

PMSE Consultation Response

1. Introduction

On the 25th July 2018, the CAA and Ofcom released safety assurance documentation through a closed consultation directed at UK ANSPs which concerned the operation of PMSE in the DME Band 960-1164 MHz. Full details were provided in the accompanying letter and guidance that was provided.

NATS provided comments to the CAA on the safety assurance documentation. NATS stated in their accompanying note that the feedback provided is not an endorsement of the sharing proposal or the safety documentation provided.

2. Document Structure

The response from NATS has a number of specific questions, but also embeds several other comments and questions into narrative text. In preparation of the response document, the response from NATS has been broken down into specific questions and each response provided against the question. Where a question is repeated, a previous answer is referred to.

In order to provide traceability back to the original text, the responses below are broken down into four sections, matching the NATS response format, the originating text is then repeated in black text with the combined CAA and Ofcom response in red.

QA1-7	Questions taken from the initial narrative of the NATS response, page 1-2
QB1-28	Specific questions from the NATS response (numbered 1-28), page 3-5
APPA	Questions regarding documents referenced in the safety assurance documentation (Listed in Appendix A in the NATS response, pages 5-7)
QD1-17	Questions taken from the NATS response (Appendix B), page 8-10

3. Comments Provided

The full response is provided in section 4 of this document. Where action is required the proposed steps are described in the specific responses. There are 3 key areas related to the Link 16 Joint Tactical Information Distribution System (JTIDS), the assumptions on operational practices of PMSE operators and protection of and potential interference to PMSE that are discussed below.

There is a focus on the use of references from the JTIDS safety case. JTIDS is a military communication system that operates under an existing safety assurance framework, JTIDS operates in the same band 960-1164 MHz and there are therefore specific assumptions that are relevant to the PMSE safety assurance case. These are generally assumptions that are made regarding the impact of interference on incumbent systems in the band, not specifics regarding the proposed sharing system. The CAA has repeated its review of these assumptions and maintains its original conclusion that any references made are appropriate. In an environment where spectrum sharing is taking place, the use of appropriate common assumptions is expected and necessary. The CAA does not feel that the assumptions used are outside the bounds of what is relevant. A full breakdown is provided in section 3. The CAA appreciates that the JTIDS documentation is not publicly available and has committed to approaching the MoD to establish if the assumptions referenced can be shared with third parties. This exercise however will not be a dependency of approval of the safety assurance case as the CAA has already completed a satisfactory assessment of them. The reliance of the PMSE safety assurance case is not considered to impact the validity of the document and the CAA expects sharing arrangements and assessments to be aligned where possible, this does not mean

the PMSE safety assurance case does not 'stand on its own merit' and the use of other existing relevant references is considered appropriate.

A number of comments concern the assumptions made about the operational practices of PMSE operators, presence of coordinators and security to remove equipment etc. The CAA believes the assumptions made have been generated in this case by the appropriate authority and subject matter expert. Ofcom currently operate the licensing mechanism and perform support, monitoring and enforcement for PMSE deployments in the 700 MHz band. As discussed, such assumptions form part of the continuous review agreement between the CAA and Ofcom, and in addition the CAA will engage with PMSE stakeholders directly to assure the assumptions made.

A series of comments have also been made regarding the protection of and potential interference to PMSE operators. As stated in the SAC, no such considerations are made in the safety documentation as this is not considered to have a direct impact on the safety of aircraft. In addition, a number of comments relate to intentional malicious acts. The CAA recognises that malicious acts related to radio transmissions is a concern, however, there are less expensive, more widely available and more disruptive equipment available to conduct a malicious act; the use of a low powered radio microphone therefore is a less likely option and would potentially be ineffective.

4. Comment Responses

See overleaf.

QA1 (Taken from the questions/comments embedded in the introductory text on page 1/2)

Within the Ofcom Documentation, there seems to be insufficient justification presented to extend the analogy with JTIDS with the use of similar assumptions, parameters and calculations for PMSE, which is what we understand to be happening. NATS understands JTIDS use to be generally (but not exclusively) airborne, using (very) fast mobile platforms / frequency hopping spread spectrum such that JTIDS cannot be a long-term interferer into an aviation system; whereas PMSE is static in use relative to aviation systems in both geographic and frequency terms. Therefore, it is clear that the impact of interference from the two systems into aviation would differ. In NATS view CAA should be seeking to ensure that assumptions, parameters and calculations should be being provided for PMSE, rather than the documentation just referring out to references that may no longer be appropriate, or appropriate in this situation.

NATS appreciates that the JTIDS FCA / safety case are not publicly available documents but it makes it very difficult to adequately assess the Ofcom documentation where it appears to rely so heavily on such military documents. The Ofcom documentation should stand on its own merits and contain its own assumptions, parameters and calculations for the purpose of assessing the impact of PMSE on civil aviation. In addition, as NATS pointed out in the workshop, PMSE and JTIDS are different systems when it comes to their “dwell times” in both geographic and frequency terms, making them very different interference sources; appropriate assumptions, parameters and calculations should be being provided by Ofcom with justifications for PMSE without just referring out to JTIDS references that may no longer be appropriate in this situation.

CAA Comment:

The CAA believes the use of elements of the JTIDS safety case as a proxy is reasonable in the correct context and setting. The SAC makes clear reference to where comparisons are made and typically this is only in reference to the impact upon the service and not the mechanics of how such interference may manifest itself. The CAA has reviewed the references made in light of this comment and stands by its initial assessment that where references to the JTIDS safety case are used it is appropriate.

The following references were identified and checked:

- 3.11 Reference to the consequence of interference
- ES – Reference to undetected corruption not being a credible outcome
- 5.2 – Reference to the impact of interference on aviation only
- 5.13 – Reference to credence of undetected corruption
- 5.15 – Reference to the permissible rate of H2 (Loss of DME facility)
- A4.22 – Reference to number of aircraft in flight over the UK at any given time (discussed later)
- A4.25 – Reference to probability that an airborne receiver is in range
- A5.2 – Reference to most stringent safety objective
- A5.5 – Reference to permissible failure rate for the safety objective identified in A5.2
- A5.7 – Reference to calculation approach used within JTIDS safety case

In developing the JTIDS safety case the CAA provided the ‘permissible probability’ of system failure (“facility” in this instance refers to a DME system comprising a ground beacon and an aircraft interrogator) for different phases of flight. These included phases relating to use of en route DME. The most stringent of these thresholds relates to “Loss of DME slant range information for more than 4 seconds during top of descent”.

These thresholds are independent of the cause of loss i.e. are not specific to the operational and technical characteristics of JTIDS. The CAA considers that these thresholds are applicable to the PMSE safety assurance case. As the most limiting threshold is applied in the PMSE safety assurance case, other, less conservative scenarios such as en route use, do not need to be specifically included.

QA2

One fundamental statement contained within the Ofcom Documentation regarding the similarity of TACAN and DME is incorrect on the airborne side; since the two types of Interrogators have different receive characteristics.

CAA Comment:

TACAN is a military system and it is not considered within the safety assurance case as set out in Table 1 and in other parts of the safety case.

Secondly, it is common to assume that TACAN and DME are similar enough to be considered the same in relation to spectrum sharing analysis, for example ECC Report 146. In addition, the MOD confirmed in March 2015 that sharing criteria in relation to DME would cover TACAN.

Consideration for interference from Airborne DME or TACAN is not considered within the SAC.

QA3

Regarding use of DME as an approach aid, in A2.8, Ofcom's operational description of DME use fails to consider its use as part of an ILS/DME at an airport, when it is the sole aid providing ranging to touchdown. These facilities will not be supplanted by GNSS in the near term timescales being considered for PMSE, and they may never be replaced by GNSS for the most stringent of landing requirements.

Original Reference:

The use of the DME depends upon the equipment on-board the aircraft. It can be a stand-alone instrument, combined with other instruments (such as VOR), or part of an integrated electronic navigation display. However, in all cases, the use of DME is to identify the distance between the aircraft and the ground station.

CAA Comment:

This is operational background. DME use with ILS is noted in A2.3.

QA4

NATS has received comments from airports that raise questions on the issuance of licences and the use of future aviation systems within the L Band spectrum

CAA Comment:

As set out in the safety case (and the SMRs), the introduction of any new ARNS or AM(R)S in the 960 MHz band will require an assessment of compatibility with PMSE. This may be a theoretical study and/or practical coexistence tests. Any assessment of compatibility would necessarily take into account the extraneous pulse environment, including use of JTIDS. From this assessment protection criteria will be defined and applied through revised spectrum management rules and the safety assurance case will also be revised. The CAA is responsible for informing Ofcom of the introduction of any new ARNS or AM(R)S system. The introduction of a new system is one of the trigger points identified in the review agreement between Ofcom and the CAA.

QA5

Airports see the need to have the notification of intention to transmit from the operator and have some form of safeguarding assessment completed to demonstrate no impact to ATC equipment. This is envisaged to be a similar process to where satellite broadcasting equipment is to be used in the vicinity of an airfield. This should also be considered for extension to cover Enroute installations.

CAA Comment:

The notification process referred to by NATS relates to deployment of transportable Earth stations (TES) often used by satellite news gathering (SNG). These transmit from the Earth to satellites at powers of the order of 40 to 50 dBW (10,000 to 100,000 Watts) using directional antennas. Notification of operation of TESs in the vicinity of an airfield is an appropriate mitigation of risk of EMC interference into aircraft avionics. By comparison, wireless microphones transmit at less than 50 mW (typically 10 mW or less).

Ofcom carried out practical coexistence testing to determine the level of impact from low power audio PMSE to ATC systems. The CAA is content that this demonstrates sharing can be achieved and there is no additional requirement to notify an intention to transmit as this is disproportionate to the level of risk.

The assessment in the SAC for this particular application does not indicate that such a system is required as a mitigation.

QA6

Future use of bandwidth must be carefully considered. GNSS and ADSB in particular have the potential for much wider use than is currently the case and this must be taken into account.

CAA Comment:

GNSS and ADS-B are already considered within the project. The protection characteristics are laid down within the spectrum management rules. Assuming a change in the current use of the systems listed above is implemented (E.G ADS-B below 100m) then this would trigger a review of the spectrum management rules. The CAA believes the current use scenarios of existing systems is appropriate and reflects current and near-term use.

Changes to the way existing systems are utilised or the introduction of new systems forms part of the review agreement between Ofcom and the CAA, which is described in our response to QA4.

QA7

Within the Ofcom documentation, the Top of Descent is given as the worse-case scenario for Enroute whereas Airports consider the case of an aircraft on approach, low level at 25 NM on the localiser at 2000' to be more onerous on the desired to undesired signal rejection case. Since the transmission path from overhead an event could be very much less than the path the airport DME, the undesired signal would have a greater ratio than a similar case at 30,000' where the path lengths from desired and undesired would be similar. It is also clear that an aircraft at 2000' (or less on approach) would have more potential effect on PMSE equipment than one at 30,000' due to less free-space path loss. The argument here is that whilst the aircraft may cope with the interference (as yet unproven fully), the aircraft DME may interfere unintentionally with the PMSE equipment.

CAA Comment:

The most stringent maximum permissible rate for the loss of a DME facility used in the safety case is based on the most stringent requirement from the JTIDS safety case. This is considered to be the most appropriate requirement and no additionally stringent requirement is known. The requirement for availability is then calculated through to represent the number of PMSE tasks. The basis for this requirement is based on the long term use and experience of operating other systems on a shared basis in the band. The safety assurance case does not consider specific requirements based around the operations of any one specific DME facility, which would be impractical. The use of the permissible rate is considered to cover all usage scenarios.

When operating within the spectrum management rules, sharing is considered 'safe' for both aeronautical and PMSE users, i.e. the success case. For the failure case, the threshold on probability of interference has been provided by the CAA and is the most limiting across a range of flight scenarios. The scenario described, i.e. aircraft on approach, is not a concern within the success case and the probability of the risk of the failure case has been assessed within the safety assurance case as falling below the probability threshold provided by the CAA. The signal is protected for the DOC of the service, regardless of the specific geometries.

With regards to the risk into PMSE, this is not a matter for the safety assurance case.

QB1 (Taken from the question list starting on page 3)

What process has CAA applied to assess Ofcom's safety work and how is CAA independently verifying Ofcom assertions / assumptions?

CAA Comment:

The CAA does not have a defined process for assessing safety work in this manner. Spectrum sharing varies based upon the specifics of the scenario, and therefore a 'one size fits all' approach would be unsuitable. Typically, the CAA uses an approach that has been used for previous spectrum sharing projects. In this case Ofcom was seen as the representative body for deploying the sharing technology (as MoD is for JTIDS) and the assessment was conducted independently by Ofcom and submitted to the CAA. The assessment was reviewed by the appropriate SMEs, and where requested by the CAA, clarification was provided by Ofcom. Within the CAA a number of subject matter experts were deployed to review specific elements of the documentation, and comments collated by the Spectrum team. This included comments from safety experts concerning the airport and the en-route environment.

QB2

Why has CAA chosen to not engage with aircraft operators for this stage of the consultation and to have it, essentially, as a closed discussion relating to airports?

CAA Comment:

The CAA consulted UK ANSPs on the potential impacts and mitigations that ANSPs consider might be necessary as a result of the potential change to the Radio Frequency environment. It was not a consultation on the content of the safety assurance case per se, although it was considered that any major omissions or errors in the safety assurance case would be highlighted by ANSPs, either during the consultation period or subsequently. On the assumption that the CAA accepts the safety assurance case, Ofcom has committed to publish both the SMRs (updated from the current version published as part of its 2016 consultation documentation) and the safety assurance case which ANSPs and operators will be able to refer to and take into account as part of their own safety case.

QB3

Has there been any approach to CAA from the airline industry on this consultation?

IATA provided the following statement:

“IATA on behalf of its member airlines would like to emphasize that the frequency band 960-1164 MHz is already fully populated with safety critical aeronautical systems - including those which are being used on a worldwide basis to safely navigate aircraft. Moreover, this frequency band is intended to be further utilized by evolving aeronautical systems in order to sustain the consistent annual growth of air traffic.

The current major aviation usage of this spectrum includes Distance Measuring Equipment (DME) – an important aircraft navigation system supporting safety critical operations such as precision approaches and automatic landings. Being a safety critical equipment, it is important that DMEs can globally operate in an environment free from harmful interference in accordance with Article 4.10 of the ITU Radio Regulations.

Particularly, compatibility of aeronautical safety services with co-band or adjacent band non-aeronautical services, such as PMSE, must be considered with extreme care in order to preserve the integrity of the aeronautical safety services.

IATA, therefore, strongly opposes the introduction of any new system in the 960-1164 MHz frequency band unless the new system can fully satisfy all conditions required by ICAO.”

UK CAA comment:

The UK is signatory to the Chicago Convention which includes effective implementation of Annex 19 to the Convention on safety management. The steps undertaken to consider spectrum sharing are, in our view, fully compatible with the requirements of ICAO Annex 19.

In the event that operational implementation of spectrum sharing as outlined in the safety assurance case takes place, we foresee an ongoing CAA activity around safety promotion among PMSE users sharing the band as well as ongoing CAA monitoring of both licensing arrangements and actual spectrum use, in addition to the monitoring tasks Ofcom undertakes. The UK CAA is both resourced and equipped to undertake such activities.

QB4

Ofcom's documentation refers throughout to assumptions and what is CAA doing to assure itself that these are valid and will remain so should CAA approve this documentation?

CAA Comment:

The CAA independently verifies assumptions made within the SAC. Assumptions made regarding PMSE operations were provided by Ofcom, who the CAA considers as the suitable body to provide subject matter expertise. Ofcom manage current policy, deliver the licensing product, and operate the monitoring and enforcement for current PMSE deployments. As discussed at the consultation meeting, in order to ensure the rigor of assumptions the CAA has also requested the opportunity to review assumptions independently with PMSE stakeholders.

The SAC and other associated documentation (such as the SMRs) is subject to regular periodic and reactive review. A review would be triggered where circumstances change meaning the assumption would need to be reconsidered. A list of such changes that may trigger a review is agreed between the CAA and Ofcom.

QB5

Ofcom presents that aviation moving to greater use of GNSS reduces the need for DME

CAA Comment:

Many of the references to GNSS are to provide additional information. Use of GNSS is not considered as part of the assurance to enable a worst-case assumption and this is made clear in the documentation.

QB6

Why does the Ofcom document and argument not stand on its own merits and provide its own derivations and justifications for assumptions, parameters and calculations for the purpose of assessing the impact of PMSE on civil aviation? These are merely quoted as being taken from the JTIDS safety case (e.g. in A5.5) and used without further explanation.

CAA Comment:

See previous response, QA1

QB7

Hazard H2 (loss of DME facility) appears to be considered only for an airport DME, where is the consideration of loss for an Enroute DME?

CAA Comment:

The hazard considers the most critical 'tolerable probability' as defined by the CAA. The maximum acceptable failure rate of PMSE is assessed against the most limiting criterion, i.e. loss of slant range at top of descent. Any hazard relating to other DME use cases, e.g. Enroute, is therefore considered to be covered by the critical use case within the SAC. This is discussed in the response to QA7

QB8

Where Ofcom has deemed a hazard to present a low risk, it is stated that the impact has not been assessed. Taking note of the requirements placed upon NATS by CAA to consider resilience, i.e. events that may be consider as being low risk of occurrence must still be assessed for impact and mitigation, it would appear that the safety documentation remains unfinished in this regard. Should the CAA request Ofcom to reassess the low risks?

CAA Comment:

It was agreed between CAA and Ofcom that if the risk assessment fell below the probability threshold as provided by the CAA then it would be considered 'acceptable' under the definition within CAP 760 and no further assessment or action is required:

Acceptable - the consequence is so unlikely or not severe enough to be of concern. The risk is tolerable and the Safety Objective has been met. However, consideration should be given to reducing the risk further to As Low As Reasonably Practical (ALARP - see later) in order to further minimise the risk of an accident or incident

This approach is in line with the that specified within CAP760 and ensures the SAC remains objective in terms of assessing the appropriate risks. Where an assessment of risk falls below the probability threshold the CAA does not intend to request a reassessment. A reassessment would be required if an assumption or variable was to change. This would be captured as part of the continuous review mechanism. No documentation can consider all risks to a service where risks are incredibly low and an element of pragmatism is required that considers what risks are required for inclusion.

UK ANSPs are and have been invited to consider the potential impacts and resulting mitigations, if appropriate, that may be required in response to this proposed change to the RF environment irrespective of the outcomes of the safety assurance case.

QB9

In A5.3, Ofcom states that the increasing use of GNSS negates the apparent CAA assumption that DMEs are the sole source of navigation aid and so there is additional safety margin. H2 appears to have been calculated on the basis of risk to an airport DME and for precision approaches DME will remain the only navigation aid associated with the ILS so Ofcom is incorrect to imply an additional safety margin. This use of DME in conjunction with ILS also appears to have been missed out of the “detailed aviation system descriptions” in section A2. An increase in the use of GNSS may change the use of DME in the Enroute environment over time but the requirement for reliable DME will not. How does CAA find Ofcom’s statements about the use of DME to be acceptable?

CAA Comment:

The comments made are considered supplementary to the analysis and do not have an impact upon the safety assessment. The statement made remarks around the generic target regarding DME being the sole source of navigation. It is true to say that in certain circumstances the use of GNSS may impact the reliance on DME, the statement does not specify these situations and therefore it is difficult to establish further comment. As it does not impact the safety assessment the CAA does not consider it necessary to investigate it further.

QB10

It is stated by Ofcom, e.g. in A5 that a DME is “typically” serving 2.2 aircraft at any time, without justification other than that it is from the JTIDS safety case. What is the derivation for this number as this it appears low even in the context of certain airport DMEs considering aircraft on approach? NATS feel that it is at least an order of magnitude too low when considering the number of aircraft using an Enroute DME.

CAA Comment:

The derivation of 2.2 comes from an equation taken from the JTIDS safety case used to determine the average number of aircraft per beacon per hour. This is based on a figure of 2.3m flight hours per year and the presence of 120 DME beacons.

Taking the number of flights and establishing a suitable ‘per hour’ figure:

$2.3\text{m} \div 365 \div 24 = 262.5$ concurrent civil flights operating within the UK FIR (where a flight is assuming to have a length of one hour).

Taking the concurrent civil flights figure and splitting them equally across all UK DME’s:

$262 \div 120 = 2.2$ (each DME beacon serves an average 2.2 systems)

Today there are 144 ground beacons (when excluding duplicate entries used for different runways at an airport), therefore the average would be less than 2.2. As this figure is representative of the average each DME beacon serves (within the JTIDS SC) the CAA considers it viable for use in the PMSE safety assurance case.

The CAA has reviewed the same data (listed in the Appendix of this document and has established an increase of 31,000 flights, representing an increase of 1.4%. This yearly figure is reflected on the NATS website for the number of yearly flights. Whilst flights have increased over the past 10 years since the 2008 figures were collected, the following 3 years saw a significant drop and then a stagnation of traffic numbers. Significant growth has increased the number of flights up to just over 2008 levels since 2014.

The CAA appreciates the comments made and that information available on the NATS website suggests increased numbers in addition to the comments regarding specific DME facilities seeing higher numbers of aircraft. It would be impractical to make individual assessments of UK DME’s, and consider each variable that would change on a case by case basis. This would need to include the geographic distribution of PMSE tasks and the operational height of an aircraft, the presence of En-route traffic, etc. It would also need to include aircraft that are only operational over the UK landmass, as opposed to the FIR, which occupies an area more than twice the size of the UK landmass.

This original assessment made has proved suitable for the safety assurance of the operation of JTIDS, which has been in operation on the argument made for over 20 years. However, Ofcom has provided an assessment that considers 700 aircraft operating over the UK at any one time, a figure that exceeds those given by the NATS website at peak time. This assessment concludes that the impact on the outcome of the safety case is still acceptable. This revised assessment has been added to the PMSE SAC and is included in the appendix of this response for convenience.

Additionally, Ofcom has also provided an assessment for the JTIDS safety case that also demonstrates the significantly higher number is acceptable and does not change the outcome of the overall assessment. The CAA stands by the precedent set by the original assessment but will review the figure as part of the standard review cycle of the JTIDS safety case.

There are a number of factors that can impact the statistics used, however with the new combined analysis the CAA considers the matter to be concluded. Further details of the figures used and the calculations are listed in Appendix A.

QB11

NATS is implementing a new DME type in the UK; how will CAA ensure this type is adequately protected in the PMSE process?

CAA Comment:

The CAA notes the change and will continue to monitor any changes to the ground infrastructure in the UK. Unless compelling evidence can be provided indicating the performance of the new equipment is significantly different to existing systems and those tested it would be assumed that existing test results reflect the interoperability for new DME systems deployed. Noting that existing testing programmes aimed to test the majority of current deployments. As per the SMR's, testing results are considered along with the MOPS of operational equipment. Any new equipment deployed would need to meet the MOPS defined. Therefore the SMRs are designed to accommodate equipment changes without significant action.

QB12

Why does safety case not address the unacknowledged issues from Ofcom's consultation?

CAA Comment:

The decision to share has been taken and agreed by the CAA and MOD based on the outcome of Ofcom's 2015 consultation (available here: https://www.ofcom.org.uk/__data/assets/pdf_file/0023/76352/new-spectrum-audio-pmse-consultation.pdf).

The safety assurance case is part of the implementation of that decision and not a rerun of the consultation.

NATS' comments in response to the consultation were addressed fully in Ofcom's subsequent statement of March 2016 (see Annex 1's 'Stakeholder Responses' : https://www.ofcom.org.uk/__data/assets/pdf_file/0021/62481/New-Spectrum-for-Audio-PMSE-statement.pdf).

Reference to 'unacknowledged issues' is vague, and Ofcom has informed the CAA that it has not received any request for a correction or clarification to the statement following its publication.

QB13

NATS argue that expensive new PMSE kit isn't going to be left on the shelf for occasional peak use. Other than assumptions, what justification is provided for the assumption that 960 MHz band equipment would only be used for "peak use" events?
Note- Ofcom didn't appear to give a consistent response on this point at the workshop.

CAA Comment:

The assumption is based on assessment of the market, size of events and spectrum availability in the remaining 470 – 703 MHz band. Appendix 2 sets out the supporting argument. As noted in the workshop, this assumption (and others) will be reviewed in light of evidence of use as part of the review mechanisms going forwards.

Noting the CAA has reserved the ability to confirm the assumptions made with equipment providers and will continue to monitor the assumption closely.

QB14

Page 6, para 2.16: This "Limitations" section states the safety assurance case is predicated on assumptions regarding the operational environment and their accuracy. Given that a number of the NATS comments on the 2015 Ofcom consultation and JCSys testing were dismissed or not adequately addressed it is not accepted by NATS that the operational environment assumptions are accurate.

CAA Comment:
See QB12

QB15

Page 9, para 3.11: As the aviation stakeholders had no knowledge of the content of the JTIDS safety case how could they be expected to raise any comment on its appropriateness in the case of PMSE?

CAA Comment:
See QA1

QB16

Page 11, para 3.22: The paragraph states that PMSE trials have not resulted in any reported instances of interference into aeronautical systems. Have the operators of aeronautical systems been asked specifically if any performance anomalies were noted at the exact dates and times of these PMSE trials?

CAA Comment:
Trials have taken place through the innovation and trial licensing procedure. Licenses have been granted on this basis and as per the usual process, under this mechanism feedback on interference must be triggered by the incumbent system operators and is not proactively sought from operators, unless the assessment of the licence requires proactive notification.

QB17

Page 14, para 4.10: NATS does not agree that the whole aeronautical system environment has been adequately taken into consideration, for example NATS did not agree with the test environment used in the JCSys testing on DME originally. Also CAA has not previously consulted with Aviation stakeholders on the JTIDS safety case so this also is not accepted as evidence supporting the use of PMSE in the band 960 to 1164MHz. Is there a plan to ensure the whole aeronautical system is taken into account and these points addressed?

CAA Comment:
See response QB12. The CAA has considered the testing undertaken and deemed it appropriate, concluding that the whole aeronautical system is considered in the testing. With regards to the supporting evidence from the JTIDS safety case, please see the response contained to QA1. QA1 lists the common assumptions, while all other environmental assumptions are contained within the Ofcom/JCSys test report.

The testing forms part of the 'success' case where a licence is deployed using the agreed spectrum management rules and does not form part of the safety assurance considerations or the consultation.

QB18

Page 17, para 4.30: It is not agreed that the laboratory testing presented a conservative worst-case interference environment. Does the CAA plan any further testing to ensure worse case is considered?

CAA Comment:
See response QB17

QB19

Page 26, para 5.27, ASM1: How will users be trained, assessed and proven to be experts?

CAA Comment:

This is not based on specific training and assessment requirements, as discussed in Appendix 2. The CAA has requested that an education piece is included in the licensing process, as discussed in the safety assurance case.

QB20

Page 28, para 6.3, A.1: It is not agreed that suitable testing was carried out and some of the comments from stakeholders, e.g. from NATS, on the JCSys testing were ignored or dismissed. How will this be addressed in accepting the Ofcom documentation?

CAA Comment:

Stakeholder comments in response to the consultation – including those of NATS - were addressed fully in Ofcom's statement of March 2016 (see Annex 1's 'Stakeholder Responses' : https://www.ofcom.org.uk/_data/assets/pdf_file/0021/62481/New-Spectrum-for-Audio-PMSE-statement.pdf).

Ofcom published the JCSys 'Test Report for the Coexistence of PMSE with Aeronautical Services in the Band 960-1164 MHz' alongside the consultation (the test report is available here: https://www.ofcom.org.uk/_data/assets/pdf_file/0024/57840/annex6.pdf

On 8 January 2016 Ofcom issued an update in response to a request from some stakeholders for additional information on the coexistence modelling in the aeronautical band 960 MHz to 1164 MHz. Ofcom consequently reopened their consultation period and stakeholders who wished to comment further were invited to do so by 22 January 2016.

The update can be found here:

https://www.ofcom.org.uk/_data/assets/pdf_file/0029/81389/audio_pmse_update_report_08-01-16.pdf

As noted in reply to QB12, above, Ofcom considers that all stakeholder comments were addressed fully in its statement of March 2016 and no subsequent requests were made by stakeholders for corrections or clarification to the statement following its publication.

QB21

Page 31, para 6.8, ASM1: What happens if unlicensed, non-expert users obtain PMSE equipment?

CAA Comment:

The scenario is addressed and considered in the safety assurance case. Unauthorised use (and accidental misuse) is considered in Fig 10. There are a number of mitigating factors that reduce the risk of the scenario occurring to levels that are ALARP and acceptable.

QB22

Page 31, para 6.8, ASM6: How will it be ensured that PMSE users will always without fail prevent unauthorised persons using the PMSE devices?

CAA Comment:

The SAC does not state that any event is 'without fail'. The SAC considers all the gates that would lead to an unauthorised user accessing and using the equipment, e.g., getting through security, getting access to the equipment and then turning it on and attempting to use it.

The assumptions made are based in part on the knowledge of Ofcom who operates the licencing regime in the current band.

QB23

Page 68, Figure 10, EV-SEC-DEV-FAIL and Page 70, Table 11, EV-SEC-DEV-FAIL row: NATS does not agree that a 1E-5 risk reduction is credible i.e. that 99,999 times out of 100,000 security prevents unauthorised access to PMSE equipment. How does CAA consider this to be credible?

CAA Comment:

This is considered credible given the argument that there are several levels of security at an event for an unauthorised person to get access to equipment. For this SAC 3 levels at 1E-2 has been assumed leading to a result of 1E-6 which has been increased by one order of magnitude as a cautious assumption.

The multi-layered protection argument is based on SME input. The CAA has reserved the right to confirm these assumptions with operators and review of assumptions are built into the periodic and dynamic review mechanisms.

QB24

What protection is there for future systems, for example 978 MHz UAT which is being trialled in the UK and considered for electronic conspicuity? In CEPT discussions Ofcom has persistently argued against its consideration with spurious arguments around whether there is operational use of UAT in Europe (or UK, despite the trials being discussed). NATS find it surprising that this is not taken into the account in the safety arguments at the outset and that the implications of the protection of UAT on the SMRs are apparently unknown from what was stated at the workshop appear is perhaps an oversight..

CAA Comment:

The possible introduction of UAT (and also LDACS) is considered in the SAC, i.e. B.6 and B.7 (page 25). Should either or both systems be introduced into the 960 MHz band then an assessment of coexistence will need to be carried out, and the spectrum management rules and the SC revised to reflect the new sharing environment.

UAT deployment in the UK is still under development and the CAA remains central to the potential development. Currently the specifics of UAT, weather data or ADS-B on 978 MHz are not finalised and it would be presumptive to assume what the eventual deployment will look like.

QB25

The near term further reduction in the amount of spectrum available for PMSE in the UK in order to protect UAT must be part of the “is it worth it” consideration for the PMSE community.

CAA Comment:

This assumption does not form part of the safety assurance case. Considerations would be made at the time as described in the response to QB24.

QB26

NATS would like the opportunity to formally review the test results for London City DME impact testing. Would this be possible, since NATS has a different understanding of the expected results compared to the ones formally presented by Ofcom.

CAA Comment:

The full conclusion from this testing has not been released. The outcome of this testing does not impact the safety assurance documentation. Sharing the report is a matter for Ofcom.

QB27

What is the process to record the locations of 1090 MHz receivers that are to be protected by geographic separation, given that they are not exclusively co-located with 1030 transmitters?

CAA Comment:

All equipment holders will be invited to provide the location of equipment confidentially to the CAA and this will be shared with Ofcom for consideration within the spectrum management rules. The CAA will write to licence holders separately regarding this matter. Any changes to this information will be managed by the CAA and updated to Ofcom.

QB28

The source of the 2.3 million flights per year figure used to derive an apparent figure for “aircraft in flight over the UK at any given time” is quoted by Ofcom in footnotes on pages 55 and 56 as being the number of all commercial flights to and from the UK derived from CAA’s UK Aviation Trends¹. The CAA statistics referenced appear to describe the number of commercial flights at reporting UK airports as being a measure of commercial aviation activity in the UK that includes both passenger and cargo flights, but excludes military flights, general aviation, and aircraft that pass through UK airspace without landing. NATS requests confirmation from CAA as to whether our interpretation of these statistics is correct and the impact that this has on its consideration. NATS note that the use of “typical” or “average” figures, e.g. numbers of aircraft per hour, appears to under-estimate parameters.

CAA Comment:

See further response/discussion under QB10

Appendix A Referenced Documents

APPA

CAA and Ofcom, “Processes and procedures for maintaining the SMRs and their application,” 2018.

CAA Comment:

This will be provided when finalised

Ofcom, "Spectrum Management Rules (as agreed between Ofcom and CAA)," www.ofcom.org.uk, 2017.

CAA Comment:

The current agreed SMRs are included in the Ofcom consultation documentation, which is publicly available from the Ofcom website. Any revised SMR's will be updated on the Ofcom website.

The SMRs are included in Annex 2 of the statement document published. A direct link is included below:

https://www.ofcom.org.uk/_data/assets/pdf_file/0021/62481/New-Spectrum-for-Audio-PMSE-statement.pdf

MoD and CAA, "JTIDS/MIDS MOD/CAA Frequency Clearance Agreement SMS Part 3: Baseline Safety Case for Aeronautical Radio CNS Systems," MoD and CAA, 2013.

CAA Comment:

As previously discussed, a limited number of references have been taken from this document and the CAA will request that the relevant detail can be released to interested parties. An update will be provided on this separately.

Document P1867A-R-005 v2.4 carried out by Cambridge Consultants Ltd on behalf of Ofcom". Cambridge consultants documents P1867A-R-001 and P1867A-R-003 are available at Ref 2.1 on Ofcom's website but we have been unable to find P1867A-R-005.

CAA Comment:

Page 26 ('ASM5') of the Safety Assurance Case references a report produced by Cambridge Consultants Ltd on behalf of Ofcom. The report was commissioned by Ofcom in order to gauge the level of support from the PMSE sector for PMSE use of spectrum in the 960 to 1164 MHz band. The report is based on interviews granted to Cambridge Consultants Ltd by important PMSE stakeholders on strict condition their responses would be kept confidential (as the information provided is commercially sensitive) and on condition that the report would not be made public.

The reference in the SAC to the report's findings has been accepted by the CAA in their assessment of the SAC and Ofcom's position on maintaining the confidentiality of the report, for the reasons given above, is unchanged.

Page 20 footnote 9 states "In accordance with the guidance in ACP 190, air-to-air TACAN assignments can be superimposed on top of other ground-based TACAN and DME assignments and therefore PMSE assignments do not need to consider the presence of air-to air TACAN."

CAA Comment:

As noted in the SC, TACAN is not considered as this is a matter for the MOD. The reference to ACP 190 and air-to-air TACAN is provided as background and is not germane to the SC.

In the case of a defence documentation it is not uncommon that such document may contain sensitive information. As discussed, the reference is provided as additional background information only. If necessary and at NATS specific request the CAA will approach MoD to establish if the document can be released to NATS.

(Taken from the Appendix A narrative starting page 6)

APPA1

NATS has located web copies of an “ACP 190”, which is the NATO “Guide to electromagnetic spectrum management in military operations” at version D (Feb13). If this is the document being cited by Ofcom then that NATO document does not appear to make reference to air-to-air TACAN so the basis for Ofcom’s assertion that PMSE assignments do not have to take account of AA TACAN appears to be missing, at least in that version. While this may not be an issue for this safety case, what assessment has been made as to the effect of AA TACAN on the availability of channels for PMSE? Given that both the interrogator and transponder are on aircraft they would have a greater interfering range to PMSE than Ofcom’s planning system will calculate on the basis of the transponder being on the ground. NATS also notes that it is indicated in the AIP that some AA TACAN use is over the UK mainland and that the transponder and interrogator may use either frequency in the assigned channel pair as the fall back mode is to swap over the frequencies in the event of interference.

CAA Comment:

The reference in question is made in Supplement 1B of ACP 190 available from NATO. No assessment has been made of the impact on A2A TACAN on PMSE as this does not form part of the safety consideration.

QD1 (Taken from Appendix B – Supporting Commentary)

The report describes the system under consideration, its usage environment, and what is meant by safety in this context. It then sets out a strategy of demonstrating that the systems fulfils the definition of safety when it is working as and where intended, and arguing that the risk is acceptable under specified failure conditions. This is all good practise when assuring the safety of a system. However, the purpose of such a document is to demonstrate that operation of PMSE does not adversely affect other identified systems, so the argument would have been more compelling were there an explicit consideration of the unwanted outcomes, and whether they can arise from the system in question. The failure case actually covers much of this, but is written with the emphasis on failures of the PMSE “system”, not on the unwanted outcomes to the aviation systems, so it is difficult to assess the completeness of the Ofcom arguments.

CAA Comment:

As agreed between the CAA and Ofcom, if the risk falls below the probability threshold then further event/severity analysis would not be required. This is in accordance with CAP760 and the definition of ‘acceptable risk’ (see answer to QB8). The document focusses on the headline risk of interruption to the safe navigation of an aircraft. The emphasis is therefore on the failure on the PMSE side that would cause this risk to come to fruition.

QD2

The argument is also made less compelling by different approaches being used for different scenarios. For example, in the SSR analysis a probability per PMSE task is derived, which is then converted to a per year figure (based on the number of such tasks) and assessed as negligible risk. In contrast, when considering DME, a per hour risk target is converted to a per task target and then compared with the predicted per task figure for the system.

CAA Comment:

The assessment of risk between PMSE and SSR (and other systems operating at 1030/1090 MHz, and GNSS above 1164 MHz) and PMSE and DME have been assessed by evaluating the risk based on PMSE tasks for each scenario (see 5.7 for the example relating to 1030/1090 MHz).

The assessment by the CAA has been made regardless of the specific structure of the argument.

QD3

Fault Tree Analysis is used, but there does not seem to have been a consideration of common cause failure. For example the tree labelled H1/4 has an undesired event mitigated by two other events, but one of those two events has some of the same base events driving it as the unwanted outcome. For the fault tree to provide assurance, extra analysis is required to show that the mitigations do not fail when they are needed due to these common events.

CAA Comment:

As part of its assessment of the SAC, the CAA has executed a full review of the fault tree analysis. It is unclear the specific question that is being asked, the CAA is not aware of any issues regarding the fault tree analysis but would be happy to discuss the matter further if additional details can be provided.

The CAA does not believe that any additional analysis is required.

QD4

In H1/4, the deliberate misuse case does not address the misuser having the ability to prevent the equipment from blocking the guard bands. Users performing set-up are described as engineers operating within unconstrained timescale...

That said, the statement that in most cases the user is an engineer performing tasks in an unconstrained timescale is very probably an invalid assumption – in practice the timescales are likely to be very constrained, increasing the frequency of errors of omission or commission.

CAA Comment:

Paragraph A4.3 makes clear that for the purpose of this safety assurance case, it is assumed that the devices will implement firmware configured guard bands (i.e. disabling selection of frequencies between 1015-1045 MHz, 1075-1105 MHz and above 1154 MHz). In addition, paragraph A4.4 notes that the intention is to assess whether or not the likelihood of the hazards occurring is credible:

-Given these two conditions we do not think a deliberate act to circumvent firmware restrictions is credible.

With regards to the operational practice of PMSE operators, such assumptions are made by SME input as described in QB23.

QD5

The possibility of equipment being brought in from other regions that may not have the guard bands implemented is not addressed. The ETSI Harmonised Standard cited does not currently specify guard bands, and so they can in principle be imported properly marked into Europe and may be deployed by those who know of CE Marking but are unaware of the additional national Interface requirements provisions. While this issue was discussed at the workshop, there was no satisfactory indication that there is an adequate control applied to the mitigation that a guard band will be implemented / equipment cannot tune within the 1030 / 1090 MHz guard bands. At the workshop, Ofcom cited the UK Interface Requirement ir2038 (Jan 18 version), however while this document introduces new sub-bands for wireless microphones avoiding the guard bands, nothing in this document, to NATS reading, precludes equipment being able to tune within the guard bands. If there is no stated regulatory requirement that equipment must not be capable of tuning in the guard bands then where is the control for the guard band mitigation – licensing only being partially relevant here.

CAA Comment:

The UK Interface Requirement IR2038 specifies the frequencies permitted for use by wireless microphones. These do not include the guard bands around 1030 and 1090 MHz. From our discussions with PMSE equipment manufacturers, the ones we are aware of who are developing and producing PMSE equipment capable of operating in this part of the radio spectrum are implementing controls that prevent tuning within the 1030 / 1090 MHz guard bands.

QD6

The logic of the SSR example (H1/4) is that there may be interference if there is an “aero system” in range, the user did not detect any interference from it when they tested their system, and they then transmit in the guard band. Time is not considered. For a large all-day event, the set-up is likely to be performed during the night before when there may be little air traffic, for example due to noise restrictions, whereas during the event there may be many SSR transactions in range. The lack of interference during testing in this situation does not appear to provide much mitigation. It may be better just to assume that any transmission in the guard band causes interference, and assess the risk of that.

CAA Comment:

It is not credible that a PMSE user would test at a moment in time when there are no transmissions on 1030/1090 MHz in range given that the audio channel is continually monitored during a performance. It is noted that GT-INTF-UNDETECT only applies to H1 (1030/1090 MHz) and is not applied to H4 (GNSS above 1164 MHz) as PMSE would be unlikely to detect interference from GNSS.

QD7

There is a finite probability of a performer, or group of performers, leaving a venue hurriedly to go on to another engagement by helicopter, and still have their microphones or instrument transponders attached and operating. Are the guard bands designed to cater for this scenario, or just for ground-based use?

CAA Comment:

The probability of a performer leaving a venue with a live microphone (GT-STRAY-DEV) is assessed in Figure 11 and Table 12 and is considered within the fault tree analysis of H2, loss of DME facility. It is not considered within the fault tree analysis of H1/4 as the guard bands are considered mitigation for these hazards.

The scenario contrived by NATS is not considered credible.

Refer to response QB8

QD8

If it is accepted for use, there needs to be a process in place to maintain this assurance case and the analysis and assignment tools that underpin it before it “goes live”. This work is said (in Annex 3) to be in progress, but it needs to be finalised, agreed and formally published prior to use. The CAA will also need to issue an Information notice to ANSPs identifying the hazards and how they have been mitigated.

CAA Comment:

This is an administrative matter and will be managed and agreed between the CAA and Ofcom. As with other parts of the safety assurance case this will be subject to periodic review.

QD9

The report mentions, at Annex 5, that there is a mechanism in place, an emergency helpline, for a PMSE User to be, for example, assigned alternative frequencies if they suffer external interference. How will a similar mechanism be provided for those suffering interference from PMSE users?

CAA Comment:

The SAC and operation of PMSE equipment in the band does not change the existing interference reporting tools that already exist. The similar mechanism that NATS refer to is already in place for existing users, regardless of the existence of a spectrum sharing agreement in the band.

QD9

Ofcom seems only to have carried out DME tests with regard to PMSE interference denying service, there is nothing, apart from an obvious failure case, on how interference may affect the integrity and/or accuracy of the navigation information whilst service continues. False guidance is a more significant hazard than loss of guidance, and so would be expected to be considered in more detail, but it is just dismissed as not credible in the assurance case;

CAA Comment:

As noted in the safety assurance case, undetected corruption is considered non-credible.

QD10

It is noted that Ofcom has used (via CAP760) the risk classification scheme of ESARR4, which has been obsolete in the EU for over a decade, whereas they should be anticipating riskassessment-related legislation that will be applicable in the time period in which they intend PMSE equipment be used in the aeronautical band, i.e. (EU) 2017/373

CAA Comment:

There is no mandate on how a safety case should be developed or presented. Use of CAP760 as a reference is deemed appropriate and suitable by the CAA. The CAA recognise the stream of work but has assessed that in the meantime the current approach is suitable. (EU) 2017/373 "The ATM IR" will not be implemented until 2020. The CAA continue to work guidance and support for the implementation of the IR.

QD11

Although deliberate mis-use is considered, it is only in the context of "the show must go on" pressures leading to an inappropriate channel being selected on the night, because the assigned ones are noisy. It does not consider, for example, the possibility of deliberate retention of devices by performers as souvenirs of the event. CAA also needs to consider malicious deliberate misuse cases; an in-depth cybersecurity risk assessment must be carried out to inform this analysis.

CAA Comment:

The CAA is content with the assessment and argument set out in the safety assurance case. An assessment of the nature described is not considered necessary. As previously discussed in the safety assurance case, the use of such equipment for deliberate misuse is considered unlikely given the nature of the equipment. NATS's opinion is noted but the CAA is satisfied that as the UK's independent spectrum regulator, Ofcom, is suitably placed to provide subject matter expertise in relation to PMSE use, policy, licensing and enforcement.

QD12

The aforementioned "the show must go on" pressures have not been factored into the consideration of failure to retrieve devices from users; a per-task failure rate is used in the calculation that pertains to the primary function of a rôle performed in unlimited timescale. Retrieving devices is not the primary function of a floor manager, who may actually have a very tight timescale in the act change-over period when devices are to be retrieved (and it is 'devices', not just the one implied); the estimated one missed device in a thousand is too optimistic, maybe by an order of magnitude. GT-STRAY-DEV is too small a result.

CAA Comment:

The CAA is content with the assessment and argument set out in the safety assurance case. See response to QB23 and QD11, above. NATS's opinion is noted but the CAA is of the view that this is a view which is not supported by any clear evidence.

QD13

Note also that the result of calculation GT-STRAY-DEV, the one in a million chance, dominates the Loss of DME due to interference calculation. It is based upon per-task probabilities, rather than per-hour; text earlier in the document states the DME target to be less than 5.2E-6 per task. The result of 1.08E-7 looks good in respect to that target, but it is a bit close for comfort if GT-STRAY-DEV is the result of over-optimistic assumptions and does not include malicious acts.

CAA Comment:

The CAA is content with the assessment and argument set out in the safety assurance case. See response to QD11. NATS's opinion is noted but the CAA is of the view that this is an unfounded assumption which is not supported by any evidence.

Malicious interference with aviation systems is an existing risk not limited to PMSE equipment. It has been explored in the analysis of this safety assurance case and judged to be unchanged by the introduction of PMSE equipment capable of tuning to 960-1164 MHz, as existing equipment (e.g. software defined radio) will remain less expensive and easier to acquire and use for such purposes.

QD14

The event EV-AVIA-AIR-IN-RANGE is based on an estimate "there are typically 262 aircraft in flight over the UK at any given time". Data regularly updated on the NATS website for aircraft in UK airspace suggest instantaneous figures 2 to 3 times that figure at peak times during the day, which should be considered as part of the assessment. Even at midevening a figure of 262 is low.

CAA Comment:

See response to QB10.

QD15

That "262 at any given time" figure appears to be based on historical statistics that suggest 2.3 million flights per year and so based on Ofcom's explanation at the workshop, their own description is incorrect as it is a per hour figure and not at any given time. Air traffic in the UK is forecasted to rise 50% by 2030. The event frequencies in the fault trees should reflect the predicted future environment, not the historic one.

CAA Comment:

See response to QB10. Noting comments about SAC review mechanisms under QA4.

QD16

There seems to be some confusion of units, and so we have less confidence in the results than if they had been made clear. For example, it is not clear how the "262 aircraft in flight over the UK at any given time" has been converted to a probability to be combined with results of a "per license application" analysis, to give a figure which is combined with a "per device" analysis, to give a result "per PMSE task".

CAA Comment:

The CAA and Ofcom believe this is adequately described in Annex 5 of the SAC

QD17

Note that there appears to be a copy and paste error in Figure 4 when the “deliberate misuse” gate is misrepresented as a licensing system failure; this does not affect the declared result.

CAA Comment:

Noted and will be corrected.

Appendix – Further details regarding DME usage and number of flights

The 2.3m figure (originally contained within the JTIDS safety case) is rounded from a reference originally taken from an aviation trends document published in 2008, listed as a measure of UK commercial flights (2,223,000 for Q1-Q4 2008).

The document is available on the CAA website:

https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Analysis_reports/Aviation_trends/AviationTrends_2008_Q4.pdf

The 2017 figure is 2,254,000, an increase of 31,000. This is not seen as a significant change (an increase of 1.4%) that would not have a material impact on the assessment and is considered by the rounding applied in both the JTIDS and PMSE safety case.

The 2017 aviation trends document is available on the CAA website:

[https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Analysis_reports/Aviation_trends/AviationTrends_2017_Q4\(1\).pdf](https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Analysis_reports/Aviation_trends/AviationTrends_2017_Q4(1).pdf)

Whilst this reference excludes En-route traffic over the UK landmass, The NATS website¹, indicates a similar figure:

NATS is the UK's leading provider of air traffic control services. Each year we handle 2.4 million flights and 250 million passengers in UK airspace.

In addition to providing services to 14 UK airports, and managing all upper airspace in the UK, we provide services around the world spanning Europe, the Middle East, Asia and North America.

For 2018 peak months the NATS website² also provides data which reflects traffic number during June, July and August 2018.

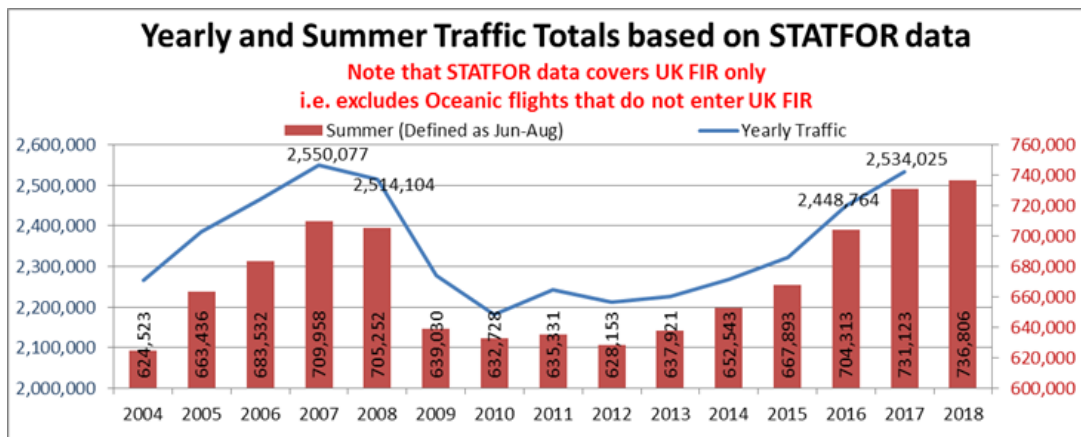
Just over 736,800 commercial aircraft flew in UK airspace over the course of June, July and August, 5,683 more than the previous record set last year and marking six consecutive years of growth since traffic levels fell following the global financial crisis.

¹ <https://www.nats.aero/> Retrieved 12th October 2018

² <https://www.nats.aero/news/uk-air-traffic-controllers-see-busiest-ever-summer/> Retrieved 12th October 2018

This peak number, which covers the whole UK FIR, averaged across 90 days, over 24 hours per day gives an hourly figure of 341 aircraft, or 682 over a 12 hour period.

The NATS website³ also provides data to illustrate that whilst traffic levels have on the whole increased since 2008, subsequent years has shown a significant drop after 2008, possibly due to the financial crash. This illustrates that whilst traffic numbers have seen rapid growth, there have also been significant drops.



The safety case will be updated to discuss changes in assumptions in respect of traffic numbers.

³ <https://www.nats.aero/wp-content/uploads/2018/09/Traffic-stats.png> Retrieved 6 February 2019