applicable NOTAM and proposed ATFM measures.
- Better coordination with Delhi ATC as per the agreed plan. Pre closure traffic was handled tactically by Delhi ATC as agreed in Stakeholders Meeting and hence no measure was applied.
- Presence of Airline representatives from 4 major Airlines helped in communication flow.
- A Met Officer was available in CCC on all days of the exercise to update on weather forecast.
- Regulated flow of Air traffic to Delhi ATC post the reopening of Airspace ensured less airborne holdings.

E. Overview:

The data for the period during which ATFM measures were applied in Delhi on 20th,21st, 22nd, 23rd ,24th & 26th January 2021 was analyzed for following ATFM parameters. 83% of total arrivals (339) consisted of Domestic traffic and were issued CTOT. 17% of total traffic consisted of international arrivals which were exempted from any ATFM measures.

(*Flights with complete data i.e. ATOT, ALDT etc. are only taken into consideration. ATOT was obtained from all concerned airports for verifying CTOT compliance.)*

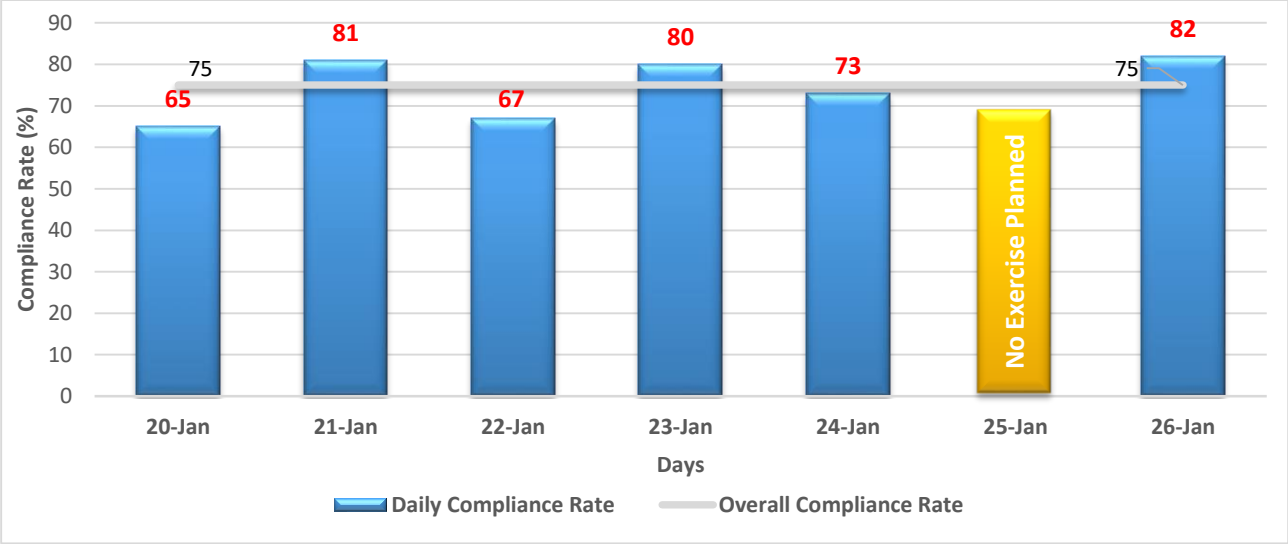
- Average delay due to ATFM measures during the CDM period on various days of exercise are as presented below.



Inference

- The Average Ground delay due to ATFM measures was highest on 22nd Jan'21 and 24th Jan'21 because arrivals were planned only after 0645 UTC as advised by IGI ATC Coordinator.
- Average Ground delay is less on other days because arrivals were planned from 0620 UTC.

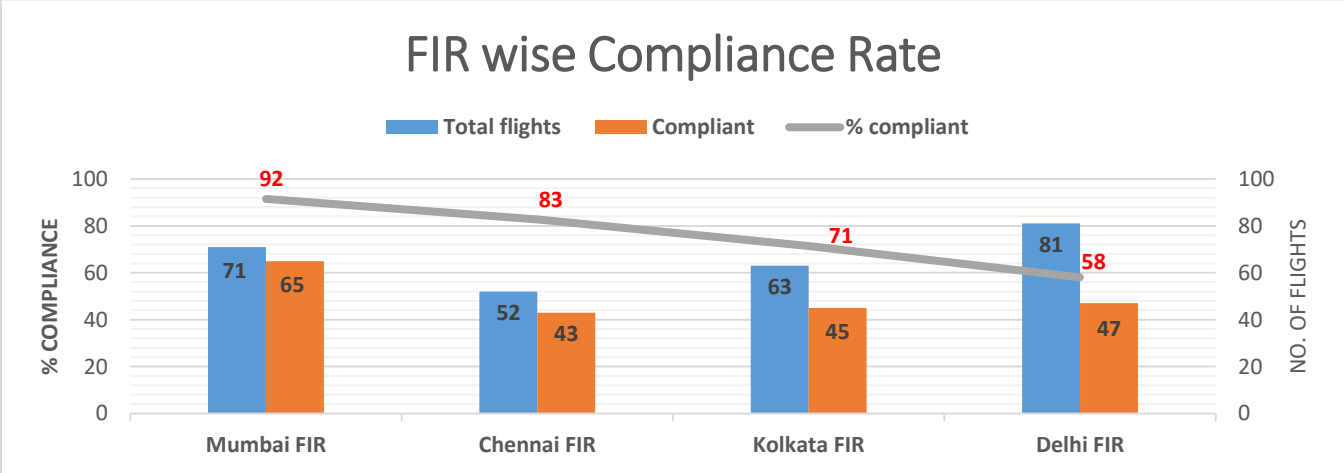
I. CTOT Compliance – Day wise:



Inference

- CTOT compliance rate was highest on 26th Jan due to Stakeholders participation and preparedness of the FMPs.
- CTOT compliance rate was lowest on 20th Jan (65%). Few Non-compliance were observed from Bagdogra, Gorakhpur, Srinagar, Leh, Shirdi.

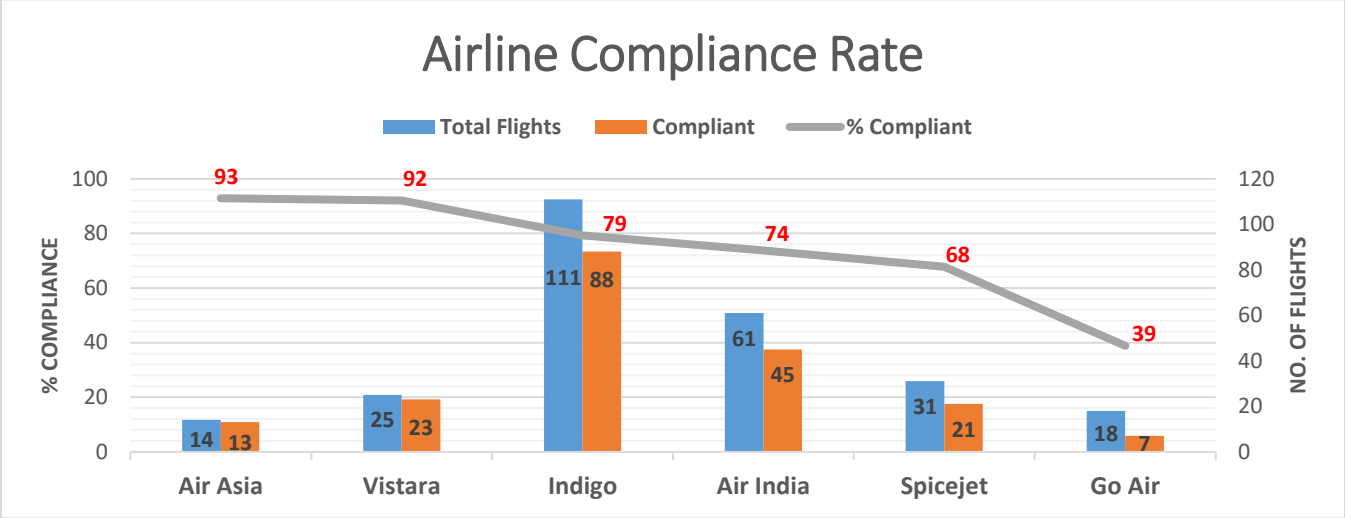
II. CTOT Compliance (FIR-wise) during the Republic day Airspace Closure:



Inference

- Mumbai FIR had the highest compliance rate of 92% whereas Delhi FIR had the minimum compliance rate of 58%.

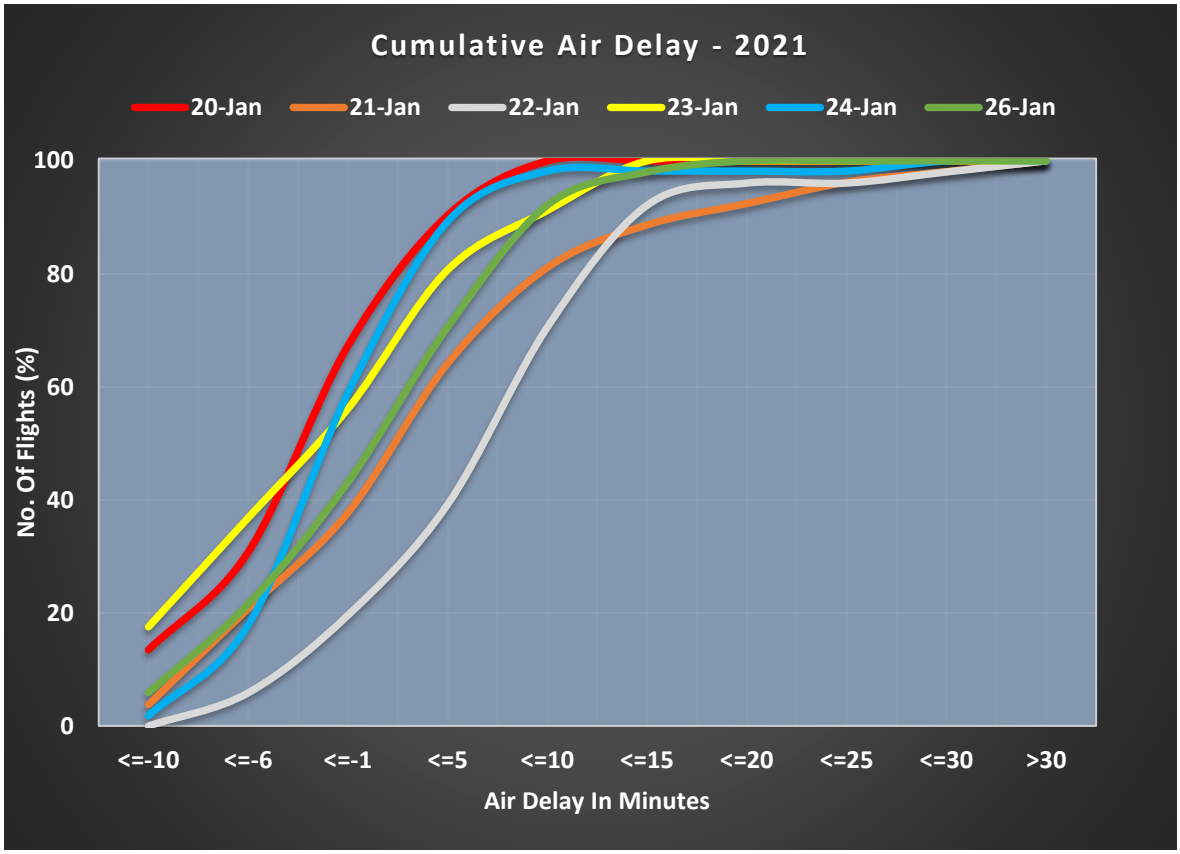
III. CTOT Compliance (Airline-wise) during the Republic day Airspace closure:



Inference

- Air Asia Airlines had the highest compliance rate of 93% whereas Go Air had the lowest compliance of 39%.

IV. Cumulative Air Delay Post Closure Period:



Inference

I. 100% of arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period on 20th Jan'21.
II. 81% of arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period on 21st Jan'21.
III. 71% of arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period on 22nd Jan'21.
IV. 91% of arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period on 23rd Jan'21.
V. 98% of arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period on 24th Jan'21.
VI. 92% of arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period on 26th Jan'21.

V. Fuel Saving due ATFM Measures on 26th Jan'21

Introduction:

A modest attempt is made to find out the tangible benefit of ATFM measures applied. A Sample study was conducted to calculate Fuel Saving due ATFM measures on 26th Jan'21 (0600-0800 UTC)

Republic day closure in Delhi entails a closure of the Delhi Airport/Airspace for almost 0140 hours on 26th Jan.

As coordinated tactically at 0330 UTC on 26th Jan'21 with Delhi ATC, the Airport was likely to be available for civil traffic from 0625 UTC and ATFM measures were planned to address any congestion arising soon after the availability of Airspace.

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.

•Landings at IGI Airport take place every 100 seconds, considering an Airport acceptance rate of 36 in two Runway configuration.

•Average Aircraft fuel burn rate = 40 litre/min

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 Delhi 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 Delhi with alternate spacing interval of 1 min and 2min.

*Ideal ELDT = ETOT + SKYFLOW calculated Flying time

Where ideal ELDT= ETOT+ SKYFLOW calculated estimated elapsed time

Actual Calculation during the CDM Period (0600 UTC to 0800 UTC)

Total Air delay (with ATFM measures) =48 min

Total Air delay (with no ATFM measures) = 200 min

Total amount of Air delay reduced due to ATFM measures= 200-48= 152 min

Fuel Saving Calculation:

Average Aircraft fuel burn rate = 40 litre/min

Fuel saved by reducing Air delay = 152 x 40= 6080 litre

Cost of Air Turbine Fuel = ₹ 50,978.78 per kl

Cost Saving = 50978.78 x 6.08 = ₹ 3,09,951

***** *the air delay sheet is attached for reference*

Calculation Sheet

Indicativ	ADEP	CTOT	ATOT	CLDT	ALDT	Delay	AIR DELA	Ideal ELDT	Ideal LDT in case no ATFM	AIR Delay with NO ATFM
IGO2184	VOBZ	04:20	04:18	06:25	06:25	00:00	-17	06:25	06:25	0
GOW203	VILH	05:30	06:44	06:34	07:54	00:00	9	06:34	06:34	0
IGO398	VERC	04:57	05:02	06:37	06:38	00:02	-11	06:35	06:36	1
AIC411	VIDN	06:02	06:15	06:38	06:44	00:02	-4	06:36	06:37	1
UPS15	VTBS	02:45	02:45	06:36	06:41	00:00	-2	06:36	06:39	3
IGO602	VAPO	04:45	04:42	06:39	06:29	00:00	9	06:39	06:40	1
IGO138	VEGK	05:35	05:36	06:47	06:47	00:00	-7	06:47	06:47	0
KMF933	OAMS	04:45	07:05	06:50	09:06	00:00	-8	06:50	06:50	0
IGO2726	VOVZ	04:50	04:53	06:52	06:57	00:00	6	06:52	06:52	0
IAD903	VABB	05:13	05:15	06:56	06:51	00:03	1	06:53	06:53	0
SEJ288	VEBD	04:45	04:47	06:53	07:08	00:00	6	06:53	06:55	2
AIC214	VNKT	05:30	06:17	06:55	07:51	00:00	1	06:55	06:56	1
VTI830	VOHS	05:01	05:01	06:57	06:55	00:01	3	06:56	06:58	2
IGO2427	VIJO	06:06	06:06	06:58	06:48	00:01	0	06:57	06:59	2
AIC482	VABP	06:01	06:03	06:59	07:07	00:01	3	06:58	07:01	3
LLR646	VIDN	06:12	06:42	07:00	07:34	00:02	4	06:58	07:02	4
IGO5002	VOHS	05:08	05:12	07:03	07:12	00:03	6	07:00	07:04	4
AIC828	VISR	05:53	05:53	07:04	07:05	00:03	20	07:01	07:05	4
FDB8759	OMDB	04:20	04:44	07:02	07:26	00:00	14	07:02	07:07	5
IGO2137	VEBN	05:52	05:54	07:06	07:03	00:02	-7	07:04	07:08	4
VTI752	VERC	05:21	05:22	07:05	07:01	00:01	-1	07:04	07:10	6
IGO2047	VOCI	04:16	04:18	07:07	07:15	00:01	5	07:06	07:11	5
GOW189	VISR	06:02	06:51	07:10	08:03	00:02	6	07:08	07:13	5
SEJ2350	VAKE	05:11	05:23	07:09	07:17	00:01	8	07:08	07:14	6
SEJ7371	VILH	06:01	05:50	07:11	06:53	00:01	-5	07:10	07:16	6
AIC405	VEBN	06:10	06:08	07:17	07:24	00:05	6	07:12	07:17	5
VTI998	VAPO	05:24	05:20	07:16	07:10	00:04	2	07:12	07:19	7
AIC106	KEWR	17:25	17:25	07:15	06:58	00:00	-10	07:15	07:20	5
AIC3450	VILH	06:07	06:14	07:18	07:21	00:02	-6	07:16	07:22	6
IGO653	VIJU	06:15	06:12	07:19	07:29	00:00	2	07:19	07:23	4
AIC3426	VISR	06:08	06:09	07:23	07:13	00:03	-4	07:20	07:25	5
IGO2169	VOCB	04:35	04:37	07:20	07:28	00:00	5	07:20	07:26	6
IGO5024	VEBD	05:12	05:23	07:22	07:42	00:02	9	07:20	07:28	8
IGO2055	VAAU	05:55	05:54	07:25	07:32	00:00	8	07:25	07:29	4
IAD829	VAPO	05:41	05:36	07:28	07:37	00:01	-7	07:27	07:31	4
KMF915	OAKB	05:50	07:22	07:27	08:59	00:00	13	07:27	07:33	6
IGO5035	VASU	06:03	06:03	07:31	07:39	00:03	0	07:28	07:34	6
VUOGT	VISG	07:05		07:32	11:31	00:00	-4	07:32	07:36	4
IGO203	VIJP	06:57	06:52	07:36	07:36	00:02	4	07:34	07:37	3
SEJ8379	VEGK	06:06	06:09	07:35	07:46	00:01	2	07:34	07:39	5
VTI960	VABB	05:45	06:08	07:34	07:50	00:00	-6	07:34	07:40	6
AIC543	VOHS	05:46	05:54	07:39	07:53	00:01	-4	07:38	07:42	4
IGO2559	VICG	06:57	07:10	07:40	07:47	00:02	13	07:38	07:43	5
SEJ7466	VAPO	05:10	05:07	07:38	07:31	00:00	-7	07:38	07:44	6
AIC851	VAAH	06:27	06:27	07:41	07:44	00:02	-4	07:39	07:46	7
AIC541	VOTP	05:25	05:37	07:43	07:56	00:00	8	07:43	07:47	4
SEJ124	VILH	06:35	06:55	07:45	07:59	00:00	5	07:45	07:49	4
IAD741	VOBL	05:30	05:39	07:47	08:16	00:00	-5	07:47	07:50	3
AIC445	VICG	07:05	07:05	07:48	07:40	00:00	-2	07:48	07:52	4
LLR806	VICG	07:05	07:18	07:55	08:10	00:00	-7	07:55	07:55	0
AIC402	VECC	05:40	05:44	07:57	07:59	00:00	-2	07:57	07:57	0
GOW132	VEPT	06:25	06:42	07:59	08:19	00:00		07:59	07:59	0

.....X.....