International Civil Aviation Organization

The Third Meeting of the Air Traffic Flow Management Task Force (ATFM/TF/3)

Bangkok, Thailand, 6 to 9 September 2005

Agenda Item 3: Flow Management Handbook

SELECTION OF BOBCAT SLOT TIME BY DISPATCHERS

(Presented by Thailand)

SUMMARY

The purpose of this working paper is to describe a methodology for selection of slot time by dispatchers and for the meeting to discuss the trade-off between the present random slot selection or other options to improve airspace utilization.

1. INTRODUCTION

1.1 The meeting would recall that discussion throughout the two ATFM/TF meetings as well as special coordination meetings since January 2005 has placed considerable importance on the degree of fairness and randomness in the BOBCAT slot allocation process. However, through the development of BOBCAT, AEROTHAI has identified an important trade-off between such a degree of fairness or randomness of slot selection compared to optimal use of slot allocation with respect to airspace usage.

1.2 Throughout the extensive development process of BOBCAT, AEROTHAI has concluded that the Maximum Acceptable Delay (MAD) factor is an important parameter in building a slot allocation request by dispatchers. A full understanding and judicious use of MAD would allow for considerable flexibility in requesting slot allocation.

1.3 The meeting would also recall that randomness of the slot allocation system has been a key request by IATA. However on some evaluations concluded by AEROTHAI in developing BOBCAT, using this procedure in some scenarios may lead to an unacceptable slot selection for some aircraft.

2. DISCUSSION

BOBCAT Slot Time Selection Mechanism

2.1 The meeting is invited to note that BOBCAT has a distinct way of assigning slot allocations to aircraft who submit requests. Details of the slot allocation mechanism are available in the Revised Concept of Operations document at **Attachment A** to this working paper. The meeting is advised that due to ongoing work with respect to the BOBCAT Human Machine Interface (HMI), Section 5 of the Concept of Operations document is still under review.

2.2 The present BOBCAT model asks for the following requests from airline dispatchers:

a) Callsign;
b) Departure Airport;
c) Destination Airport;
d) Estimated Wheels-Up Time;
e) Route description through BOBCAT area;
f) Flight Level choice over route planned;
g) Maximum Acceptable Delay on each choice within each individual flight slot request;

2.3 BOBCAT structures a slot request according to Figure 1.

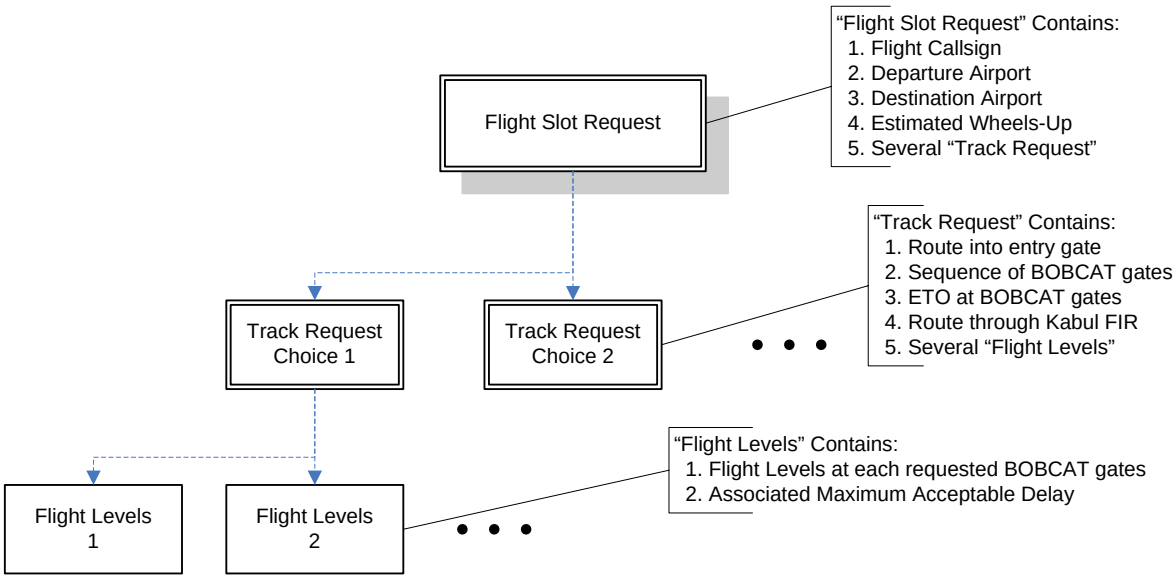

Figure 1 Diagram delineating BOBCAT flight slot request structure

2.4 Once slot allocation cut-off time has arrived, BOBCAT starts allocating slots according to the Flow Chart in Figure 2.

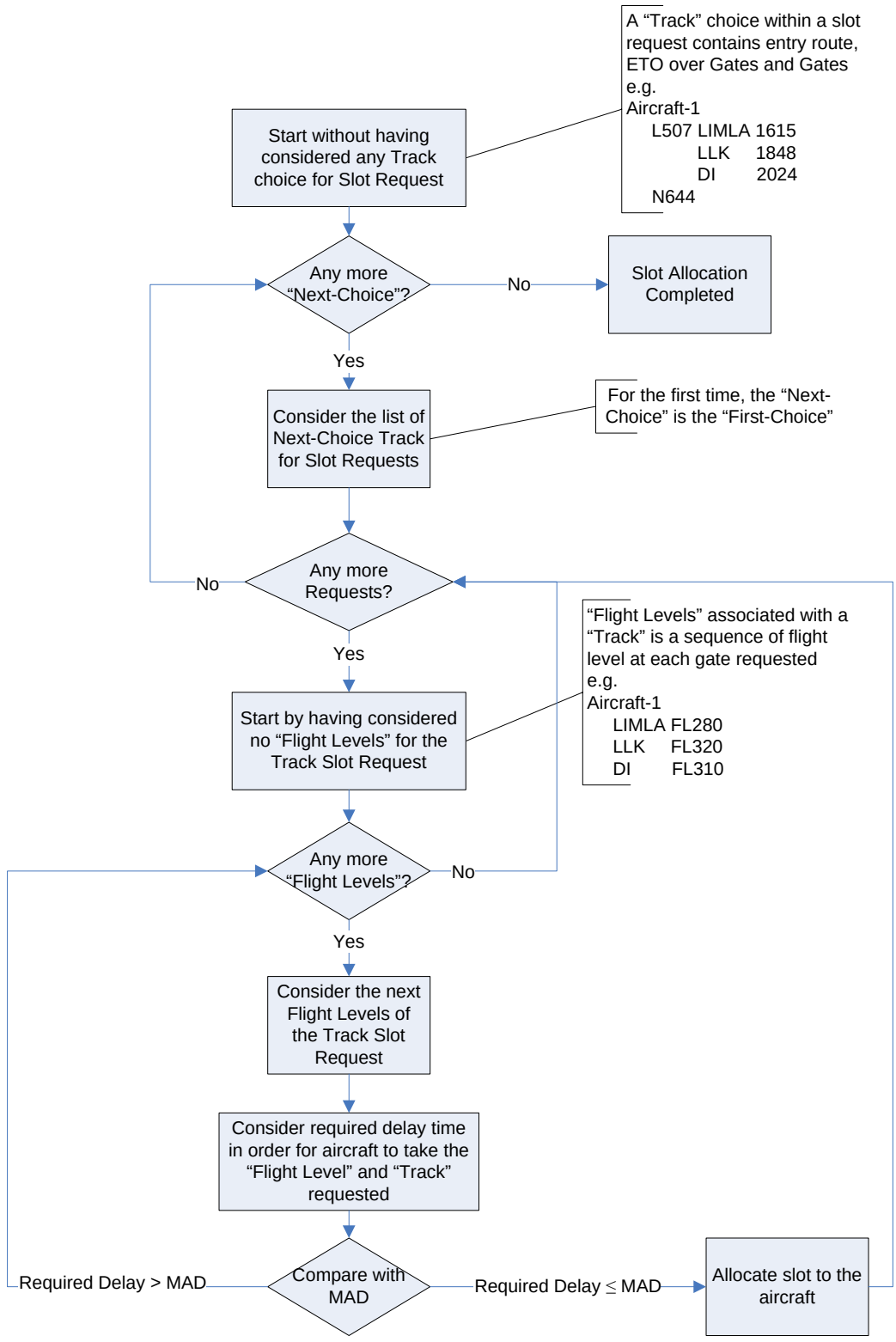

Figure 2 Flow Chart delineating slot assignment process in BOBCAT

2.5 An example presented with this paper would illustrate the effect of maximum acceptable delay choice an aircraft chooses to submit.

2.6 Consider two aircraft wishing to submit slot allocation request through BOBCAT with the following common parameters:

a) Depart from the same airport;
b) Transit the same Bay of Bengal of route;
c) Transit the same Kabul gate;
d) Same aircraft type;
e) Travel at the same speed;

2.7 Let the first aircraft have callsign of AC1 be an aircraft departing from Singapore requesting the following routes from BOBCAT:

AC1 Choice	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Maximum Acceptable Delay
1	WSSS	1000UTC	L759	L750	FL280	FL310	60
						FL350	60
2	WSSS	1000UTC	M770	N644	FL280	FL310	60
						FL350	60
3	WSSS	1000UTC	P628	G792/ V390	FL280	FL310	90
						FL350	90

2.8 Let the second aircraft have callsign of AC2 be an aircraft departing from Singapore requesting the following routes from BOBCAT:

AC2 Choice	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Maximum Acceptable Delay
1	WSSS	1000UTC	L759	L750	FL280	FL310	10
						FL350	10
2	WSSS	1000UTC	M770	N644	FL280	FL310	60
						FL350	60
3	WSSS	1000UTC	P628	G792/ V390	FL280	FL310	90
						FL350	90

2.9 The meeting should note that this scenario is designed in such a way as departures from airports in India/Pakistan would not affect planning of these flights as flights originating India/Pakistan will have higher priority on FL300 and above.

2.10 When BOBCAT allocates slot selection in the above example, there are two possible scenarios, all things being equal:

a) AC2 is allocated slots prior to AC1's allocation;
b) AC1 is allocated slots prior to AC2's allocation;

2.11 In the scenario where AC2 is allocated slots first, the following slot allocation will be given:

Aircraft	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Assigned Delay
AC2	WSSS	1000UTC	L759	L750	FL280	FL310	0
AC1	WSSS	1015UTC	L759	L750	FL280	FL310	15

2.12 In the scenario where AC1 is allocated slots first, the following slot allocation will be given:

Aircraft	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Assigned Delay
AC1	WSSS	1000UTC	L759	L750	FL280	FL310	0
AC2	~~WSSS~~	~~1015UTC~~	~~L759~~	~~L750~~	~~FL280~~	~~FL310~~	~~15~~
						~~FL350~~	~~15~~
	WSSS	1000UTC	M770	N644	FL280	FL310	0

2.13 As can be seen, if Maximum Acceptable Delay submitted is less than the combined aircraft spacing parameter and wheels-up buffer time (15 minutes) while other flights are requesting same routing with exactly the same route preference, the dispatcher runs a risk of being allocated another route by BOBCAT.

2.14 However, Maximum Acceptable Delay submitted being less than the combined aircraft spacing parameter and wheels-up buffer time is not equivalent to submitting zero Maximum Acceptable Delay.

2.15 Let's look at another example. We will include another aircraft AC3 with detail shown below:

AC3 Choice	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Maximum Acceptable Delay
1	WSSS	1010UTC	L759	L750	FL280	FL310	10
						FL350	10
2	WSSS	1010UTC	M770	N644	FL280	FL310	60
						FL350	60
3	WSSS	1010UTC	P628	G792/ V390	FL280	FL310	90
						FL350	90

2.16 The aircraft AC3 submits request at the same time as AC1, while no request was submitted for AC2 flight. In this scenario, there are two slot assignment scenarios, all things being equal:

a) AC1 is allocated slots prior to AC3's allocation;
b) AC3 is allocated slots prior to AC1's allocation;

2.17 In the scenario where AC1 is allocated slots first, the following slot allocation will be given:

Aircraft	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Assigned Delay
AC1	WSSS	1000UTC	L759	L750	FL280	FL310	0
AC3	WSSS	1015UTC	L759	L750	FL280	FL310	5

2.18 In the scenario where AC3 is allocated slots first, the following slot allocation will be given:

Aircraft	Departure	Wheels-Up Time	BoB Route	Kabul Route	BoB FL	Kabul FL	Assigned Delay
AC3	WSSS	1010UTC	L759	L750	FL280	FL310	0
AC1	WSSS	1025UTC	L759	L750	FL280	FL310	25

2.19 In this example, it is noted that the aircraft with a higher Maximum Acceptable Delay parameter (see para 2.7 and para 2.15) may suffer more delay. This is to be contrasted to the previous example that the aircraft with lower Maximum Acceptable Delay parameter suffers rerouting given slot request conflicts

2.20 The meeting is invited to note the importance of Maximum Acceptable Delay as a key factor in any slot allocation request submitted to BOBCAT.

Trade-Off between the Random Slot Allocation Process and Overall Airspace Utilization

2.21 Throughout the design process of BOBCAT, it has become evident that there exists a trade-off between Random slot allocation process and overall airspace utilization. An example shown below will demonstrate such trade-offs.

2.22 Take an example where there are 3 aircraft wishing to request slots from BOBCAT. For simplification, assume that all three flights:

a) Depart from the same airport;
b) Transit the Bay of Bengal on same route;
c) Transit Kabul through same entry gate;
d) Same aircraft type;
e) Travel at the same speed;

2.23 Let the first aircraft have callsign AC4, with the following request to BOBCAT:

AC4 Choice	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Kabul Entry	Maximum Acceptable Delay
1	WSSS	L759	FL280	L750	FL310	1000UTC	60
					FL350		60

2.24 Let the second aircraft have callsign AC5, with the following request to BOBCAT:

AC5 Choice	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Kabul Entry	Maximum Acceptable Delay
1	WSSS	L759	FL280	L750	FL310	1005UTC	60
					FL350		60

2.25 Let the third aircraft have callsign AC6, with the following request to BOBCAT:

AC6 Choice	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Kabul Entry	Maximum Acceptable Delay
1	WSSS	L759	FL280	L750	FL310	1015UTC	60
					FL350		60

2.26 The meeting should note that, similar to the example on Maximum Acceptable Delay, this scenario is designed in such a way that departures from airports in India/Pakistan would not affect planning of these flights above due to previous agreements on allocation of level priority through Kabul FIR

2.27 If BOBCAT is to assign a slot in a random manner, there would be six possible sequences of assigning slots to these aircraft:

Sequence	First Allocation	Second Allocation	Third Allocation
1	AC4	AC5	AC6
2	AC4	AC6	AC5
3	AC5	AC4	AC6
4	AC5	AC6	AC4
5	AC6	AC4	AC5
6	AC6	AC5	AC4

2.28 If random score sequence appears as sequence 1, the slot assignment would be as follows:

Aircraft	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Assigned Kabul Entry	Assigned Delay
AC4	WSSS	L759	FL280	L750	FL310	1000UTC	0
AC5	WSSS	L759	FL280	L750	FL310	1015UTC	10
AC6	WSSS	L759	FL280	L750	FL310	1030UTC	15

2.29 If random score sequence appears to be of sequence 2 in para 2.27, the slot assignment would be as follows:

Aircraft	Departure	BoB Route	Kabul Route	BoB FL	Kabul FL	Assigned Kabul Entry	Assigned Delay
AC4	WSSS	L759	L750	FL280	FL310	1000UTC	0
AC6	WSSS	L759	L750	FL280	FL310	1015UTC	0
AC5	WSSS	L759	L750	FL280	FL310	1030UTC	25

2.30 If random score sequence appears to be of sequence 3 in para 2.27, the slot assignment would be as follows:

Aircraft	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Assigned Kabul Entry	Assigned Delay
AC5	WSSS	L759	FL280	L750	FL310	1005UTC	0
AC4	WSSS	L759	FL280	L750	FL310	1020UTC	20
AC6	WSSS	L759	FL280	L750	FL310	1035UTC	20

2.31 If random score sequence appears to be of sequence 4 in para 2.27, the slot assignment would be as follows:

Aircraft	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Assigned Kabul Entry	Assigned Delay
AC5	WSSS	L759	FL280	L750	FL310	1005UTC	0
AC6	WSSS	L759	FL280	L750	FL310	1020UTC	5
AC4	WSSS	L759	FL280	L750	FL310	1035UTC	35

2.32 If random score sequence appears to be of sequence 5 in para 2.27, the slot assignment would be as follows:

Aircraft	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Assigned Kabul Entry	Assigned Delay
AC6	WSSS	L759	FL280	L750	FL310	1015UTC	0
AC4	WSSS	L759	FL280	L750	FL310	1000UTC	0
AC5	WSSS	L759	FL280	L750	FL310	1030UTC	25

2.33 If random score sequence appears to be of sequence 6 in para 2.27, the slot assignment would be as follows:

Aircraft	Departure	BoB Route	BoB FL	Kabul Route	Kabul FL	Assigned Kabul Entry	Assigned Delay
AC6	WSSS	L759	FL280	L750	FL310	1015UTC	0
AC5	WSSS	L759	FL280	L750	FL310	1030UTC	25
AC4	WSSS	L759	FL280	L750	FL310	1000UTC	0

2.34 Characteristics of delay suffered by aircraft in different scenario is summarized below:

Sequence	Aircraft Sequence	Delay Suffered at Kabul Entry			Total Delay
		AC4	AC5	AC6	
1	AC4 – AC5 – AC6	0	10	15	25
2	AC4 – AC6 – AC5	0	0	25	25
3	AC5 – AC4 – AC6	20	0	20	40
4	AC5 – AC6 – AC4	35	0	5	40
5	AC6 – AC4 – AC5	0	25	0	25
6	AC6 – AC5 – AC4	0	25	0	25

2.35 As can be seen from possible outcomes of the scoring sequence from para 2.28 to para 2.33, summarized in para 2.34, it is the case that assigning slots in order of Kabul Entry time would provide the best trade-off between delay suffered by aircraft and total delay suffered.

2.36 Moreover, it should be noted that by assigning slot in order of gate ETO, more slot allocation will be available for aircraft with ETO. Table below summarize the next available gate time for aircraft with same closing speed:

Sequence	Aircraft Sequence	Next Available
1	AC4 – AC5 – AC6	1045UTC
2	AC4 – AC6 – AC5	1045UTC
3	AC5 – AC4 – AC6	1050UTC
4	AC5 – AC6 – AC4	1050UTC
5	AC6 – AC4 – AC5	1045UTC
6	AC6 – AC5 – AC4	1045UTC

2.37 The meeting is also invited to note that the optimization of slot time used is only as good as the accuracy of airlines' estimated time of entry into Kabul FIR.

2.38 The meeting should be aware that the examples displayed in this working paper above have used examples of aircraft departing from one location using one route and having the same Mach number. There has been no consideration in these examples of differences which may occur in slot allocation times if any of these criteria were different to each other. The Paper Trial will also take into account these items to insure that all variables are looked into.

Paper Trial and the conduct of a Dispatcher Workshop

2.39 It is understood that there is difficulty within the timeframe and structure of a Task Force meeting, to fully understand the consequences or benefits of each scenario. It is therefore suggested that the BOBCAT Paper Trial which will commence in the last week of September/first week of October should demonstrate all options. A representation on behalf of airlines concerned as well as ANSPs is invited to attend the trial demonstrations.

2.40 In regard to the conduct of a dispatcher workshop, AEROTHAI is willing to be included as a part this workshop in order to demonstrate and answer questions on BOBCAT system.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the importance of Maximum Acceptable Delay in order for airline dispatchers to obtain the best slot allocation for their flights;

b) Note the importance of trade-off between random selection of the slot allocation process and optimal slot time for entry into Kabul FIR;

c) Consider looking at complete random slot allocation compared to slot allocation scheme that emphasizes optimizing airspace usage over Kabul FIR;

d) Agree that these issues be demonstrated during the Paper Trial of BOBCAT; and,

e) If required, ICAO to organize a workshop for dispatchers to assist their input into BOBCAT.

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