Matching last FlightRadar24 data with ADS-B Log for MH370

Introduction

The purpose of this document is to compare the data captured by FlightRadar24 and the official Malaysian ADS-B log for MH370.

History

We noticed Paul Sladen who has prepared a briefing about the Inmarsat Satellite log for the U.K. Air Accident Investigation Branch (AAIB) on the on 3rd July 2014 also has made a comparison of the data from all the Flight Tracking Sites. This includes Flightradar24,Flightaware,Planefinder, Lib Home Radar and Radarbox24.

His conclusions on the flight tracking sites data was:

Aside from the fake FA entry at 17:50:50, the datasets have reasonably separate sourcing and can be correlated.

What we will be looking at

We will just be looking at the FlightRadar24 data and later on the official Malaysian ADS-B data.

FlightRadar24

Paul over 10 years ago firstly downloaded the FlightRadar24 data for the 8/3/2014 flight of MH370.

He did this by requesting an API call to the FlightRadar24 server.

This was done via the following command.

```
curl -X POST 'http://api.fr24.com/api/common/v1/json-rpc/' -X POST -d
'{"jsonrpc":"2.0","method":"Aircraft.doGetPlaybackSingle","params":[47716903]
,"id":1}' -o fr24-pinned-47716903.json
```

We did the same but as expected now 10 years on it returned no data (See Appendix A - Null return for API to FlightRadar24 server for MH370.

When Paul ran the same API request 10 years ago the data returned is shown in Appendix B - Data returned to Paul after API call to FlightRadar24 server for MH370.

Afterwards Paul obtained the data that would be shown to the customer when playing back a flight. This is shown in Appendix C - FlightRadar24 play back data for MH370.

You can also see all this data by playing back the MH370 flight. Please see https://youtu.be/mzayWbjS_VM?si=Lf8CMZS9wXXpfhCD. (They both match up).

On the left side of the screen you will see the aircraft registration (9M-MRO), the altitude, vertical speed, Speed, Track, Latitude, Longitude, Radar-Id and MH370's Squawk code of 2157.

Please freeze the screen towards the end of the flight and write down the last two sets of values displayed. These are:

Latitude	Longitude	Altitude	What does his indicate
6.93	103.59	0	The altitude is zero and the matching entry for the initial data captured by FlightRadar24 is 35,000 ft. See Appendixes B + c
6.97	103.63	0	The altitude is zero and the matching entry for the initial data captured by FlightRadar24 is 35,000 ft. See Appendixes B + c. Also this entry (and the approximately 50 prior) are missing from the official Malaysian ADS-B log. See Appendix D.

So you can confirm the values extracted by Paul directly correlate with the playback of the MH370 flight.

Malaysian ADS-B Log

The Malaysian ADS-B log was part of the data related to MH370 investigation. Please see Appendix D - for an extract of the last few records from the ADS-B Log.

Issues Detected.

There appears to be some things that do not make any sense.

These are:

1 - Altitudes do not match up

The FlightRadar24 data extracted from its ADS-B receivers show the last two entries having an altitude of 35,000 ft (Please see Appendix B - Data returned to Paul after API call to FlightRadar24 server for MH370).

However when a customer plays back the MH370 flight these last two entries instead show an altitude of zero. (Please see Appendix C - FlightRadar24 play back data for MH370). Also you can play back the MH370 flight by clicking on this URL https://youtu.be/mzayWbjS_VM?si=H_T0rH7TUg-kmaBA.

Therefore we cannot see how the altitude initially captured having a value of 35,000 ft is now played back to the customers with a value of zero feet.

2 - Missing 50 plus MH370 transmissions from the ADS-B log

The last transmission from MH370 was received by FlightRadar24 at 17:21:03 UTC (Latitude 6.97 N and Longitude 103.63 E).

However the last transmission received in the official Malaysian ADS-B log was at 17:20:35. This means the ADS-B log did not capture the last 28 seconds of transmissions from MH370. As MH370 would be transmitting these at around one every half second that means around 50 transmissions were lost.

This does not make sense as if the FlightRadar24 ADS-B receiver was able to pick up the 17:21:03 transmission then so should the Malaysian ADS-B receiver.

Also please see APPENDIX E - Summary of likely anomalies found in FlightRadar24 data and ADS-B log for more details.

3 - 28 seconds to turn transponder rotary transponder switch

There was speculation that the process of manually moving the Transponder Mode Selector knob from TA/RA to STBY would cause the transponder to go into ALT OFF mode as the selector passed through that switch position.

However the first zero altitude picked up by FlightRadar24 was at 17:20:35 (Latitude 6.93 N and longitude 103.59 E) and the last zero altitude picked up was at 17:21:03 (Latitude 6.97 N and Longitude 103.63 E). That is a distance of 6.2 kilometres and a time difference of 28 seconds.

That means the Transponder Mode Selector Knob would need to be held for 28 seconds in that intermediate position. This does not seem very likely. In other words whoever turned off the transponder would first have to move it to the altitude not displayed position then count one thousand and one, one thousand and two, one thousand and three …… one thousand and twenty seven, one thousand and twenty nine and then move the knob to the off or standby position.

4 - Sudden rounding of Latitude/Longitude values

Normally computer programs that import data in this case from the ADS-B receivers perform the same logic for each entry imported. It is a bit strange that towards the end of the file the rounding changes from 5 decimal places to two decimal places and to one entry to just on decimal place for some entries.

Please see Appendix B - Data returned to Paul after API call to FlightRadar24 server for MH370.

Examples are:

Latitude	Number Decimal Places
2.89041	5
2.97043	5
5.66496	5
6.58	2
6.8	1
6.93	2

That's about 6 out of 63 have been rounded to two or one decimal places and all are found towards the end of the file.

Appendix A - Null return for API to FlightRadar24 server for MH370.

We sent the same request to the FlightRadar24 server as done by Paul 10 years earlier. As expected we got a resource not found. Typically as we are asking for data that is too far back and possibly now it is a paid for service.

Request for data

colli@MSI-3070 ~
$ curl -X POST 'http://api.fr24.com/api/common/v1/json-rpc/' -X POST -d '{"jsonrpc":"2.0","method":"Aircraft.doGetPlaybackSingle","params":[47716903],"id":1}' -o fr24-pinned-47716903.json

```
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100   545    0   461  100    84    547     99 --:--:-- --:--:-- --:--:--   648
```

Response from server

$ CAT fr24-pinned-47716903.json
{"errors":{"message":"Resource not found.","errors":"no-resource-found"},"_api":{"copyright":"Copyright (c) 2014-2024 Flightradar24 AB. All rights reserved.","legalNotice":"The contents of this file and all derived data are the property of Flightradar24 AB for use exclusively by its products and applications. Using, modifying or redistributing the data without the prior written permission of Flightradar24 AB is not allowed and may result in prosecutions."}}

Appendix B - Data returned to Paul after API call to FlightRadar24 server for MH370.

This is the data returned to Paul for the MH370 flight.


```
{"result":
 {"success": true,
  "data": {
   "flight": [47716903,"MH370","MAS370","KUL","PEK"],
   "airport": [
    ["KUL","Kuala Lumpur International Airport",   "Kuala
Lumpur",2.745578,101.7099,  "MYT","Malaysia Time",8],
    ["PEK","Beijing Capital International Airport","Beijing",
40.080109,116.584503,"CST","China Standard Time",8]],
   "aircraft": [7667855,"75008F","9M-MRO","B772","Boeing 777-2H6ER","Malaysia
Airlines",null],
   "track": [
    [2.7983, 101.689, 1500,183,328,"2157",1394210550,"F-WMSA2"],
    [2.80333,101.686, 1575,188,327,"2157",1394210557,"F-WMSA2"],
    [2.80838,101.683, 1650,196,327,"2157",1394210563,"F-WMSA2"],
    [2.81292,101.68,  1725,201,327,"2157",1394210570,"F-WMSA2"],
    [2.81841,101.676, 1825,207,327,"2157",1394210576,"F-WMSA2"],
    [2.82454,101.673, 1950,210,327,"2157",1394210585,"F-WMSA2"],
    [2.84732,101.659, 2375,237,336,"2157",1394210608,"F-WMSA2"],
    [2.85393,101.657, 2475,240,346,"2157",1394210615,"F-WMSA2"],
    [2.86138,101.657, 2600,242,353,"2157",1394210621,"F-WMSA2"],
    [2.88317,101.664, 3350,258, 24,"2157",1394210642,"F-WMSA2"],
    [2.89041,101.668, 3675,260, 24,"2157",1394210648,"F-WMSA2"],
    [2.89769,101.671, 3975,261, 25,"2157",1394210655,"F-WMSA2"],
    [2.90666,101.675, 4375,264, 26,"2157",1394210663,"F-WMSA2"],
    [2.9144, 101.679, 4700,265, 26,"2157",1394210669,"F-WMSA2"],
    [2.92126,101.683, 5000,266, 26,"2157",1394210676,"F-WMSA2"],
    [2.94003,101.692, 5850,269, 26,"2157",1394210693,"F-WMSA2"],
    [2.95332,101.698, 6450,270, 26,"2157",1394210706,"F-WMSA2"],
    [2.97043,101.707, 7225,273, 25,"2157",1394210719,"F-WMSA2"],
    [2.98223,101.712, 7675,277, 25,"2157",1394210731,"F-WMSA2"],
    [2.99764,101.72,  8275,279, 25,"2157",1394210744,"F-WMSA2"],
    [3.01179,101.726, 8900,281, 25,"2157",1394210757,"F-WMSA2"],
    [3.02815,101.734, 9500,284, 25,"2157",1394210769,"F-WMSA2"],
    [3.04202,101.741,10025,286, 25,"2157",1394210780,"F-WMSA2"],
    [3.07915,101.759,10625,318, 25,"2157",1394210811,"F-WMSA2"],
    [3.12341,101.78, 11125,355, 25,"2157",1394210843,"F-WMSA2"],
    [3.17575,101.804,12350,369, 25,"2157",1394210878,"F-WMSA2"],
    [3.22691,101.829,13800,375, 25,"2157",1394210910,"F-WMSA2"],
    [3.28058,101.854,15275,377, 25,"2157",1394210942,"F-WMSA2"],
    [3.37436,101.899,17475,391, 25,"2157",1394211003,"F-WMSA2"],
    [3.48001,101.949,19800,400, 24,"2157",1394211064,"F-WMSA2"],
    [3.58718,101.999,21875,416, 25,"2157",1394211126,"F-WMSA2"],
    [3.69732,102.052,23850,424, 25,"2157",1394211188,"F-WMSA2"],
    [3.80878,102.104,25425,438, 25,"2157",1394211249,"F-WMSA2"],
    [3.92207,102.157,26775,452, 25,"2157",1394211310,"F-WMSA2"],
```

```
    [4.03972,102.213,28200,461, 25,"2157",1394211371,"F-WMSA2"],
    [4.15912,102.269,29550,470, 25,"2157",1394211432,"F-WMKC1"],
    [4.2768, 102.325,30775,476, 25,"2157",1394211494,"T-WMKP2"],
    [4.3997, 102.383,31900,485, 25,"2157",1394211555,"T-WMKP2"],
    [4.5389, 102.448,34000,472, 25,"2157",1394211623,"T-WMKP2"],
    [4.6595, 102.505,35025,467, 25,"2157",1394211684,"T-WMKP2"],
    [4.7784, 102.561,35000,467, 25,"2157",1394211749,"T-WMKP2"],
    [4.91203,102.625,35000,469, 25,"2157",1394211811,"F-WMKC1"],
    [5.03286,102.682,35000,469, 25,"2157",1394211873,"T-WMKN1"],
    [5.16255,102.743,35000,467, 25,"2157",1394211938,"T-WMKN1"],
    [5.28712,102.802,35000,468, 25,"2157",1394212004,"F-WMKC1"],
    [5.41933,102.864,35000,469, 25,"2157",1394212070,"F-WMKC1"],
    [5.54037,102.922,35000,470, 25,"2157",1394212131,"F-WMKC1"],
    [5.66496,102.981,35000,471, 25,"2157",1394212193,"F-WMKC1"],
    [5.78574,103.038,35000,472, 25,"2157",1394212255,"F-WMKC1"],
    [5.909,  103.096,35000,472, 25,"2157",1394212316,"F-WMKC1"],
    [6.03113,103.154,35000,472, 25,"2157",1394212378,"F-WMKC1"],
    [6.15088,103.211,35000,472, 25,"2157",1394212439,"F-WMKC1"],
    [6.27365,103.27, 35000,472, 25,"2157",1394212501,"F-WMKC1"],
    [6.39583,103.328,35000,472, 25,"2157",1394212562,"F-WMKC1"],
    [6.5197, 103.386,35000,473, 25,"2157",1394212624,"F-WMKC1"],
    [6.58,   103.41, 35000,473, 25,"2157",1394212659,"F-WMKC1"],
    [6.68,   103.46, 35000,473, 25,"2157",1394212719,"F-WMKC1"],
    [6.78333,103.512,35000,473, 25,"2157",1394212757,"F-WMKC1"],
    [6.8,    103.52, 35000,474, 25,"2157",1394212768,"F-WMKC1"],
    [6.90314,103.57, 35000,472, 28,"2157",1394212818,"F-WMKC1"],
    [6.93,   103.59, 35000,471, 40,"2157",1394212835,"F-WMKC1"],
    [6.97,   103.63, 35000,471, 40,"2157",1394212863,"F-WMKC1"]
   ]
  }
 },
 "id":"2","jsonrpc":"2.0"
}
```

Appendix C - FlightRadar24 play back data for MH370.

When a customer plays back MH370 on the FlightRadar24 system this is the information returned. Note, the last entry with latitude 6.97 is missing from the Malaysian official ADS-B log.


```
[
 ["75008F", 2.81, 101.68, 327, 1700, 200, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394210567, "KUL", "PEK", "MH370", 0, 896, "MAS370", 0],
 ["75008F", 2.86, 101.66, 353, 2600, 242, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394210621, "KUL", "PEK", "MH370", 0, 1280, "MAS370", 0],
 ["75008F", 2.93, 101.69, 26, 5400, 267, "2157", "F-WMSA2", "B772", "9M-MRO",
1394210685, "KUL", "PEK", "MH370", 0, 3072, "MAS370", 0],
 ["75008F", 3.0, 101.72, 25, 8475, 280, "2157", "F-WMSA2", "B772", "9M-MRO",
1394210748, "KUL", "PEK", "MH370", 0, 3072, "MAS370", 0],
 ["75008F", 3.08, 101.76, 25, 10600, 314, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394210808, "KUL", "PEK", "MH370", 0, 512, "MAS370", 0],
 ["75008F", 3.16, 101.8, 25, 11950, 367, "2157", "F-WMSA2", "B772", "9M-MRO",
1394210867, "KUL", "PEK", "MH370", 0, 2560, "MAS370", 0],
 ["75008F", 3.25, 101.84, 25, 14475, 377, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394210925, "KUL", "PEK", "MH370", 0, 2816, "MAS370", 0],
 ["75008F", 3.35, 101.89, 25, 16925, 387, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394210986, "KUL", "PEK", "MH370", 0, 2304, "MAS370", 0],
 ["75008F", 3.45, 101.94, 25, 19225, 399, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394211048, "KUL", "PEK", "MH370", 0, 2432, "MAS370", 0],
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MRO", 1394211106, "KUL", "PEK", "MH370", 0, 1920, "MAS370", 0],
 ["75008F", 3.66, 102.03, 25, 23100, 426, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394211168, "KUL", "PEK", "MH370", 0, 2560, "MAS370", 0],
 ["75008F", 3.77, 102.09, 25, 24850, 434, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394211227, "KUL", "PEK", "MH370", 0, 1536, "MAS370", 0],
 ["75008F", 3.88, 102.14, 25, 26300, 448, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394211288, "KUL", "PEK", "MH370", 0, 1280, "MAS370", 0],
 ["75008F", 4.0, 102.19, 25, 27675, 459, "2157", "F-WMSA2", "B772", "9M-MRO",
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 ["75008F", 4.07, 102.23, 25, 28625, 464, "2157", "F-WMSA2", "B772", "9M-
MRO", 1394211405, "KUL", "PEK", "MH370", 0, 1280, "MAS370", 0],
 ["75008F", 4.22, 102.3, 25, 30175, 473, "2157", "T-WMSA8", "B772", "9M-MRO",
1394211463, "KUL", "PEK", "MH370", 0, 1280, "MAS370", 0],
 ["75008F", 4.33, 102.35, 25, 31275, 481, "2157", "T-WMKP2", "B772", "9M-
MRO", 1394211522, "KUL", "PEK", "MH370", 0, 1152, "MAS370", 0],
 ["75008F", 4.46, 102.41, 25, 32825, 480, "2157", "T-WMKP2", "B772", "9M-
MRO", 1394211587, "KUL", "PEK", "MH370", 0, 2176, "MAS370", 0],
 ["75008F", 4.58, 102.47, 25, 34475, 470, "2157", "T-WMKP2", "B772", "9M-
MRO", 1394211644, "KUL", "PEK", "MH370", 0, 1536, "MAS370", 0],
 ["75008F", 4.7, 102.52, 25, 35000, 467, "2157", "T-WMKP2", "B772", "9M-MRO",
1394211704, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
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MRO", 1394211757, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
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MRO", 1394211824, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
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1394212004, "KUL", "PEK", "MH370", 0, -128, "MAS370", 0],
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MRO", 1394212058, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 5.53, 102.92, 24, 35000, 471, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212126, "KUL", "PEK", "MH370", 0, -128, "MAS370", 0],
 ["75008F", 5.65, 102.97, 25, 35000, 471, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212185, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 5.77, 103.03, 25, 35000, 472, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212246, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 5.89, 103.09, 25, 35000, 472, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212305, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.0, 103.14, 25, 35000, 472, "2157", "F-WMKC1", "B772", "9M-MRO",
1394212365, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.13, 103.2, 25, 35000, 472, "2157", "F-WMKC1", "B772", "9M-MRO",
1394212425, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.24, 103.26, 25, 35000, 472, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212486, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.36, 103.31, 25, 35000, 472, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212545, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.48, 103.37, 25, 35000, 473, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212605, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
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MRO", 1394212659, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.68, 103.46, 25, 35000, 473, "2157", "F-WMKC1", "B772", "9M-
MRO", 1394212719, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.8, 103.52, 25, 35000, 474, "2157", "F-WMKC1", "B772", "9M-MRO",
1394212768, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.93, 103.59, 40, 0, 471, "2157", "F-WMKC1", "B772", "9M-MRO",
1394212835, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0],
 ["75008F", 6.97, 103.63, 40, 0, 471, "2157", "F-WMKC1", "B772", "9M-MRO",
1394212863, "KUL", "PEK", "MH370", 0, 0, "MAS370", 0]
]
```

Appendix D - for an extract of the last few records of the ADS-B log.

Last few entries in the Malaysian ADS-B LOG

Time sequence	Time UTC	Latitude	Longitude	Altitude	Time Gap (Secs)
62433.1	17:20:34	6.929675	103.5904	350	-
62433.61	17:20:34	6.930275	103.591	350	.51
62434.15	17:20:34	6.931273	103.5919	0	.54
62434.55	17:20:35	6.931917	103.5925	0	0.4

APPENDIX E - Summary of likely anomalies found in FlightRadar24 data and ADS-B log.

Table 1 - Last few entries in the FlightRadar24 log accurate data (Extract no 1 - fr24-pinned-47716903.json)

Time seq	Time UTC	Latitude	Longitude	Distance (NM)	Heading/Calc Heading	Speed ADS-B/Calc	Time diff (secs)	Altitude
1394212768	17:19:28	6.8	103.52	-	-	-	-	35000
1394212818	17:20:18	6.90314	103.57	6.87	28/25.7	472/502	50	35000
1394212835	17:20:35	6.93	103.59	2.00	40/36.5	471/423	17	35000
1394212863	17:21:03	6.97	103.63	3.3817	40/44.79	471/434.8	28	35000

Table 2 - Last few entries in the FlightRadar24 log for play back (Extract no 2 - fr24-time-ads-b-extracted.json)

Time seq	Time UTC	Latitude	Longitude	Distance (NM)	Heading/Calc Heading	Speed ADS-B/Calc	Time diff (secs)	Altitude
1394212768	17:19:28	6.8	103.52					35000
1394212835	17:20:35	6.93	103.59	8.85	40/?	471/476	67	0
1394212863	17:21:03	6.97	103.63	3.38	40/45	471/435	28	0

Table 3 -Last few entries in the Malaysian ADS-B LOG

Time seq	Time UTC	Latitude	Longitude	Altitude
62433.61	17:20:34	6.930275	103.591	35000
62434.15	17:20:34	6.931273	103.5919	0
62434.55	17:20:35	6.931917	103.5925	0

Possible issues

Issue 1 - According to reports from Paul Sladen FlightRadar24 received the ADS-B transmissions from MH370 and stored the data as shown in Table1.

When the MH370 flight is played back on the FlightRadar24 website the information shown to the customer is as per Table 2.

The official ADS-B data captured by the Malaysian ADS-B receiver (s) is shown in Table 3.

All the altitudes for the entries at UTC time 17:20:35 for all the tables (i.e. Table 1, Table 2 and Table 3) should all have the same altitude being zero feet. However the altitude in Table 1 is different (being 35000 ft). See Turquoise highlighted entries.

Issue 2- FlightRadar24 shows the last transmission being at 17:21:03 (See tables 1 + 2). However the last transmission captured by the Malaysian ADS-B receiver (s) is at 17:20:35. This means the Malaysian ADS-B receiver missed over 28 seconds of transmissions. If FlightRadar24 was able to pick up these last transmissions then so should the Malaysian ADS-B receiver (s). But they did not. See Green highlighted lines.

Note as the ADS-B log captures details approximately every half second then the ADS-B log is missing around the last 50 transmissions from MH370. If FlightRadar24 was able to pick up transmissions up to 17:21:03 then so should the ADS-B log. But it did not.