# Appendix G Demonstration Exercise EXE-VLD-06-002 (Gatwick XMAN 350NM) Report

## G.1 Summary of the Demonstration Exercise EXE-VLD-06-002 Plan

This appendix is a report concerning the execution of the Demonstration Exercise EXE-VLD-06-02. The aim of this exercise was to extend the arrival management horizon for Gatwick airport and use arrival management techniques for the calculation and updating of arrival constraints for airborne aircraft. Delay information or speed advisories from the destination arrival management system were then to be passed to upstream control units.

### G.1.1 Exercise description and scope

The Gatwick (EGKK) Cross Border Arrival Management (XMAN) concept EXE-VLD-06-002 is part of the SESAR XStream project that aims to reduce time spent in low level orbital holds and improve delivery for Gatwick airline operators. This concept has been developed and proven using web-centric Single European Sky ATM Research (SESAR) technologies and the prior installation of an XMAN system at Heathrow Airport.

To maximise the effectiveness of linear holding and metering, the use of cross border traffic management on a tactical basis is an essential element of current queue management techniques. The benefits include reduced fuel burn and associated $CO_2$ emissions, reduced complexity in TMA airspace and better airfield arrival and departure planning.

London Gatwick is one of the busiest single runway operations in the world with traffic movements continuing to grow significantly year on year as Table 1 indicates.

| Year | No. of Movements | % Change |
|---|---|---|
| 2011 | 251,067 | - |
| 2012 | 246,987 | -1.63 |
| 2013 | 250,520 | 1.43 |
| 2014 | 259,692 | 3.66 |
| 2015 | 267,760 | 3.11 |
| 2016 | 280,666 | 4.82 |
| 2017 | 285,989 | 1.89 |
| 2018 | 283,926 | -0.7 |

**Table 1** - EGKK Movements per annum

Since 2013, the rolling average for holding at London Heathrow (EGLL) has reduced from 8.5 minutes to 7.5 minutes today. Contrary to this, London Gatwick (EGKK) has seen a steady increase over the same period from approximately 5 minutes of average delay to over 6 minutes in today's operation.

Being a single runway operation means that arrival and departure traffic demand have a significant impact on each other's schedules. For arriving aircraft, this can result in low-level orbital stack holding in the London Terminal Manoeuvring Area (TMA). Stack holding has several negative impacts which include increased $CO_2$ emissions and higher fuel costs to airlines. There is also an impact on departure profiles which contributes to the complexity within the TMA environment and impacts on airport delay targets.

Gatwick is unique amongst London's airports in its representation of the three main airline business models: full service, low-cost and charter. As of the end of 2017, these respectively accounted for 28.2%, 57.5% and 14.2% of Gatwick's seat capacity. The last two of these models mainly service the tourist industry and represent 71.7% of Gatwick's seat capacity. Due to the seasonal nature of this traffic, it can cause significant bunching and over-delivery of traffic to both the airport and surrounding ATC sectors, resulting in delays and increased workload.

The objective of the Gatwick EXE-VLD-06-002 is to develop, validate and propose operational concepts that alleviate, as far as possible, the afore mentioned issues.

The reduction of orbital (stack) holding, via the transfer of a portion of the anticipated delay, into linear holding (speed reduction in the cruise and descent phase of flight) is the key concept of XMAN. Linear holding is proven to be more fuel efficient than low-level orbital holding.

Delays will be calculated by the Gatwick AMAN (Arrival Manager) and transmitted to the adjacent partner ANSP's via a SWIM-WS (System Wide Information Management web service). When arrival delays exceed a defined trigger value partner ANSPs will be requested to reduce the speed of Gatwick arrivals, at a specified distance from the IAF (Intermediate Approach Fix), also known as the Holding Stack.

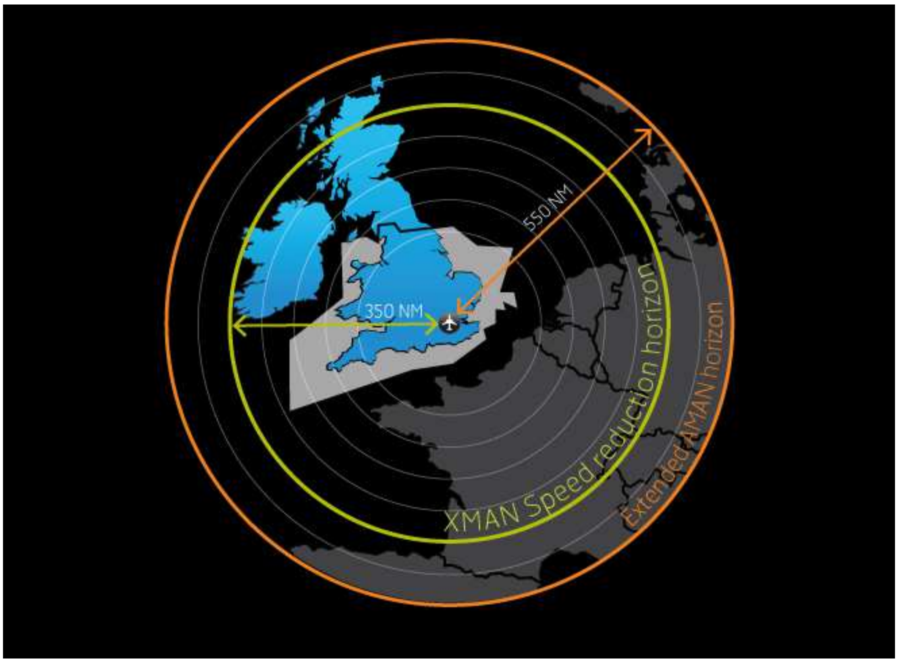


**Figure 1: London extended AMAN horizons**

In addition to speed reductions by partner ANSPs, NATS LAC controllers will also slow aircraft down in the descent phase to maximise the reduction in low-level orbital holding.

Delay at Gatwick is calculated using the Harris Orthogon AMAN system. The calculated delay is transmitted to neighbouring centres: DSNA Reims, EUROCONTROL Maastricht (MUAC) and NATS Prestwick (PC) via an XML (Extensible Mark-up Language) based Arrivals Sequence Message. For the IAA, NATS converts the XML message into the OLDI format for transmission to Shannon ANSP.

Each partner ANSP is responsible for determining how best to display this information to their controllers;

- For NATS LAC, the AMAN system EAT information is displayed on a Support Information Screen (SIS) with a colour change to orange for 6 minutes or more EAT delay.
- For NATS PC, the EAT delay is provided to ATCO's via a similar Support Information screen at the controller position, which uses a colour change to orange (6-7 minutes) to indicate to the controllers that delay may be increasing and that the flight can expect a speed control in the descent and a change to red (8 minutes or greater) to indicate that a mach reduction of up to 0.04 needs to be applied.
- For MUAC the EGKK XMAN data is provided to ATCO’s via the Track Data Block (TDB).
- For Reims the EGKK XMAN data is provided to ATCO's via the 4ME HMI installed between the Executive and Planner controller positions.
- For Shannon the Gatwick XMAN data, presented as TTL figures, will be displayed against a flights TDB at which point a corresponding speed reduction is then applied. The EGKK XMAN

data is sent in an OLDI AMA message. NATS SWIM-WS and OLDI FMTP systems have been adapted to provide this capability.

The Coordination Points (COPs) that are configured for generating the delay parameters are listed in the table below, they are boundary or release of control points between the relevant centres.

| Partner | IAF | LAC Interface Sector | Partner Interface Sector | COP |
|---|---|---|---|---|
| **DSNA Reims** | TIMBA | Lydd (S17) | 2D/4R/4N | KESAX, ABB, TRACA |
| **DSNA Brest** | WILLO | Hurn (S22) | JU/JH/JS | SITET, ORTAC, REVTU, SALCO, ANNET, GANTO, SUPAP, PEMAK, NEVIL |
| **MUAC** | TIMBA | Clacton (S13/14) | Brussels/Deco/Hannover | LUMEN, GALSO |
| **NATS Prestwick** | WILLO | Lakes (S4/7) | Rathlin/Central/Deancross/Humber | IOM, DCS, LARDI |
| **IAA Shannon** | WILLO | Lakes (S4/7) | Dynamic sectorisation | LIFFY, DEXEN |
| | WILLO | West End (S9, S35) | | GAPLI, LESLU, NORLA<br>EVRIN, BANBA, SLANY, BAKUR, LULOX, ARKIL, SAMON |

**Table 2** – Configured COPs

The Gatwick XMAN Concept of Operation (CONOPS) has been approached with a delay sharing strategy which allows the transfer of a portion of the anticipated delay calculated by the NATS AMAN system, into linear holding (speed reduction in the cruise and descent phase of flight) due to the more fuel-efficient approach this provides compared to low-level orbital holding.

The delay sharing strategy is defined as the order in which the NATS AMAN calculated delay is successively attributed and the maximum value (the most optimal model of application, the reality is values are less due to time for controller to apply and pilot to respond) that can be absorbed within each band.

- LTC (London Terminal Control) Delay: delay in the holding stack (IAF) and between the stack and the runway. In order to keep pressure on the runway, this is the first allocated delay.

- LAC (London Area Control) Delay: delay from the COP to the IAF. The delay allocated to allow for AC controllers application of the Gatwick Descent Speed Procedure (see 5.5).

The partner delay is defined as:

- En-route Delay: delay from a maximum range of 350NM from EGKK to the relevant COP.
- The Partner En-Route delay indicated in the table below is the delay sharing strategy applied by the EGKK XMAN CONOPS

*Note - there is no expectation that this delay will be absorbed by the partner ANSP's.*

| Total delay | NATS delay | | Partner En-route delay |
|---|---|---|---|
| | LTC delay | LAC delay | |
| **1** | 1 | 0 | 0 |
| **2** | 2 | 0 | 0 |
| **3** | 3 | 0 | 0 |
| **4** | 4 | 0 | 0 |
| **5** | 5 | 0 | 0 |
| **6** | 5 | 1 | 0 |
| **7** | 5 | 2 | 0 |
| **8** | 5 | 2 | 1 |
| **9** | 5 | 2 | 2 |
| **10** | 5 | 2 | 3 |
| **11** | 6 | 2 | 3 |
| **12** | 7 | 2 | 3 |
| **13** | 8 | 2 | 3 |
| **14** | 9 | 2 | 3 |
| **15** | 10 | 2 | 3 |
| **16** | 11 | 2 | 3 |
| **17** | 12 | 2 | 3 |
| **Etc.** | Etc. | Etc. | Etc. |

**Table 3** – Partner En-Route Delay

The following are to be applied by all partner ANSPs during the trial:

1. XMAN activation trigger when EGKK AMAN-indicates a delay of greater than seven minutes.
2. Speed reduction up to M0.04 (best effort) and conversion to 250kts descent speed if the transition is commenced in an-ANSP partners airspace.
3. XMAN speed reduction at 350NM range from Gatwick
4. If not already transitioned, crews can anticipate a 250kts descent in LAC airspace when the XMAN speed reduction is applied. Note – there is no formal requirement for Partner ANSP's to pass this information on the R/T.

Ensuring separation and complying with exit conditions, contained within Letters of Agreement (LoA), must always be prioritised over the Gatwick XMAN procedures. Moreover, the XMAN procedures should apply only when workload allows; at this stage, XMAN procedures are understood as “best effort” measures and are not mandatory.

In order to enable pilots to plan their descent in advance, when applying an XMAN speed reduction, the en-route controller, subject to workload, will inform the crew that the delay is because of arrival management at Gatwick. It may be possible that the AMAN sequence calculation results in proposing overtake situations at or prior to the COP which are not suitable for traffic presentation. To mitigate the potential bunching effect, it is left to the en-route controllers’ discretion to adapt the speed reduction so that aircraft are presented at the COP with an element of streaming.

Appropriate engagement and communication with the airlines affected by the EGKK XMAN Trial will be initiated by NATS to ensure the appropriate application of XMAN speed requests. The application of M0.04 will be used initially in line with the Heathrow XMAN CONOPS but is subject to review and modification following engagement with the affected airlines as stated above.

A speed reduction of M0.04 will normally be within the capabilities of the majority of aircraft types. If, however, it is not possible to reduce speed by M0.04 then the maximum possible reduction should be applied.

In the event of any unusual occurrences, such as runway loss, bad weather conditions or technical problems, it is the responsibility of the LAC Operational Supervisor (OS) to agree a plan of action regarding the delivery of traffic with en-route group supervisors (GS) and decide whether the XMAN procedures should still be applied.

If circumstances preclude one of the partner ANSPs from applying XMAN procedures for an extended period this should be communicated to the appropriate GS at LAC. Both the duration that the partner will not be applying the procedures and the reasoning should be recorded by the GS. This is to enable the tracking of partner participation and also the measurement of the effectiveness of the procedures.

### G.1.2 Summary of Demonstration Exercise EXE-VLD-06-002 Demonstration Objectives and success criteria

The objectives and success criteria for EXE-VLD-06-002 are provided in the xStream DEMOR main document in chapter 3.4 "Summary of the xStream Demonstration Plan".

### G.1.3 Summary of Demonstration Exercise EXE-VLD-06-002 Demonstration scenarios

The exercise has been executed on the following dates and times;

| Partner | Dates | Times |
|---|---|---|
| LAC | 4th September – 30th November | 0630-2200 |
| PC | 4th September – 30th November | 0630-2200 |
| REIMS | 16th September – 30th November | 0630-2200 |
| Shannon | 20th September – 30th November | 0630-2200 |
| MUAC | 3rd October – 11th October[1] | 0630-2200 |

**Table 4** – Trial Dates

[1] On conclusion of the MUAC trial duration, their operation deemed the trial to be successful with no operational issues identified so have moved into full operational service with an update to the NATS/MUAC Letter of Agreement (LoA) submitted.

### G.1.4 Summary of Demonstration Exercise EXE-VLD-06-002 Demonstration Assumptions

The assumptions concerning EXE-VLD-06-002 are provided in the xStream DEMOR main document, in chapter 3.4 "Summary of the xStream Demonstration Plan".

## G.2 Deviation from the planned activities

The trials were planned to be executed from the 4th of September to the 15th of October (trials with Shannon, Reims and Prestwick are ongoing ahead of anticipated migration to full operational service by the 30th of November) daily between 0630UTC to 2230UTC .

There were no deviations from the planned activities.

## G.3 Demonstration Exercise EXE-VLD-06-002 Results

### G.3.1 Summary of Demonstration Exercise EXE-VLD-06-002 Demonstration Results

See DEMOR main document chapter 4.

| ANSP | Centre | All flights | % of all EGKK arrivals | Stack Holding: Delayed flights | Stack Holding: Total delay (mins) | Stack Holding: Avg delay/ delayed flight (mins) | Number of candidate flights | % of all flights | Number of instructed flights | % of candidate flights |
|---|---|---|---|---|---|---|---|---|---|---|
| DSNA | RUAC | 2170 | 30% | 738 | 4635 | 6.3 | 230 | 11% | 184 | 80% |
| Eurocontrol | MUAC | 1222 | 17% | 259 | 1488 | 5.7 | 151 | 12% | 131 | 87% |
| IAA | Shannon | 765 | 11% | 318 | 2223 | 7.0 | 51 | 7% | 36 | 70% |
| NATS | Prestwick | 600 | 8% | 238 | 1743 | 7.3 | 56 | 9% | 39 | 70% |
| **All partner ANSPs** | | **4757** | **66%** | **1553** | **10089** | **6.5** | **488** | **10%** | **390** | **80%** |

**Table 5** - Summary of application of XMAN by ANSP and associated benefit

# 1. Results per KPA

During demonstration Exercise EXE-VLD-06-02 both LAC and PC centres opportunities to capture controller feedback were provided in the form of logs books at each participating sector group, this was in addition to the existing electronic mandatory safety reporting methods already in operational use.

## a. KPA Safety

As agreed in the CONOPS and detailed in the Temporary Operating Instructions, if either LTC, LAC, PC or external partner deemed it necessary to suspend the trial they had the authority to do this and were requested, if time permitted, to notify the relevant adjacent ANSP supervisor.

The non-mandatory nature of the requirement to issue the speed reduction will also play a part in the limitation of any safety impacts.

### i. Quantitative Assessment

**Number of Incident Reports**

No safety incidents were reported in connection with EXE-VLD-06-002 trials.

### ii. Qualitative Assessment

The EXE-VLD-06-002 trial is yet to conclude and as such questionnaires have yet to be fielded to the ATCO community, however, thus far no Safety Incidents have been reported.

## b. KPA Environment

Environment KPA was assessed quantitatively by analysing the performance indicators of calculated fuel consumption, based on BADA 4.2

### i. Quantitative Assessment

**Fuel consumption**

An annualisation factor of 21.6 was used. A factor was applied based on the number of days in the trial compared to in October, which gives an expected benefit for all October. This was then annualised by the ratio of potential XMAN candidate flights (according to actual holding delay) in October compared to a full year.

The CO2 ratio to fuel burn is 3.18.

The cost of fuel used is £445 per tonne.

| Flight counts | | Instructed flights – time absorbed (mins) | | Average holding fuel burn per flight (kg/min) | Holding fuel burn benefit | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sample | Annualised | | | | |
| Candidate | Instructed | Per flight | Total | | Fuel (T) | Time absorbed (mins) | Fuel (T) | CO2 (kT) | £M | |
| 488 | 390 | 0.90 | 353 | 45.9 | 16.2 | 7625 | 349 | 1.11 | 0.16 | |

**Table 6** - Fuel Burn results for En-Route Phase

| Flight counts | | Instructed flights – time absorbed (mins) | | Average holding fuel burn per flight (kg/min) | Fuel burn benefit | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sample | Annualised | | | |
| Candidate | Instructed | Per flight | Total | | Fuel (T) | Time absorbed (mins) | Fuel (T) | CO2 (kT) | £M |
| 1988 | 1590 | 0.55 | 882 | 44.7 | 39.5 | 19052 | 853 | 2.71 | 0.38 |

**Table 7** - Fuel Burn results for Descent Phase

### ii. Qualitative Assessment

No qualitative assessment was performed regarding environment.

## c. KPA Cost Efficiency

### i. Quantitative Assessment

**Average holding time**

According to the results presented in the tables below, flight efficiency was increased due to a reduction of holding time in TMA.

| Avg holding time / flight (mins) | Avg reduced holding / flight (secs) | Avg holding time including reduction (mins) | 3Di associated with avg holding time | 3Di with impact of reduced holding | 3Di benefit (overall UK score) |
|---|---|---|---|---|---|
| 6.5 | 7.9 | 6.4 | 0.87 | 0.83 | 0.04 |

**Table 8** – Holding Reduction results for En-Route Phase

| Avg holding time / flight (mins) | Avg reduced holding / flight (secs) | Avg holding time including reduction (mins) | 3Di associated with avg holding time | 3Di with impact of reduced holding | 3Di benefit (overall UK score) |
|---|---|---|---|---|---|
| 6.5 | 19.7 | 6.2 | 0.87 | 0.78 | 0.09 |

**Table 9** – Holding Reduction results for Descent Phase

### ii. Qualitative Assessment

None.

## d. KPA Capacity

### i. Quantitative Assessment

None.

## ii. Qualitative Assessment

Transfer of TMA holding to the en-route phase of flight has reduced ATCO workload in the TMA.

There have been no reports of unacceptable increases in workload from the En-Route ATC partners that have participated in the trial. The mitigation against this is the non-mandatory requirement for the application of the speed reduction.

Complexity & workload can be reduced with the use of XMAN procedures due to the fact that when delays are building up on the arrival flows, partner ANSPs are able to reduce the speed of aircraft in the upstream sectors based on XMAN output to avoid absorbing all of the delay solely within the London TMA.

## 2. Results impacting regulation and standardisation initiatives

During planning EXE-VLD-06-002, a reduction of Mach 0.04 was decided as the standard Mach number reduction to be applied to London Gatwick arrivals at 350NM for XMAN operations.

## G.3.2 Analysis of Exercises Results per Demonstration objective

## 1. EXE-VLD-06-002 OBJ-VLD-01-001 Results

This objective was to show that xStream operational improvements are respecting the current level of safety in air traffic management.

The corresponding success criterion is fulfilled when the safe management of traffic by ATC is not compromised and new procedures do not cause critical incidents.

No safety occurrences were reported during the trial & feedback from operational staff confirms that the safe management of traffic was never compromised within London AC or TC Operations.

This objective can be considered fulfilled.

## 2. EXE-VLD-06-002 OBJ-VLD-03-001 Results

This objective was to show that xStream operational improvements provide benefits in terms of environmental sustainability of air traffic.

The corresponding success criterion is fulfilled when fuel efficiency of air traffic is increased while emissions are reduced.

According to the obtained results, fuel consumption has been reduced.

This objective can be considered fulfilled.

# 3. EXE-VLD-06-002 OBJ-VLD-04-001 Results

This objective was to show that xStream operational improvements increase cost efficiency from more efficient processes for AU.

The corresponding success criterion is fulfilled when flight efficiency is increased and/or flight management / flight coordination costs are reduced.

This objective was not required by the demonstration plan but is nevertheless covered by the assessment.

According to the performed analysis, flight efficiency was improved due to a reduction of holding time in TMA.

The objective can be considered fulfilled.

# 4. EXE-VLD-06-002 OBJ-VLD-05-001 Results

This objective was to show that ATC capacity usage in TMA is optimized by xStream operational improvements.

The corresponding success criterion is fulfilled when Traffic load, ATC workload or complexity in terminal sectors is reduced.

There were no reports of increased ATC workload, traffic load or traffic complexity during the trial within Terminal Sectors. Likewise, there were no reports of situational awareness being affected.

This objective can be considered fulfilled.

# 5. EXE-VLD-06-002 OBJ-VLD-05-002 Results

This objective was to show that available En-Route sector capacity allows the application of xStream operational improvements.

The corresponding success criterion is fulfilled when Traffic load, ATC workload or complexity in En-Route sectors do not exceed available capacity.

There were no reports of increased ATC workload, traffic load or traffic complexity during the trial within En-Route Sectors. Likewise, there were no reports of situational awareness being affected.

This objective can be considered fulfilled.

## G.3.3 Unexpected Behaviours/Results

None

## G.3.4 Confidence in the Demonstration Results

### 1. Level of significance/limitations of Demonstration Exercise Results

The lack of participation in the trial from Brest & Karlsruhe ACC impacted on the ability for the EGKK XMAN Concept to realise the full fuel and associated environmental benefits through reduction in low-level holding at a full 350NM horizon.

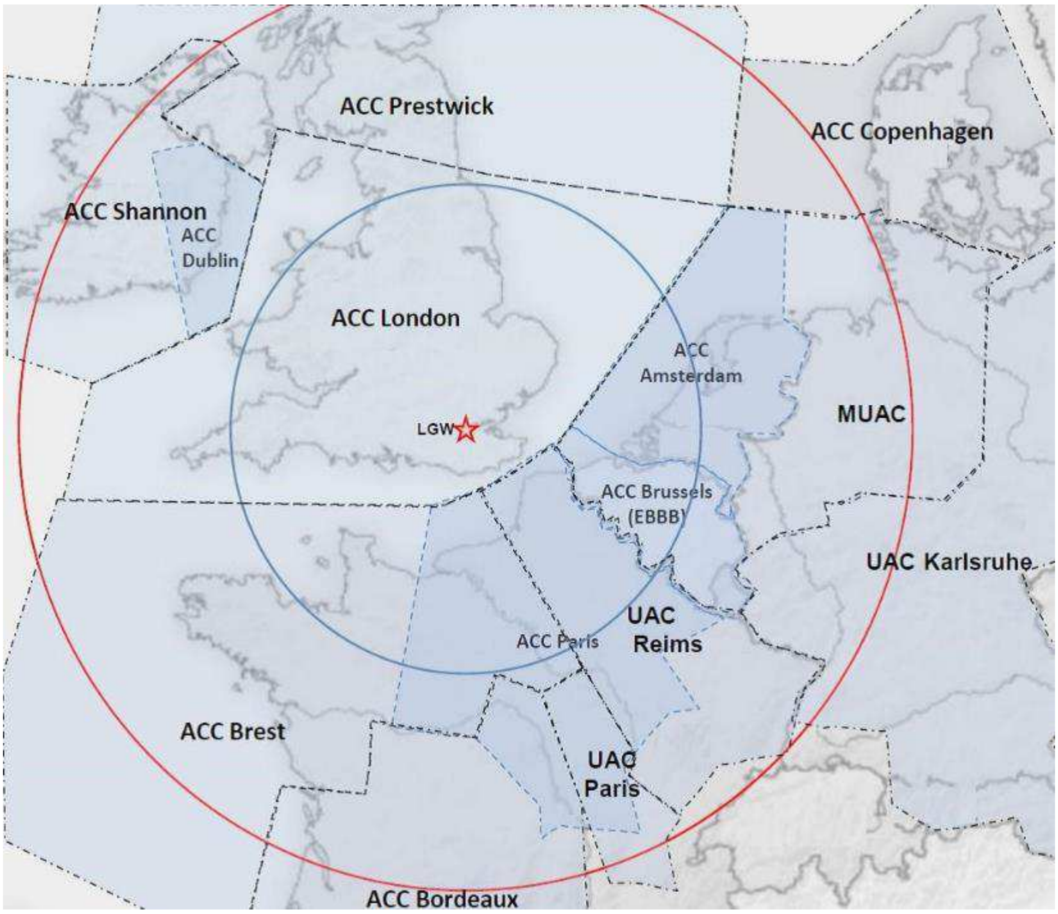


**Figure 2: EGKK full 350NM horizon**

| Upstream ACC/UAC | Amount of arrivals |
|---|---|
| UAC/ACC Reims | 31% |
| UAC/ACC Brest | 25% |
| UAC/ACC Prestwick | 13% |
| Maastricht UAC | 8% |
| ACC Brussels | 6% |
| UAC/ACC Shannon | 6% |
| ACC Dublin | 3% |
| ACC Amsterdam | 3% |
| UAC/ACC Paris | <1% |
| UAC Karlsruhe | <10% |

**Table 10** – Arrivals Share

## 2. Quality of Demonstration Exercise Results

This section describes all issues concerning the quality of the results achieved during the Demonstration Exercise. Therefore, quality could refer to both the accuracy of results or the confidence in those same results which might be influenced by decisions, constraints or assumptions made at exercise level.

As noted above, the lack of participation in the trial from Brest & Karlsruhe ACC was a constraint on the demonstration.

Throughout the duration of the trial there were no weather or technical issues to adversely affect the results or any other issues related to the degradation of the service.

# 3. Significance of Demonstration Exercises Results

| ANSP | Centre | XMAN Cruise Time Absorbed (mins) | Avg time absorbed per instructed flight | Avg Instructed Distance (NM) | Speed Change (Mach) | Initial Speed (Mach) | Candidate flights | Instructed Flights | % of Candidate Flights |
|---|---|---|---|---|---|---|---|---|---|
| DSNA | RUAC | 163 | 00:00:53 | 295 | 0.033 | 0.77 | 230 | 184 | 80% |
| Eurocontrol | MUAC | 120 | 00:00:55 | 284 | 0.037 | 0.77 | 151 | 131 | 87% |
| IAA | Shannon | 36 | 00:01:01 | 340 | 0.031 | 0.80 | 51 | 36 | 70% |
| NATS | Prestwick | 34 | 00:00:52 | 256 | 0.040 | 0.77 | 56 | 39 | 70% |
| **Total** | | **353** | **00:00:54** | **292** | **0.035** | **0.77** | **488** | **390** | **80%** |

**Table 11** – ANSP Partner Participation

Significance of the results refers to statistical and operational significance.

The benefits realised in the reduction of low-level stack holding achieved during the trial and the subsequent anticipated move into full time operation will continue to build on those achieved through the EGLL XMAN service and those in operation within the SESAR community.

It should be noted that the significance of the benefits is only able to be fully realised when the participating partners are able to apply the XMAN requests. As more airports introduce XMAN Concepts into operation, the need to coordinate these services to ensure that a safe and acceptable level of application can be achieved will become increasingly important.

## G.4 Conclusions

As identified in the results section of this report above, significant reductions in low level holding, fuel saving and environmental benefit in $CO_2$ reduction have been achieved through the hard work and collaboration of partner ANSPs across FIR boundaries to deliver real benefit to the airline customer.

- The sample period results (all ANSPs) illustrate an average in-flight time absorption of 54 seconds per instructed flight for 15% of the EGKK arrivals recorded as holding.
- This equates to an average reduced holding per delayed flight of 7.9 seconds (assuming 100% transfer from delay in hold to en-route).
- On average, 80% of candidate flights observed for XMAN partner ANSPs were issued XMAN speed control instructions.
- Total time absorption (all centres) during the analysis period was 353 minutes. This translates into a sample period holding fuel burn benefit of 16.2 tonnes.
- If the benefit is annualised it would approximately equate to a 349T fuel saving (using BADA 4.2 aircraft type specific fuel burn rates and the annualisation methodology outlined in the results), or £0.16 million per year for operators.
- The reduced speed descent phase adds a further 39.5 tonnes of fuel reduction, which equates to 853 tonnes per annum, transferring almost 900 minutes of delay out of the TMA during the demonstration period, equating to 19,000 minutes per annum.

Full participation of neighbouring ANSPs is essential to provide a complete study of the EGKK XMAN concept.

# G.5 Recommendations

## G.5.1 Recommendations for industrialization and deployment

The EGKK XMAN CONOPS of linear delay absorption through the slowdown of aircraft in the en-route phase of flight, mirroring the concept that has been in operation at EGLL for 4 years, should be provided as a Guidance and Framework to contribute towards a common concept for future applications at other airfields. This concept, along with those developed and implemented at other European partner airports, should be shared so that the associated benefits can be realised by a greater percentage of the airline and controller customers.

Electronic coordination of speed advisories between XMAN and the upstream/downstream ACCs CWPs to allow better implementation and visibility of XMAN actions.

Participation of neighbouring ACCs handling the major arrivals flows to the airport in the Extended AMAN process is crucial.

Provide a comprehensive briefing and cross-training of Tower Supervisors, Flow Managers, Approach & upstream ACC ATCOs to provide a global view of the concept to all the operational staff.

The compliance with the Letters of Agreement between upstream ACC, AC and TC should have priority to XMAN actions to avoid any confusion between the operational staff.

Attain the best AMAN delay accuracy possible in order to have the most realistic sequence and take the most appropriate actions.

## G.5.2 Recommendations on regulation and standardisation initiatives

It is recommended to:

- Standardize the XML format for the exchange of requests with upstream ACCs (speed advisories, TTL, STA, etc.).
- Provide an automatic way of determining the status of a request (has it been implemented or not) with the XMAN Status.