ATM Network Performance Report

January 2018

Foreword

Welcome to this edition of the monthly ATM Network Performance Report for January 2018. January was a good month for Network Performance - the combined 75th Percentile for Airborne Delay across the four major airports was **2.8** minutes, and the median was **0.3** minutes. These results were:

- an improvement of 0.5 minutes delay for the 75th percentile from the previous month;
- broadly in line with the same time last year; and
- met the KPI targets of 3.5 minutes and 0.6 minutes for the 75th percentile and median respectively.

The tempo of our post operational analysis has increased in recent months and examples of this are available towards the end of this report. The analysis is revealing some interesting insights and is also validating that the strategic initiatives underway will have a direct positive impact on Network Performance.

An example of this was the analysis of a three-hour period on the morning of 25 January at Melbourne. A significant factor in this event was the arrival of 12 international aircraft between 0600 and 0900 local time. This number of international aircraft across this time period is not abnormally high, however the actual arrival times of these international aircraft was between 18 and 59 minutes different from their calculated landing time (i.e. slot in Harmony). The situation was compounded by weather conditions that impacted on capacity. The outcome was a significant increase in Airborne Delays (16 minutes for the 75th upper percentile). The Long Range ATFM project will provide a solution to improve international arrival predictability and closer adherence to their assigned ATFM arrival slot. This type of analysis also supports our advocacy of airport-administered strategic slot management schemes which are aimed at balancing available airport capacity with the number of airlines and flights that plan to operate at the airport.

Regards,

Paddy Goodall,
ATM Network Services Manager.

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Summary

Overview

The combined 75th Percentile performance for Airborne Delay across the four major airports (Sydney, Melbourne, Brisbane & Perth) was **2.8** minutes, and the median was **0.3** minutes.

These monthly performance figures were

- an improvement of 0.5 minutes delay for the 75th percentile from the previous month;
- broadly in line with the same time last year; and
- met the KPI targets of 3.5 minutes and 0.6 minutes for the 75th percentile and median respectively.

Airborne Delay during January was impacted by 17 notable events. The primary trigger for these notable events was adverse weather. However, there were two notable events triggered by aircraft technical issues (departing aircraft returning to land during peak demand and an aircraft disabled on the runway).

These events and the extent of the Airborne Delay are depicted in **Figure 1**.

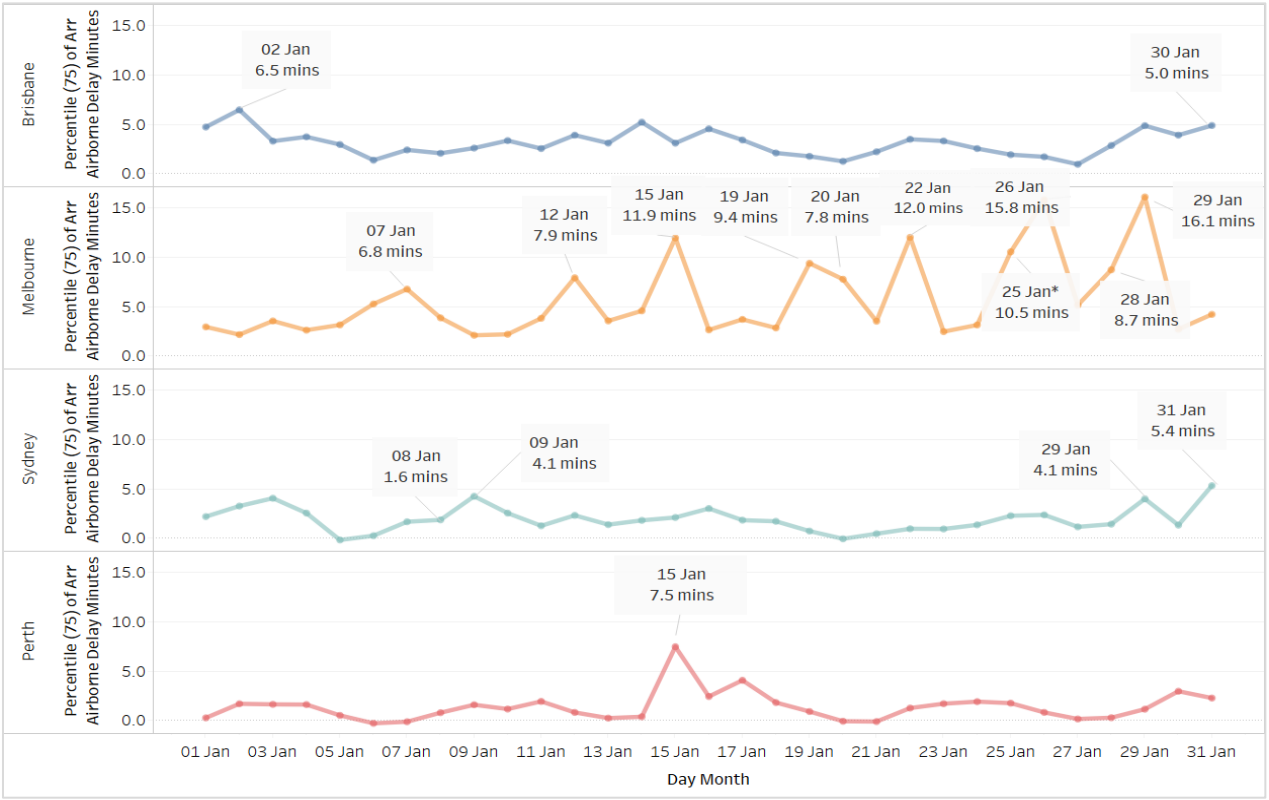

Figure 1: Notable delay impact events during January 2018 where the airborne delay is elevated for the entire day (* indicates a post operational review is available)

During the 17 notable events experienced in January, 10 resulted in a prolonged and moderately elevated Airborne Delay for the entire day (75th Percentile greater than 7 minutes across the entire day).

The other 7 events resulted in a shorter and more intense period of elevated Airborne Delay (2 or more consecutive hours where the 75th Percentile was over 10 minutes). These are summarised in **Table 1** below.

Location	Day	Local Time	Event Description
Brisbane	02 Jan	18-21	Thunderstorm activity - Level 1 revision at 1200
	31 Jan	18-19	Thunderstorm activity
Melbourne	07 Jan	16-19	Runway 16 unserviceable due to nose-wheel collapse
	12 Jan	15-16	Thunderstorm followed by low visibility
	15 Jan	08-12	Low visibility
	19 Jan	16-19	Wind and Level 1 revision
	20 Jan	07-10	Low visibility
	22 Jan	08-12	Low visibility
	25 Jan	07-10	Thunderstorms
	26 Jan	07-12	Low visibility – Level 2 revision at 0800
	28 Jan	15-19	Thunderstorms
	29 Jan	07-08	Thunderstorms followed by low vis Level 2 revision at 0700
Sydney	08 Jan	18-19	Thunderstorms and associated high winds
	09 Jan	19-21	Aircraft unwilling to make an approach due thunderstorm overhead the field for 35 minutes
	29 Jan	07-08	Low cloud
	31 Jan	08-09	Compliance issues relating to full arrival program and internationals
Perth	15 Jan	18-19	6 go arounds in the busy evening arrival period

Table 1: Notable event descriptions

Three of the 17 notable events were subject to a detailed Post Operational Performance Reviews. These Reviews are available in Appendix A - Appendix C.

The key learnings from the Reviews highlight what are already known factors in a dynamic network management system where the impacts of weather and traffic subtly change each day. The learnings were:

- Mornings with low arrival rates at Melbourne tend to see large build-up of delays due to a large proportional of international flights that arrive off-schedule. This will be addressed by the introduction of Long Range ATFM, and additionally, investigations are underway to establish the feasibility of a morning GDP revision to provide a better network outcome.
- The impact of the accuracy of pre-tactical flight time estimates in Harmony. This has been included in planning for the next software version of Harmony.

Network Wide Performance

Airborne Delay

The combined median and 75th percentile Airborne Delay at the four major airports is indicated below. **Figure 2** indicates that the long-term trend is upwards.

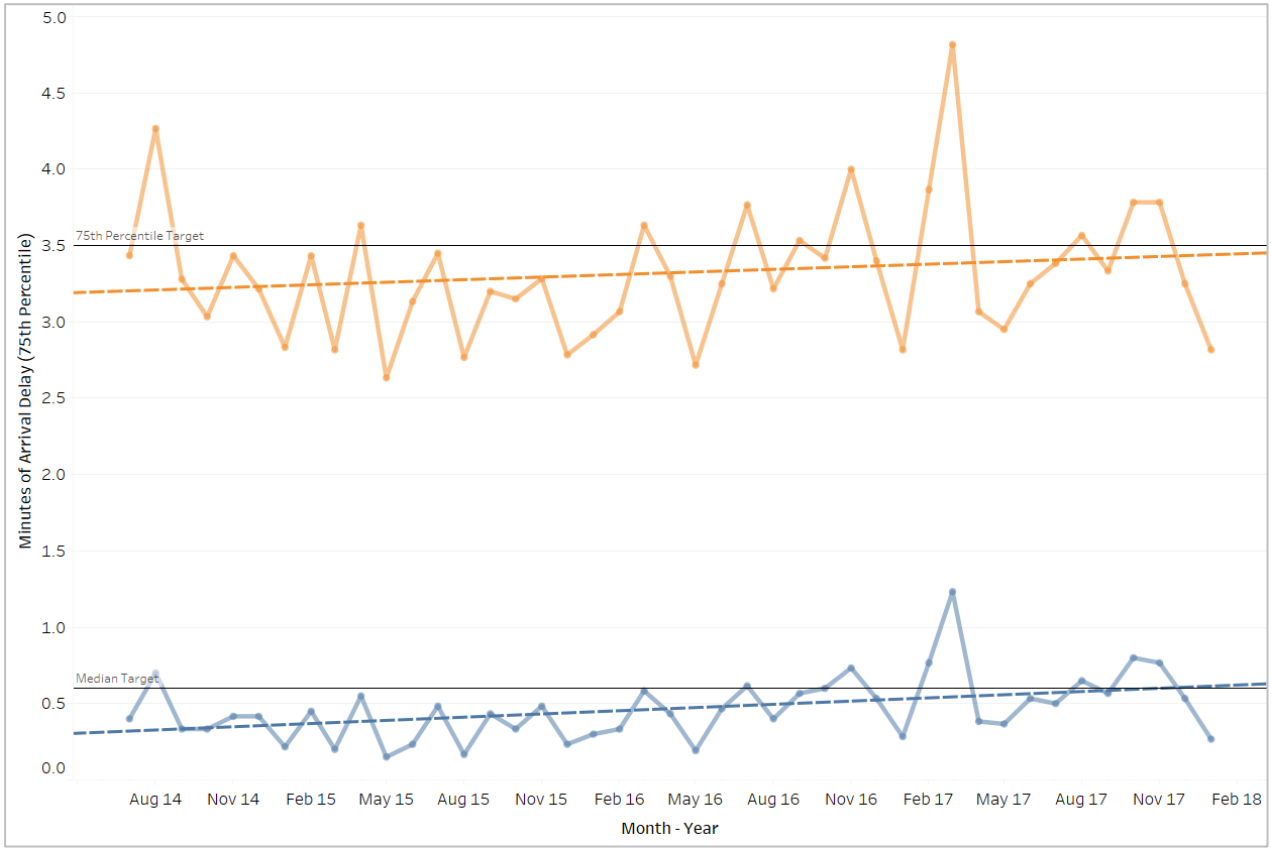

Figure 2: Long-term combined Airborne Delay median and 75th percentile (July 2014 to January 2018), and corresponding targets.

Figure 3 shows the long-term trends for each of the four major airports. The long terms trends for Sydney and Melbourne are upwards, and downwards for Brisbane and Perth. More detailed analysis is presented for each of the airports later in this report.

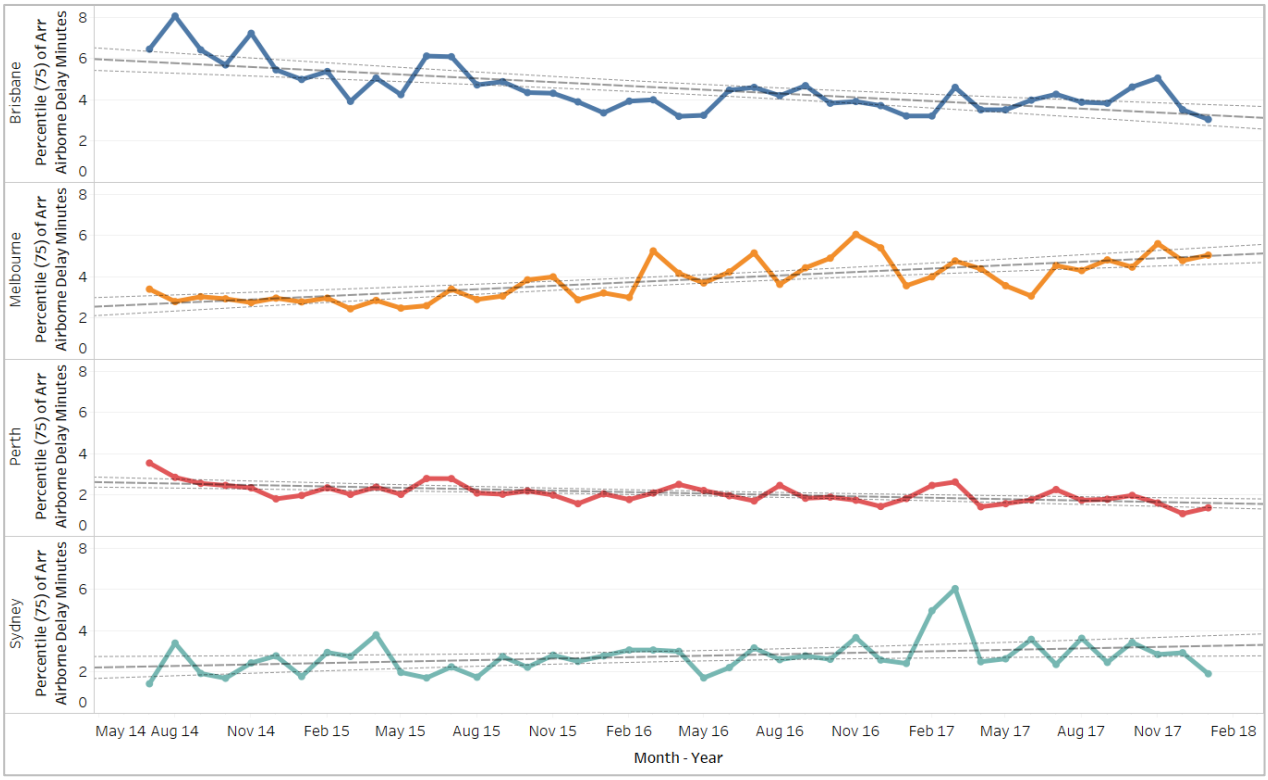

Figure 3: Long-term Airborne Delay 75th percentile by airport (July 2014 to January 2018)

Sydney

Airborne delay

The 75th percentile performance figures for airborne delay at Sydney are indicated in **Figure 4**.

Airborne delay experienced during January (1.9 minutes) met target (3.5 minutes) and was lower than from the same period last year (2.4 minutes). The long-term trend for airborne delay at Sydney is upwards.

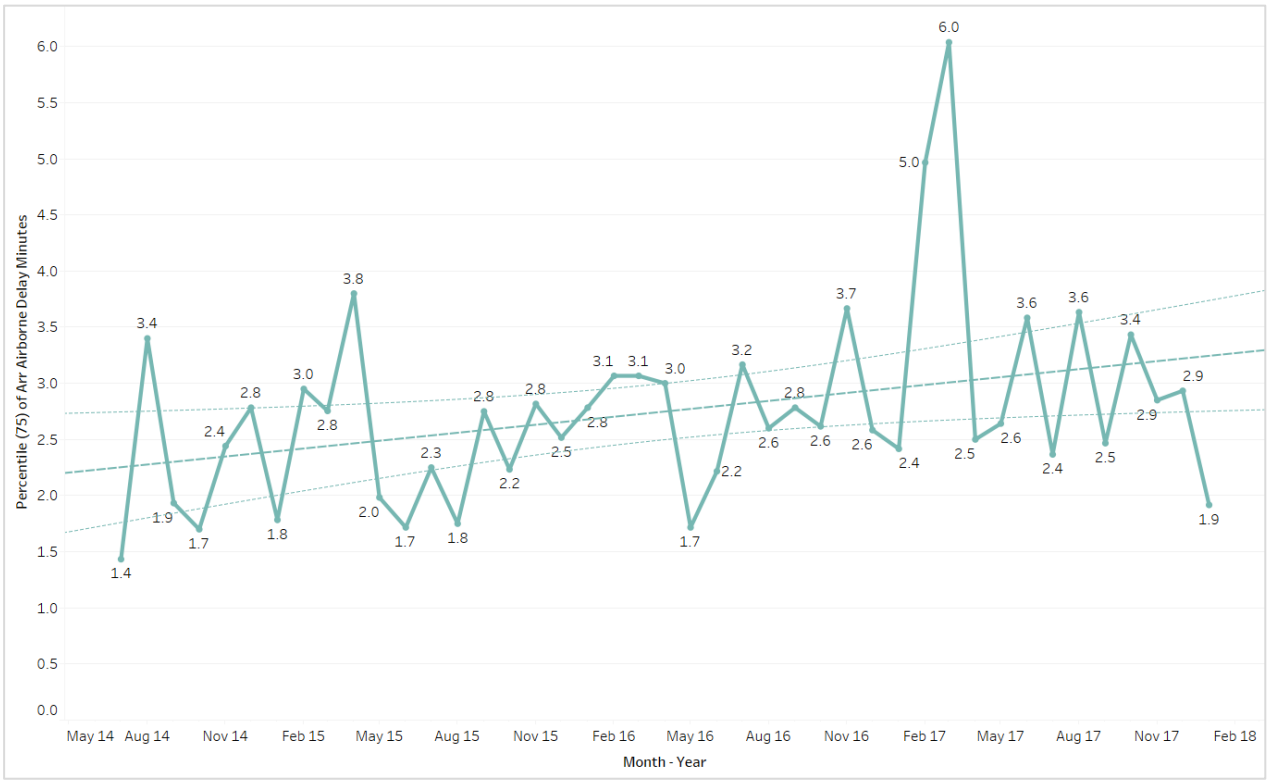

Figure 4: Sydney Airborne Delay 75th Percentile

Notable events

The following commentary describes the notable airborne delay events during January in Sydney:

- 08 Jan – Thunderstorms and associated high winds (1800 – 1900 local)
- 09 Jan – Pilots elected not to make an approach due thunderstorm overhead for 35 minutes (1900 – 2100 local)
- 29 Jan – Low cloud (0700 – 0800 local)
- 31 Jan – Landing accuracy issues relating to full arrival program and internationals (0800 – 0900 local)

Melbourne

Airborne delay

The 75th Percentile performance figures for airborne delay at Melbourne are indicated in **Figure 5.**

January performance (5.0 minutes) did not meet target (3.5 minutes) and performance was worse than the same period last year (3.6 minutes). The long-term trend for airborne delay at Melbourne is upwards.

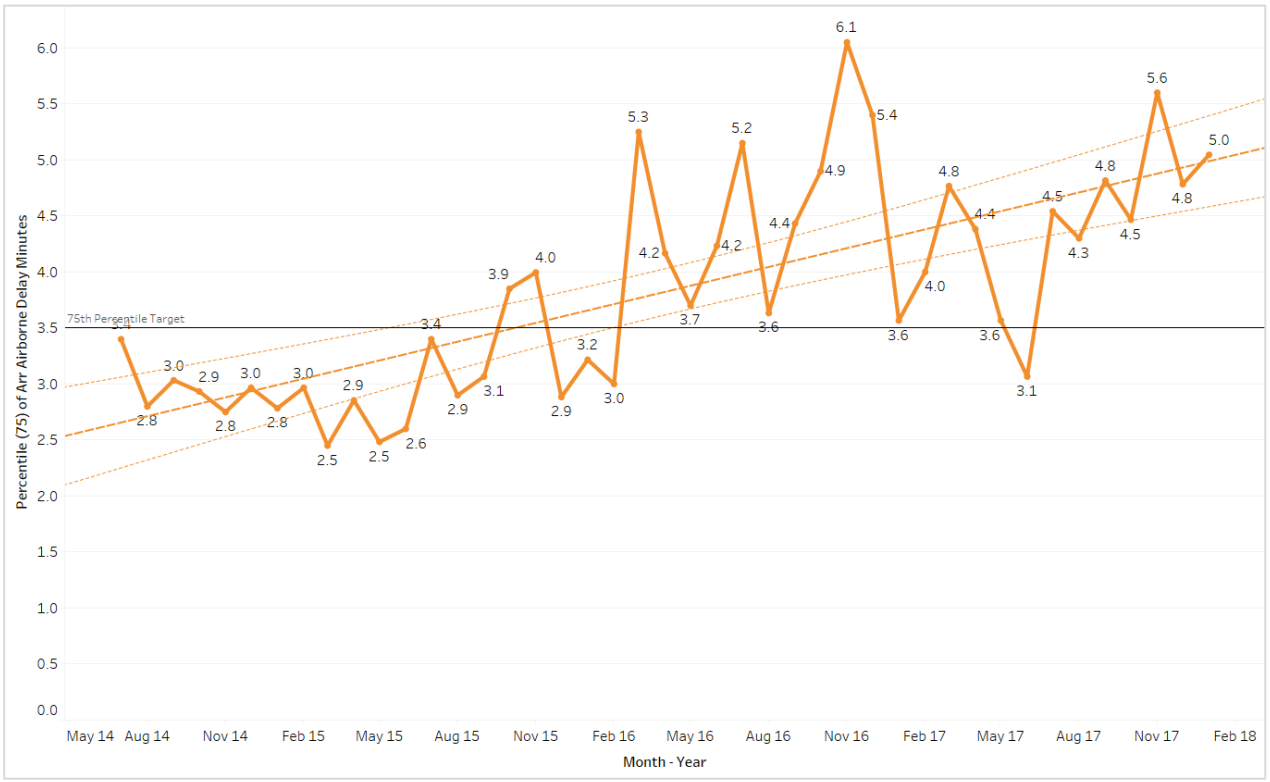

Figure 5: Melbourne Airborne Delay 75th Percentile

Notable events

The following commentary describes the most significant Airborne Delay events (10) during January in Melbourne:

- 07 Jan – Runway 16 unserviceable due to nose-wheel collapse (1600 – 1900 local)
- 12 Jan – Thunderstorm followed by low visibility (1500 – 1600 local)
- 15 Jan – Low visibility (0800 – 1200 local)
- 19 Jan – Wind and Level 1 revision (1600 – 1900 local)
- 20 Jan – Low cloud (0700 – 1000 local)
- 22 Jan – Low cloud (0800 – 1200 local)
- 25 Jan – Thunderstorms (0700 – 1000 local)
- 26 Jan – Low visibility and Level 2 revision at 0800 (0700 – 1200 local)
- 28 Jan – Thunderstorms (1500 – 1900 local)

- 29 Jan – Thunderstorms followed by low visibility. Level 2 revision at 0700 (0700 – 0800 local)

The event on 25 January resulted in significant Airborne Delays of 16 minutes (75th upper percentile) between 0600 and 0900 local and was subject to a detailed analysis (**Appendix A**). A significant factor in this event was the arrival of 12 international aircraft during the three hour period. The actual arrival times of these international aircraft was between 18 and 59 minutes different from their calculated landing time (i.e. slot in Harmony). The situation was compounded by weather conditions that impacted on capacity and which resulted in a situation where demand and capacity where evenly matched through the period.

In periods where demand and capacity are evenly matched, the effectiveness of the ATFM program is reduced by the presence of international aircraft where the actual landing time is vastly different to the calculated landing time. The Long Range ATFM project will provide a solution to increase international arrival predictability and adhere closer to their assigned arrival slot. Further detail on the 25 January event can be found in the full review in **Appendix A**.

Brisbane

Airborne delay

The 75th Percentile performance figures for airborne delay at Brisbane are indicated in **Figure 6**.

January performance (3.1 minutes) met the target (3.5 minutes) and airborne delays were lower than same period last year (3.2 minutes). The long-term trend for airborne delay at Brisbane is downwards.

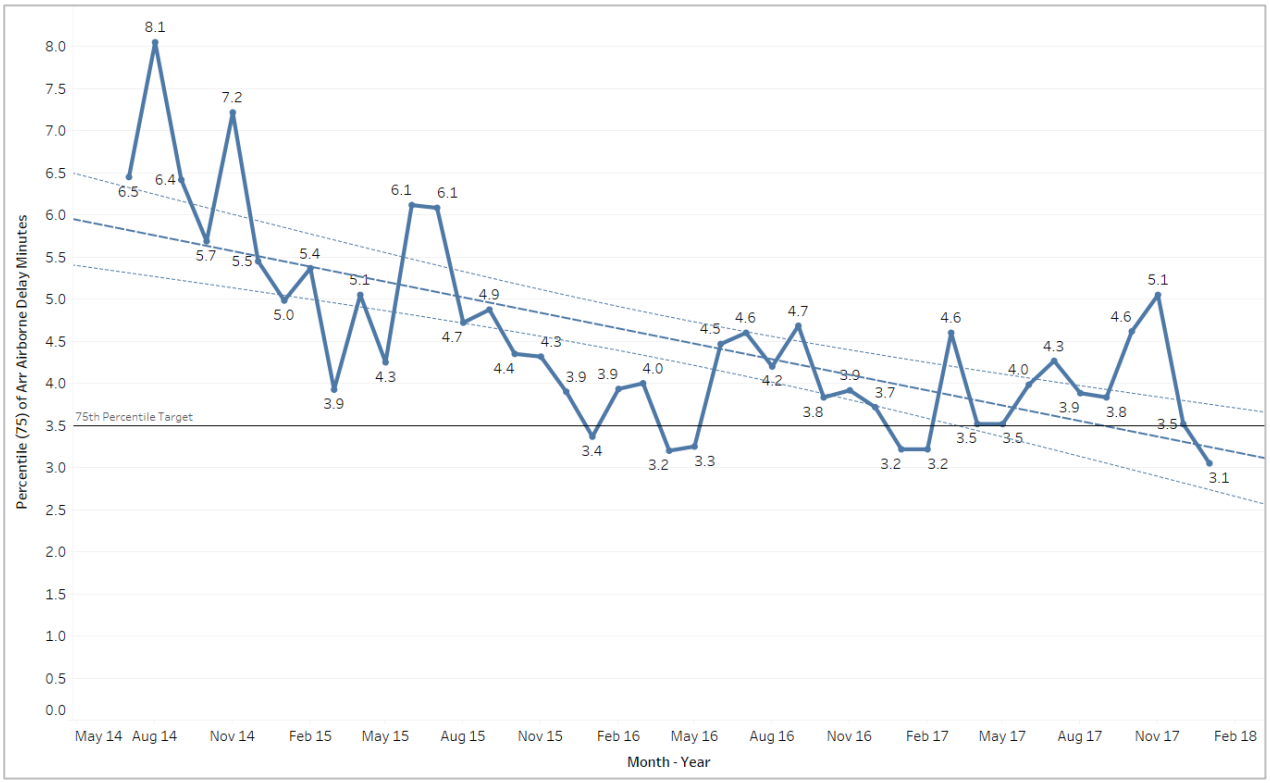

Figure 6: Brisbane airborne delay 75th Percentile

Notable Events

The following commentary describes the most significant airborne delay events during January in Brisbane:

- 02 Jan – Evening thunderstorms (1800 – 2100 local) and a Level 1 revision conducted in advance at midday.
- 13 Jan – Evening thunderstorms (1800 – 1900 local)
- 28 Jan – Program accuracy issues
- 31 Jan – Evening thunderstorms (1800 – 1900 local)

The event on 28 January was subject to a detailed analysis (**Appendix B**) following an abnormal increase in arrival delay during the peak evening period. This resulted from the late arrival of six aircraft immediately prior to the peak period. The impact of these late arrivals cascaded into delays for the following two hours. The elevated arrival delay occurred despite benign weather conditions and the throughput achieved by ATC was above set tactical rates for much of the period. This illustrates the impact that a small number of non-compliant flights can have on arrival delay.

Perth

Airborne delay

The 75th Percentile performance figures for airborne delay at Perth are indicated in **Figure 7**.

January performance (1.4 minutes) met the target (3.5 minutes) and airborne delay was also lower than same period last year (1.8 minutes). The long-term trend for airborne delay at Perth is downwards.

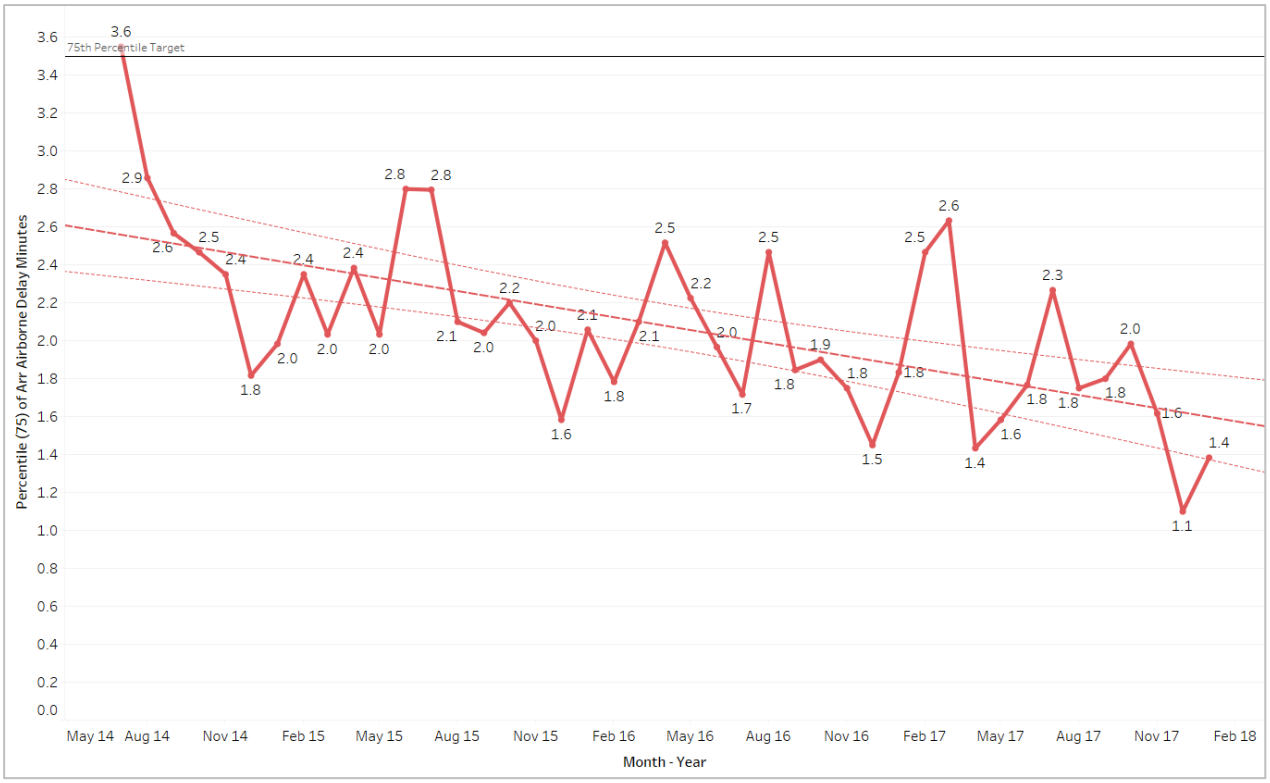

Figure 7: Perth Airborne Delay 75th Percentile

Notable Events

There was 1 notable delay event for Perth on 15 January during the busy evening arrival period between 1800 – 1900 local that was caused by 6 go-arounds due to wind shear.

There were 3 post operational reviews undertaken for Perth to analyse elevated evening delays and departure delays.

The key learnings from the 18 January review (**Appendix C)** includes:

- The impact of late and early flights (and diverted flights) on fully subscribed programs
- The impact of the accuracy of pre-tactical flight time estimates in Harmony. This has been included in planning for the next software version of Harmony.

Appendix A

Post Operational Performance Review

Melbourne Airport - 25th January 2018

Event Description

Elevated arrival delay was observed in the AM period between 0600 – 0900L at Melbourne as shown in Figure 8. The initial MET forecast indicated a cloud ceiling of 1500ft, leading to a reduced pre-tactical arrival rate of 23 as shown in Figure 9. There were 23 planned arrivals for each hour between 0700-0900L which matched the tactical rate over the period. This was only resolved between 1000 and 1100L when capacity increased and demand fell.

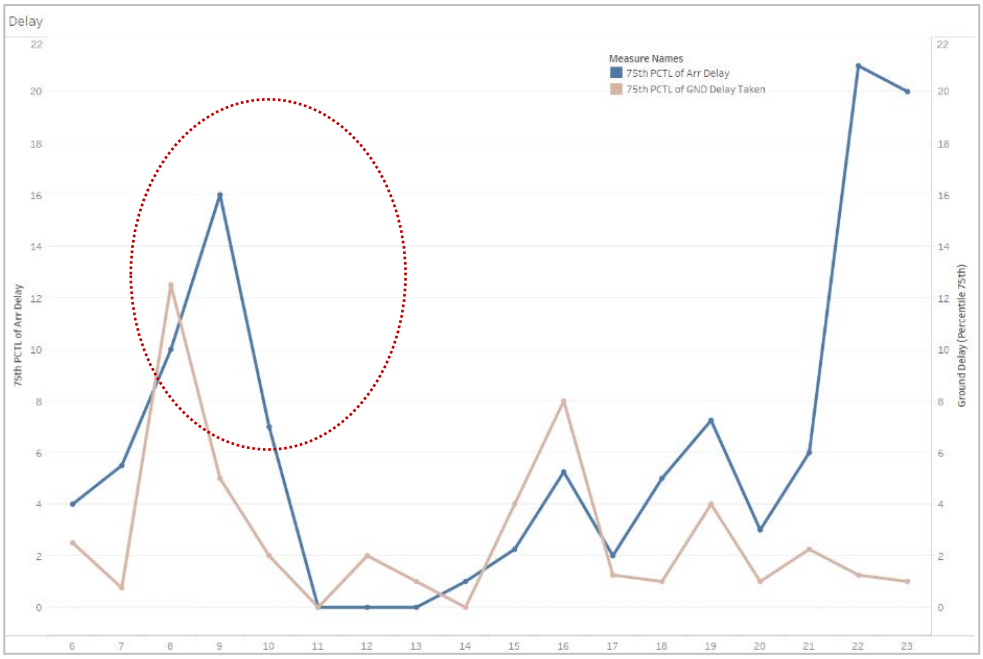

Figure 8: **Flight delay chart, airborne delay in blue, ground delay in beige. The time window the delay spike occurred is indicated by the dashed red circle**

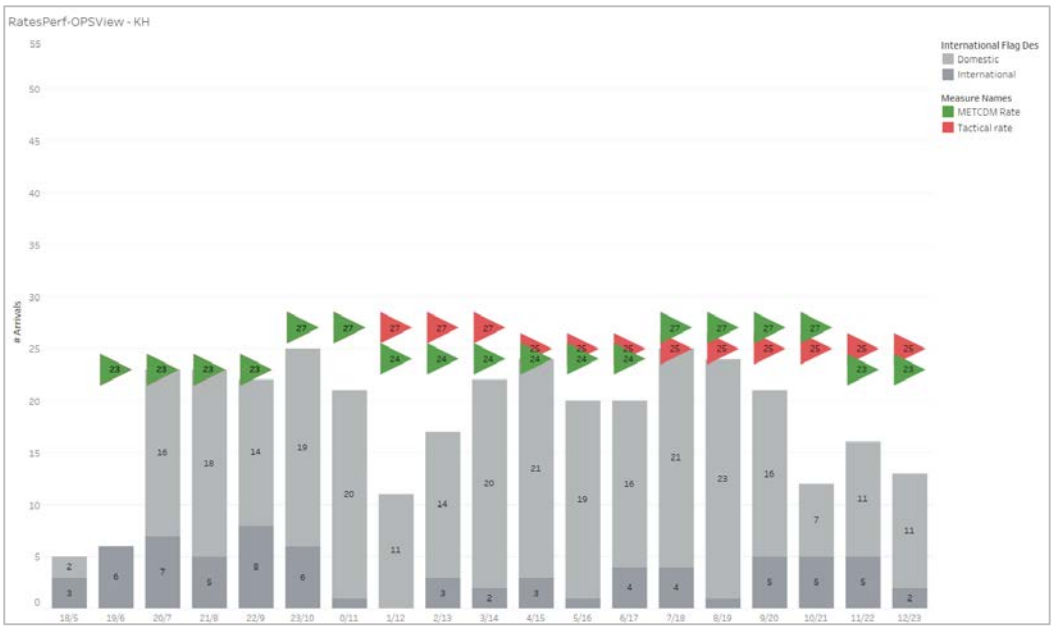

Figure 9: **MetCDM rates in green, tactical rates in red. Bars show actual arrivals by hour. Dark grey are internationals, light grey is domestic.**

Analysis

For the hours 0700-0900L The tactical rate of 23 was identical to the number of arrivals (and very close during 0900-1000L), resulting in the case of capacity = demand. This left no room for any unexpected perturbations and even without any external issues arising, the variability in flight arrival times already leads to a certain level of delay.

During 0700-0900L, a significant number of international (and therefore GDP exempted flights) arrived more than 15 minutes past their CLDT, as shown in Figure 10 and Table 2. To accommodate these, a large number of domestic arrivals had to be delayed.

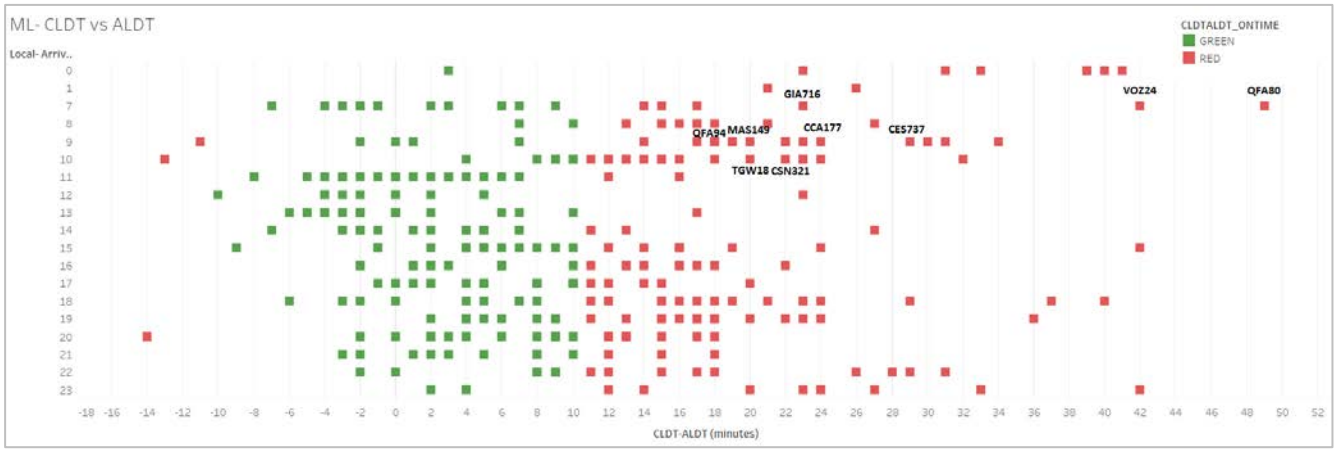

Figure **10: CLDT-ALDT for domestic and international arrivals. Flights with CLDT-ALDT > 15 are considered as non-compliant and displayed red, while compliant flights are shown in green. International flights with ALDT-CLDT > 15 min are marked with their individual flight numbers.**

Landing hour (local)	Flight number	Departure airport	ALDT-CLDT [min.]
0600-0700	CPA135	VHHH	59
0700-0800	QFA152	NZAA	18
	ANZ891	NZCH	24
	GIA716	WIII	23
	VOZ24	KLAX	42
	QFA80	RJAA	49
0800-0900	CCA177	ZSPD	24
	QFA94	KLAX	18
	MAS149	WMKK	20
	CES737	ZSPD	29
0900-1000	CSN321	ZGGG	22
	TGW18	WSSS	20

Table 2: **International flights with ALDT-CLDT > 15 min.**

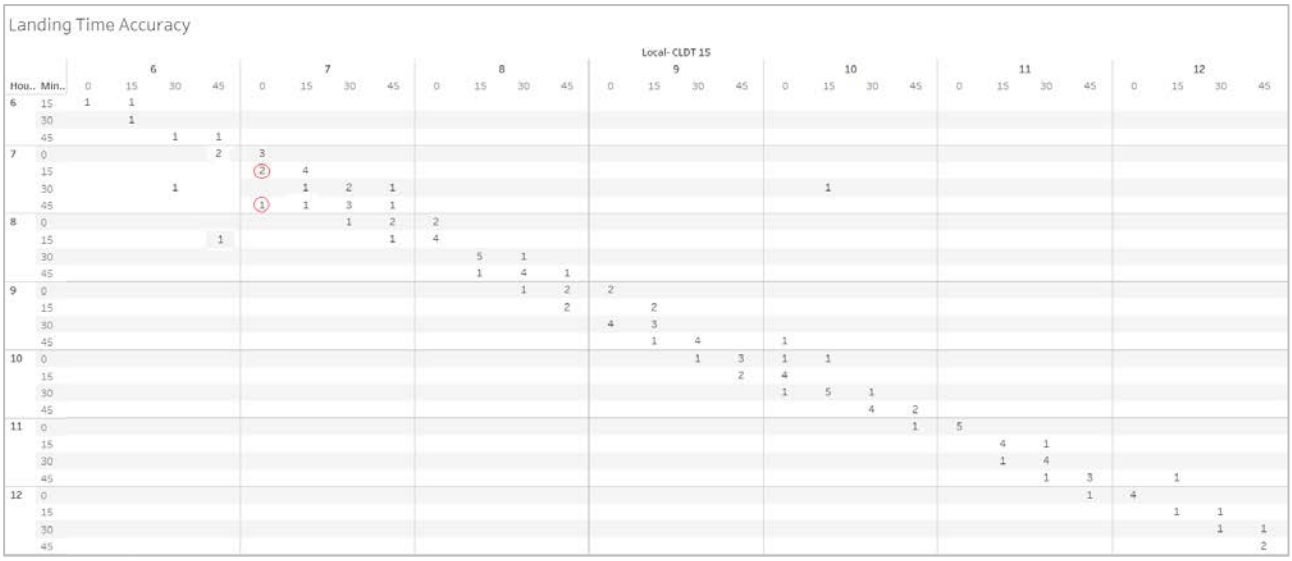

Figure **11: Delay cascade with 15 minute blocks. CLDT is on the x-axis, ALDT on the y-axis. Numbers below the diagonal line correspond to delayed arrivals. The 3 delayed flights during the 0700-0715L period are indicated by red circles.**

In particular, during the interval 0700-0715L, 3 of the arrivals scheduled, arrived between 0715-0745L. This shift in demand increased the demand for slots post 0715L by 3, while at the same time left 3 slots during 0700-0715L unused.

During these hours the capacity at Melbourne airport was equal to the demand, which resulted in a significant disruption to the arrival pattern that ultimately triggered a delay cascade that was impossible to resolve while demand is still equal to capacity. Figure 11 shows a representation of such a cascade for 15 minute slots.

The over-demand could only be accommodated from around 1000L on, when the tactical maestro rate increased to 27 arrivals per hour. From 1100L the demand also started to decrease down to 21, which quickly resolved the spike in delay within that same hour.

This peak in delay could have been avoided, if the international arrivals would have arrived closer to their ALDT.

Summary

A significant spike in delay of up to 16 minutes (75th upper percentile) occurred for Melbourne airport between 06-09L from a combination of 4-5 inbound international aircraft per hour with deviations between 18 and 59 minutes on their calculated time of arrival compounded by weather conditions that required the airport to operate with a reduced capacity that was equal or close to the demand for 3 hours. The Long Range ATFM project will provide a solution to increase international arrival predictability and adhere closer to their assigned arrival slot.

Appendix B

Post Operational Performance Review

Brisbane Airport - 28th January 2018

Event Description

Elevated arrival delay was observed in the evening peak period from 0800-1000z (1800-2000 local) at Brisbane on 28 January 2018 (see Figure 12). The airborne arrival delay (75th percentile) in this period peaked at 10 minutes.

MET-CDM considered CROPS for the afternoon and evening period but single runway rates were implemented due to uncertainty around wind direction and cloud ceiling. The forecast included a risk of showers and a slight risk of thunderstorms but only light showers eventuated. Tactical rates above the original METCDM rates were implemented (see Figure 13).

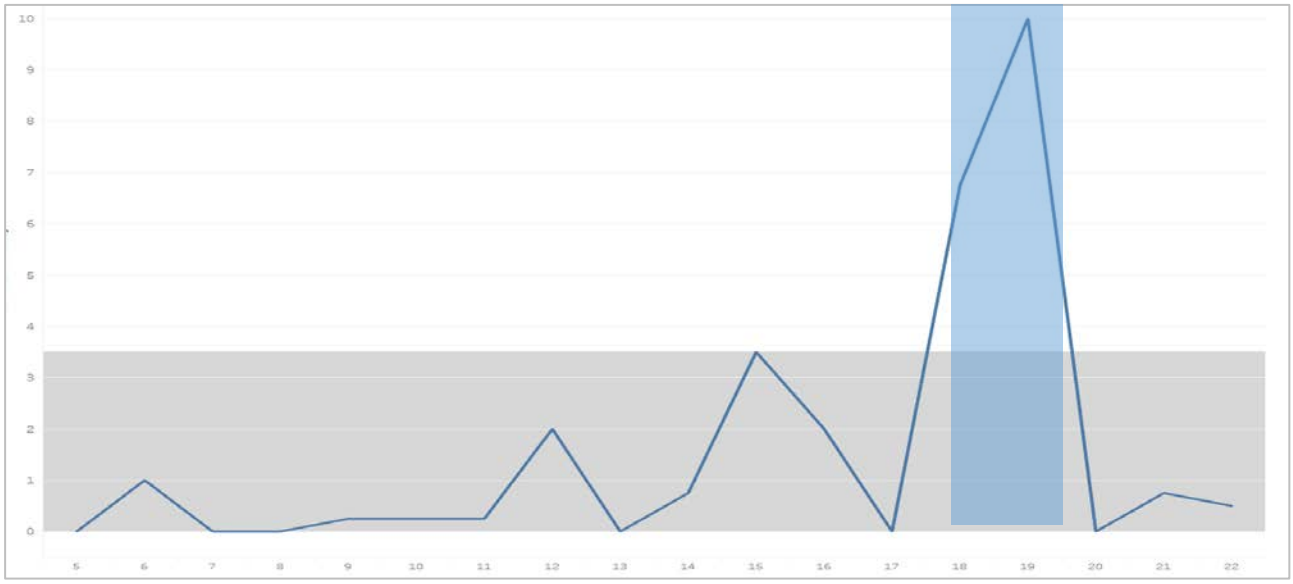

Figure 12: Arrival delay (75th percentile) by hour (UTC) at Brisbane on 28 January 2018. Period of elevated delay is highlighted in blue.

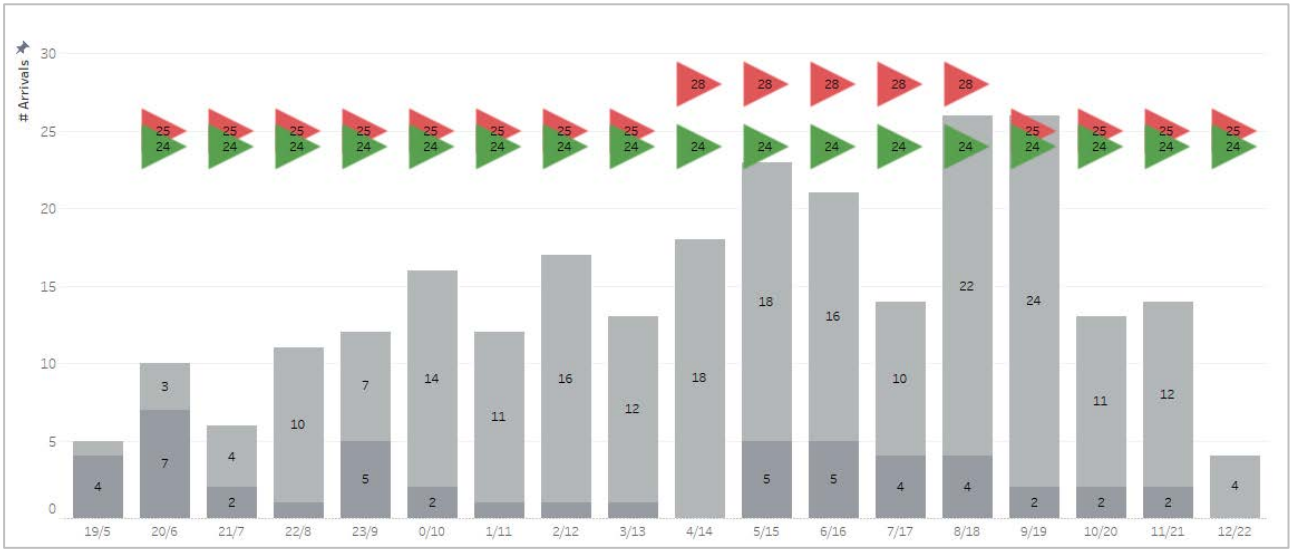

Figure 13: Arrivals by hour (local/UTC) at Brisbane on 28 January 2018. Domestic arrivals in light grey, internationals in dark grey. Pre-tactical (METCDM) rates shown by green triangles, tactical rates shown by red triangles.

Analysis

Figure 14 shows how the observed airborne arrival delay began to build up at the beginning of the 0800z hour. No flights presented to land in the 0745-0800z window. Subsequently, six flights with a CLDT in this time were landed in the 0800-0815z window. As there was no spare capacity during this peak period, these late flights cascaded into late arrivals for the following two hours.

			CLDT (UTC)															
			07				08				09				10			
			0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45
ALDT (UTC)	07	0	4															
		15		3														
		30		1	4													
		45																
	08	0				6	2						1					
		15					3	2	1									
		30					1	3	1					1				
		45						1	1	2					1			
	09	0							1	3	2							
		15							1		1	2	1					
		30								1	3	3						
		45										1	3	3				
	10	0												2	1			
		15														2		
		30											1		1	1	2	
		45															1	2

Figure 14: Arrival accuracy in 15 minute windows for 0700-1100z at Brisbane on 28 January 2018. No flights were landed from 0745-0800z due to six late flights spilling into 0800-0815z (red box). Following this there is a cascade of late arrivals particularly between 0815-1000z (pink boxes).

Late non-compliant flights were noticeable contributors to the events that precipitated the period of elevated arrival delay. Of the six flights that missed their CLDT in the 0745-0800z window (Table 1):

- Three were late non-compliant.
- Two flights were compliant/exempt but presented late.
- One flight (QLK535D from Longreach) appears to have presented slightly late and then experienced delays likely from being re-sequenced to fit with the other late flights.

Table 3: Summary of flights with CLDT between 0745-0800z. All of these flights missed their nominated landing window and instead

ACID	ADEP	ALDT (UTC)	CLDT (UTC)	CTOT Compliance	ATOT-CTOT (min)	DELAY MAESTRO (min)	CLDT-ALDT (min)
RON1	AGGH	0805	0755	Exempt	26	0	10
VOZ1225	YSCB	0800	0757	Late non-compliant	16	0	3
VOZ341	YMML	0810	0745	Late non-compliant	24	0	25
QLK535D	YLRE	0812	0752	Compliant	-5	13	20
QFA542	YSSY	0814	0747	Late non-compliant	31	0	27
QFA664	YPAD	0808	0750	Compliant	12	0	18

The impact of cascading arrival delay was mitigated by strong throughput during the peak period aided by better than forecast weather. Nine aircraft were landed between 0800-0815z, three more than planned for that window. The throughput (26) for the 0900z hour was also above tactical rates (25).

Summary

Elevated arrival delay during the peak evening period (0800-1000z) at Brisbane on 28 January 2018 resulted from the late arrival of six aircraft immediately prior to this period. This included three late non-compliant aircraft from the 0745-0800z window. The impact of these late arrivals cascaded into delays for the following two hours. The elevated arrival delay occurred despite nil SIGWX and throughput above tactical rates for much of the period. This illustrates the impact that a small number of non-compliant flights can have on arrival delay.

For further information please contact Network Performance and Analysis @
OPS_ANALYSIS_ADMIN@AirservicesAustralia.com

Appendix C

Post Operational Performance Review

Perth Airport – 18th January 2018

Event Description

A review was initiated for operations at Perth Airport on the 18th January 2018 based on an observation of elevated delay period from 1700 to 1800 local time. Figure 15 shows the 75th-percentile of airborne arrival delay in each hour block of the day (circled is the elevated delay period). Figure 16 shows arrivals by hour (grey bars), tactical rates (red triangles) and pre-tactical rates (green triangles). Arrivals during 1700 hour increased to 22 (from 8 in the previous hour) with a rate of 24. In 1800 there were 25 arrivals, with a pre-tactical rate of 24, and a tactical rate of 26.

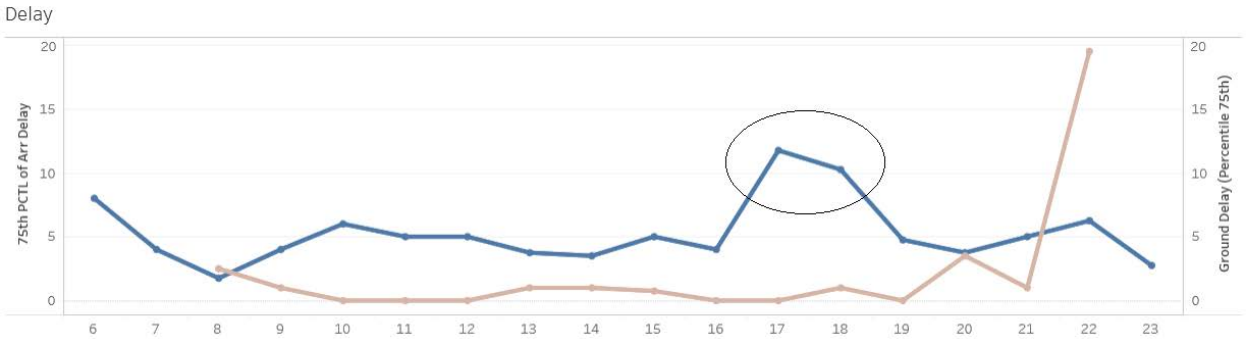

Figure 15 – **Airborne arrival delay (75th Percentile), shown in blue, into Perth for the 18th January 2018 by local hour. Circled is the time period for which the cause of delay is investigated in the current report.**

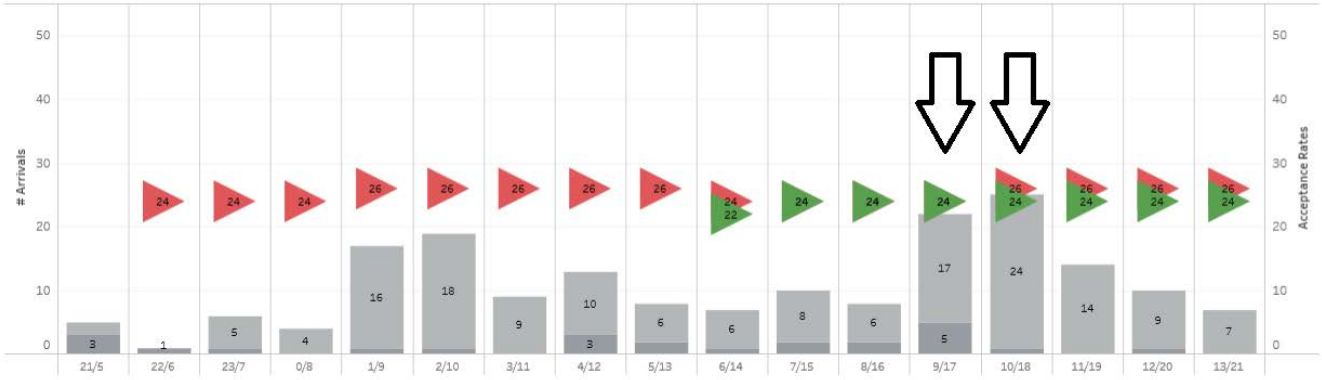

Figure 16 – **Arrivals by hour, tactical and pre-tactical rates for 18th January 2018 by hour (UTC/local) @ PH. Domestic arrivals in light grey, internationals in dark grey. Pre-tactical rates shown in green, tactical rates shown in red. Black arrows indicate the hour blocks with elevated arrival delay.**

Analysis

During the 4 hours leading up to the elevation in arrival delay, 10 aircraft, or less, landed during each hour. Additionally, during the afternoon operations were limited to a single runway (21), initially the MET-CDM calculated rates using both runway 21 and 24 for arrivals, with some wind activity between headings 80 and 100 degrees at 7 knots.

During both the 1700 and 1800 hour blocks, compliance to CTOT may have been a contributing factor to the elevated arrival delay. In the 1700 hour block 5 exempt aircraft landed, 3 with large variation between CTOT and ATOT (-21, 21 and 37 minutes – see Table 4). Five aircraft were compliant, but with a variation of greater than 10 minutes. 2 aircraft were early non-compliant (one with 37 minute variation). Additionally, 1 aircraft conducted a go-around, before landing 15 minutes later, causing a lost slot and adding to later demand.

In the 1800 hour block 1 exempt flight landed. 2 aircraft were late non-compliant (17 and 29 minutes). 3 aircraft were compliant, but with a variation greater than 10 minutes. 1 aircraft was early non-compliant, and 1 aircraft returned to Perth (after departing approximately 2.5 hours earlier).

Additionally, 2 exempt aircraft (-11 and 30 minutes) arrived during the 1600 hour block.

Table 4 and Table 5 below show the flights where ATOT compliance to CTOT may have caused an issue for sequencing of arrivals into Perth, for 1700 and 1800 hour blocks, respectively.

Table 4- **Arrivals in the 1700 hour block, which are either: exempt, early/late non-compliant, or compliant with at least a 10 minute difference between CTOT and ATOT. * This flight also performed a go around before landing**

ACID	ADEP	ATYP	CTOT-ATOT	CTOT Compliance
WBQ	YLEO	SW4	15	Compliant
RXA2126	YABA	SF34	15	Compliant
QFA793	YPDN	B738	13	Compliant
TGG413	Melbourne Departures	A320	12	Compliant *
VOZ9296	YCNF	F100	11	Compliant
NWK1683	YFDF	F100	-6	Early Non Compliant
UTY603	YPXM	F70	-37	Early Non Compliant
SIA223	WSSS	B772	37	Exempt
AWQ544	WADD	A320	21	Exempt
TGW008	WSSS	B789	-21	Exempt
UAE420	OMDB	A388		Exempt
VPCTH	WIHH	GLF4		Exempt

Table 5- **Arrivals in the 1800 hour block, which are either: exempt, early/late non-compliant, or compliant with at least a 10 minute difference between CTOT and ATOT.**

ACID	ADEP	ATYP	CTOT-ATOT	CTOT Compliance
RXA2376	YESP	SF34	15	Compliant
UTY807	YLST	F100	12	Compliant
QFA1115	YPPD	B738	11	Compliant
ZOA	YPKG	B190	-6	Early Non Compliant
QTR900	OTHH	B77W		Exempt
VOZ691	Melbourne Departures	A332	29	Late Non Compliant
UTY736	YCPR	F70	17	Late Non Compliant
NWK1616	YPPH	F100		**diverted return flight**

Figure 17 and Figure 18 show the landing and take-off sequence during the 1700 and 1800 hour blocks, respectively. These plots show the number of arrivals rising from 1700 to 1730, with consistent arrivals through past 1900.

Three flights performed a go-around. One (TGG413) occurred at 1714 (around the time the arrival delay begins to elevate). The other two flights (NWK2655 and JTE767) first attempted a landing after 1930, after the arrival delay had fallen to much lower levels.

Additionally, a comparison was made between the Harmony estimated flight time (OCLDT minus OCTOT) and the flight time calculated from ODAS data. For the 1700 period, 4 flights had an actual flight time of at least 5 minutes less than the Harmony time (7.1, 7.6, 8.3 and 29.7 minutes), while 7 flights had an actual flight time at least 5 minutes greater (5.6, 5.7, 9.2, 14.0, 14.5, 26.5 and 46.4 minutes). For the 1800 period, this same comparison found 3 flights (6.0, 7.4 and 7.6 minutes) and 13 flights (6.7, 8.5, 9.7, 10.5, 11.5, 14.0, 15.6, 16.9, 17.1, 17.9, 20.5, 28.8 and 38.9 minutes), respectively. It should be noted that the larger values for actual flight time are expected, as the analysis covers a period of elevated delay.

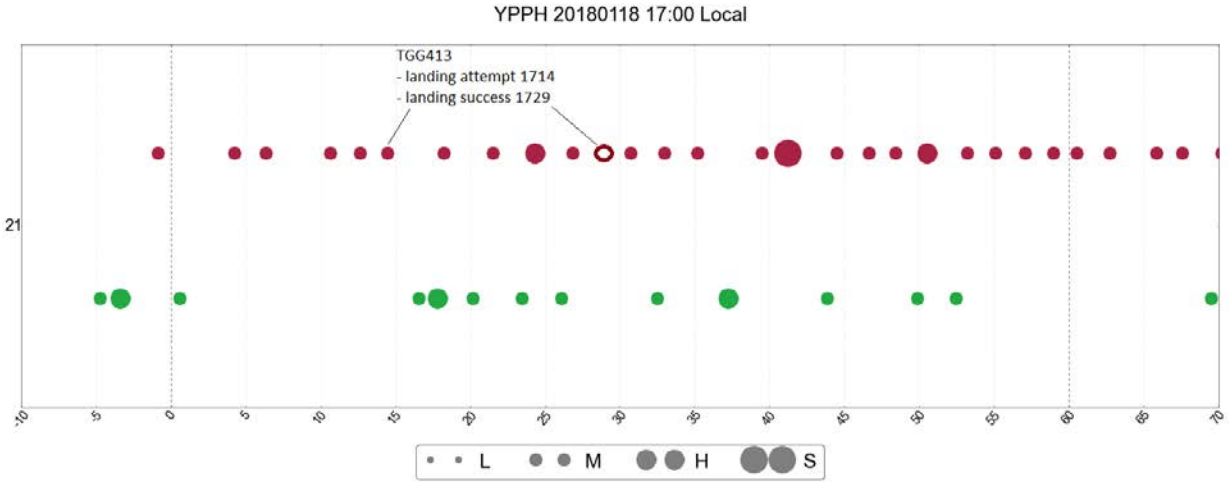

Figure 17- **Arrivals (red) and departures (green) during the 1700 hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and S (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated is the arrival which went around at 1714 before landing at 1729.**

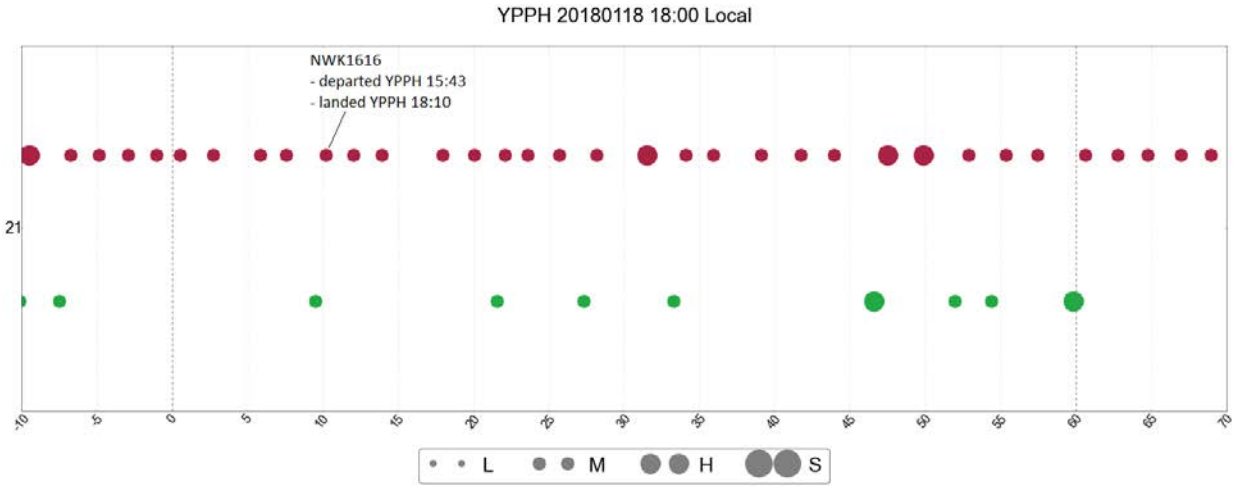

Figure 18- **Arrivals (red) and departures (green) during the 1700 hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and S (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated is the arrival which is a flight diverted back to Perth.**

Figure 19 below shows the difference between the calculated landing hour (CLDT) and the actual landing hour (ALDT). This figure illustrates whether the pre-tactical plan was achieved and what the delivery accuracy of that plan was (in terms of meeting the allocated landing slot). In the case of increasing delays this graphic will generally show a cascading effect of late aircraft shown in red, as aircraft arrive later than planned due to airborne delays. During hours 17 and 18 we can see several 'late' aircraft.

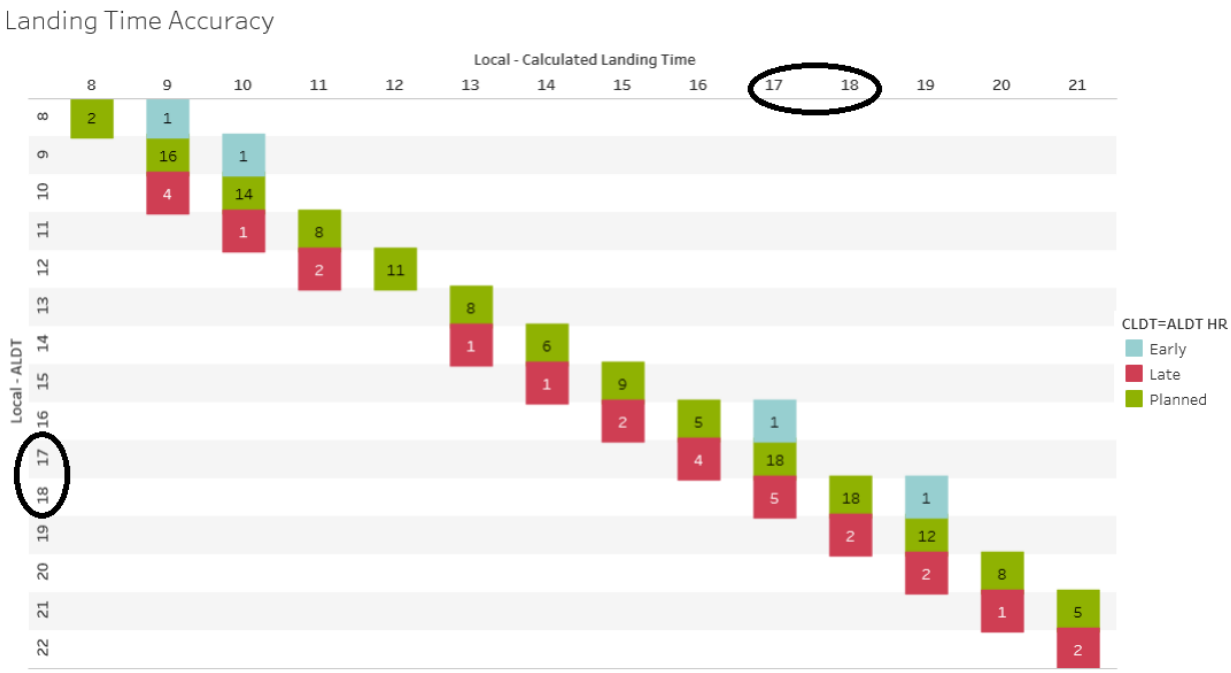

Figure 19 – Calculated landing hour vs actual landing hour

Summary

This review focused on a delay event (delays exceeding 10 minutes) occurring in the late afternoon/early evening time period at Perth that typically sees the arrival demand of aircraft increase from about 10 an hour to above 20 for two hours, before dropping off. During this increased demand in arriving traffic, the number of aircraft programmed to arrive was close to the capacity of the airport, and aircraft began to present in the TMA at times materially different than planned due to issues with compliance to CTOT (19 flights), inaccurate flight time estimates (27 flights by at least 5 minutes), and unexpected events (1 go around, and 1 flight diverted to Perth), this caused an accumulation of delay.

The key learnings from this review include:

- The impact of late and early flights (and diverted flights) on fully subscribed programs
- The importance of accurate pre-tactical flight time estimates in Harmony. Harmony v6 will provide improved pre-tactical flight time estimates.

Appendix D

Corporate Plan Key Performance Indicator Profile: Arrival airborne delay

Corporate Plan Description:

The median (and 75th percentile) excess time incurred during the arrival airborne phase of flight in reference to the estimated time of arrival for high-volume operations. (High volume operating environments defined as Brisbane, Melbourne, Perth and Sydney).

Corporate Plan Targets:

Year	17/18	18/19	19/20	20/21	21/22
75%	3.5	3.4	3.3	3.2	3.1
Median	0.6	0.6	0.6	0.6	0.6

What is it: Excess time incurred during the arrival phase of flight.

What is measured: It is measured by comparing the estimated flight time and actual flight time for the portion of the flight within 250 NM of the destination aerodrome.

Why 250NM: The 250NM threshold has been identified as the distance from the aerodrome at which arrival demand/capacity balancing measures and arrival flight paths start taking effect. It is a true reflection of the tactical arrival management of the flight, and is not skewed by other non-related issues such as congestion at the departure aerodrome.

Why measure Median rather than Average/Mean: In some cases, the actual flight time within 250NM of the destination aerodrome will be less than the estimated flight time (e.g.: ATC has provide track shortening). In the dataset, this translates into a 'negative' value for that particular flight.

The Median shows the mid-point of the data set and allows us to demonstrate our impact on all flights, not just the ones that were delayed. Additionally, over short timeframes and small datasets (such as a daily report), Median measurement is more resilient to data errors and small groups of outliers which may skew the average.

Why measure the 75th percentile: This supplements the Median and is valuable to demonstrate how effectively we have managed the arrival of most of the fleet.

The last 25th percentile can typically contain arrival data from flights that were impacted by non-routine events, such as Medical priority traffic or aircraft in an emergency or diversion.

How do we measure:

Uses the high-fidelity Dalí trajectory-based model. For Sydney, some assumptions are built in to calculations as the actual flight path is unique for each flight.