# ANALYSIS OF FANS SERVICES IN THE EUR/SAM CORRIDOR (CANARIAS AIRSPACE). CFRA 2021 REPORT

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# ANALYSIS OF FANS SERVICES IN THE EUR/SAM CORRIDOR (CANARIAS AIRSPACE). CFRA 2021 REPORT

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| Prepared by: | Reviewed by: | Approved by: |
|---|---|---|
| *Visado en Gestor Documental* | *Visado en Gestor Documental* | *Visado en Gestor Documental* |
| Susana González Benito<br>**Department of Research and Definition of Advanced Air Navigation Systems** | Mª del Mar Tabernero Serrano<br>**Head of Department of Research and Definition of Advanced Air Navigation Systems** | Nicolás Martín Martín<br>**Head of Navigation and Surveillance Division** |

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## Executive Summary

This report presents the FANS services performance and use for flights of the EUR/SAM Corridor in the Canarias airspace, presenting traffic data, data link utilization, CPDLC exchange, etc., during the period of research.

This report is based on ADS-C/CPDLC data from January to December 2021 of the Canarias FIR. The results reflect the beginning of the recovery from the impact of COVID-19 pandemic on air traffic data, showing a significant increase of flights after the dramatic decrease suffered from March 2020.

Apart from Canarias airspace, data from ASA Cape Verde and ASECNA Dakar were also received. These data have been compared with those corresponding to ENAIRE and no major discrepancies have been detected.

For Canarias data analysis, "EUR/SAM Corridor flights" are considered as follows:

- Those flights either overflying EDUMO, TENPA, IPERA or GUNET, or flying those routes with NELSO and/or ROSTA as route waypoints and with XIGLU as entry/exit point at the south of Canarias airspace.
- Those flights overflying the DCT Area (see Figure 1) over FL295, with the following criteria:
    - Flights overflying ROSTA and with GOBEG, INSAD, IXIKU, KUXOV or LAPTU as entry/exit waypoints at the west of Canarias airspace;
    - Flights overflying OCE sector entering the FIR by RIPOD, PIBIL, OSLEV, NEXUX or KETID and leaving by GOBEG, INSAD, IXIKU, KUXOV or LAPTU, or the other way around.

Traffic data in this period are depicted in Table ES-1, where it can be noticed that the percentage of air traffic making use of FANS services (ADS-C/CPDLC) is rather stable and that most of FANS equipped aircraft (94.65%) connect to ENAIRE FANS Ground System. This table also shows that traffic in the EUR/SAM Corridor using FANS services in 2021 was almost 80% (79.69%) of total traffic, which means an increase from 2020 (73.20%). Focusing on absolute values, the table reflects the beginning of the recovery from the dramatic impact of COVID-19 on air traffic figures in 2020.

| Traffic Data Summary | 2021 Mean Value | Max Value | Min Value |
|---|---|---|---|
| Number of connected flights (Monthly average) | 1032 | 1880 [Dec] | 635 [Feb] |
| Percentage referred to total number of flights in the EUR/SAM Corridor | 79.69% | 85.43% [Jan] | 70.95% [Nov] |
| Percentage referred to flights in the EUR/SAM Corridor indicating data link and ADS-C capacity in the Flight Plan | 94.65% | 97.69% [Jan] | 92.77% [Aug] |
| Number of different aircraft (aircraft registration) connecting to ENAIRE FANS Ground System (Monthly average) | 277 | 392 [Dec] | 208 [Feb] |

**Table ES-1**
**Traffic Data Summary**

Figure ES-1 shows, for the most significant airlines during the analysed period, their percentages referred to the total number of connected flights for the whole time of study. Figure ES-2 shows the percentage of the different types of connected aircraft for each of these airlines.

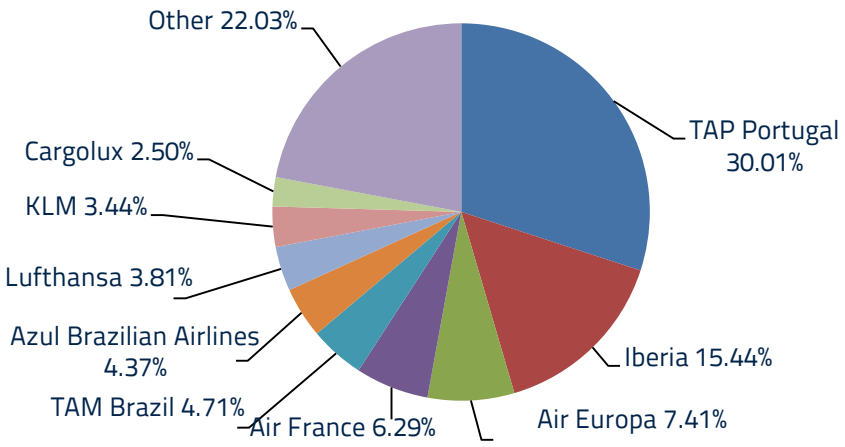


**Figure ES-1**
**Average percentage of most significant airlines (2021)**

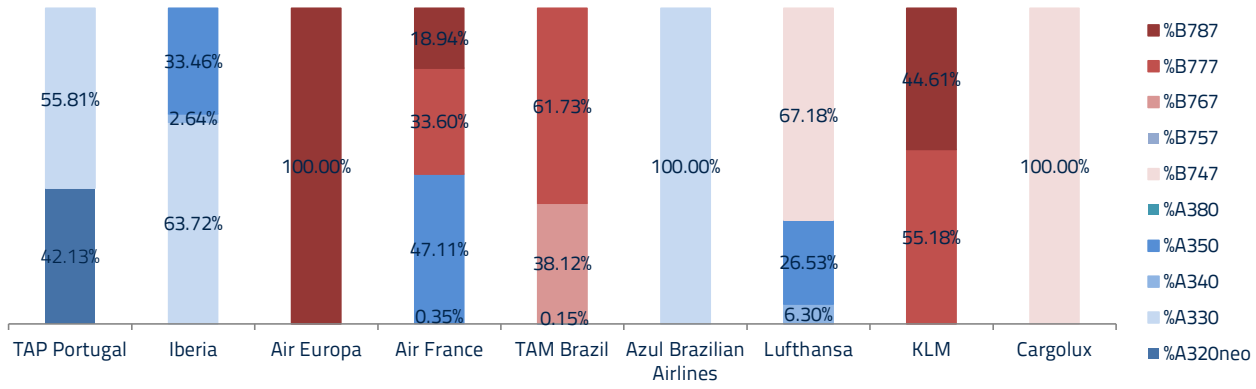


**Figure ES-2**
**Different types of connected aircraft for the most significant airlines (2021)**

With respect to ADS-C functionality, in the Canaries FIR a 15-minute periodic contract and an event contract are requested to all logged aircraft. Additionally, demand contracts and non initial periodic and event contracts have been also requested during 2021.

As far as ADS-C surveillance data accuracy is concerned, almost all (99.98%) of the analysed ADS-C messages in the studied period report a FOM value equal to or better than 6 (FOM parameter, Figure of Merit, provides information about how precise the aircraft position notified in an ADS-C report is, FOM 6 meaning that the position error is lower than 0.25NM with a probability of 95%).

Regarding the use of CPDLC communications, Table ES-2 shows the most frequent CPDLC message elements on both uplink and downlink directions.

| Type | Message element | Percentage referred to total | | |
|---|---|---|---|---|
| | | 2021 Mean Value | Max Value | Min Value |
| UPLINK | [freetext] | 21.72% | 22.56% [Sep] | 20.31% [Jan] |
| | CONTACT [icaounitname] [frequency] | 20.88% | 22.16% [Apr] | 19.97% [Sep] |
| | MONITOR [icaounitname] [frequency] | 13.30% | 14.93% [Sep] | 11.22% [Jan] |
| | NEXT DATA AUTHORITY [icaofacilitydesignation] | 11.90% | 13.85% [Jul] | 11.21% [Nov] |
| | END SERVICE | 11.45% | 13.03% [Jul] | 10.78% [Sep] |
| | SQUAWK [beaconcode] | 9.83% | 10.89% [Oct] | 7.68% [May] |

| Type | Message element | Percentage referred to total | | |
|---|---|---|---|---|
| | | 2021 Mean Value | Max Value | Min Value |
| DOWNLINK | WILCO | 63.48% | 67.36% [Apr] | 60.30% [Mar] |
| | ROGER | 11.12% | 12.61% [Mar] | 9.94% [Aug] |
| | [freetext] | 7.93% | 9.83% [Mar] | 6.87% [Apr] |
| | POSITION REPORT [positionreport] | 4.53% | 6.26% [Sep] | 3.59% [Jun] |

**Table ES-2**
**Most frequent CPDLC message elements (2021)**

With regard to downlink (air-to-ground) message delays, figures are quite stable during the studied period. These data are presented in Table ES-3:

| Month | Downlink messages delay (seconds) | |
|---|---|---|
| | 95% delays | 99% delays |
| Jan 2021 | 33s | 93s |
| Feb 2021 | 32s | 99s |
| Mar 2021 | 37s | 116s |
| Apr 2021 | 33s | 89s |
| May 2021 | 34s | 93s |
| Jun 2021 | 36s | 96s |
| Jul 2021 | 38s | 110s |
| Aug 2021 | 34s | 94s |
| Sep 2021 | 36s | 97s |
| Oct 2021 | 36s | 94s |
| Nov 2021 | 32s | 87s |
| Dec 2021 | 32s | 88s |

**Table ES-3**
**Downlink (air-to-ground) delays (AFN, CPDLC and ADS-C) (2021)**

# 1. Introduction

The present report shows data relative to the performance and use of FANS services for the year 2021, concerning aircraft of the EUR/SAM Corridor flying in the Canarias airspace.

The EUR/SAM Corridor covers the routes between Europe and South America crossing the Information Regions (FIR/UIR) of Atlantico, Dakar Oceanic, Sal Oceanic and Canarias. For Canarias data analysis, "EUR/SAM Corridor flights" are considered as follows:

- Those flights either overflying EDUMO, TENPA, IPERA or GUNET, or flying those routes with NELSO and/or ROSTA as route waypoints and with XIGLU as entry/exit point at the south of Canarias airspace.
- Those flights overflying the DCT Area (see Figure 1) over FL295, with the following criteria:
    - Flights overflying ROSTA and with GOBEG, INSAD, IXIKU, KUXOV or LAPTU as entry/exit waypoints at the west of Canarias airspace;
    - Flights overflying OCE sector entering the FIR by RIPOD, PIBIL, OSLEV, NEXUX or KETID and leaving by GOBEG, INSAD, IXIKU, KUXOV or LAPTU, or the other way around.

Conclusion SAT FIT7/6 assigned to SATMA the CFRA functions for the EUR/SAM Corridor. ENAIRE, on behalf of SATMA, has carried out this analysis for the year 2021, which results are depicted in the present report.

As Air Navigation Service Provider responsible for ATS services in Canarias, ENAIRE monthly oversees FANS 1/A service in Canarias airspace. This report is the data summary of such monitoring activities for 2021, focusing on traffic overflying the EUR/SAM Corridor part lying in Canarias. Consequently, it only takes into account data corresponding to the Canarias FIR. This report describes the FANS services performance and use in terms of traffic data, data link utilization by aircraft, CPDLC exchange, etc.

Per conclusion SAT FIT 8/01, SAT States shall provide SATMA the required data to perform the analysis of FANS services in the EUR/SAM Corridor and the South Atlantic. In this regard, valuable data from ASA Cape Verde and ASECNA Dakar were received although, as they did not comprise the whole set of studied data, they could not be used in the statistics. Nevertheless, these data have been compared with those corresponding to ENAIRE and no major discrepancies have been detected (for more details, see Annex A: Cape Verde, Dakar and Canarias Data Comparison).

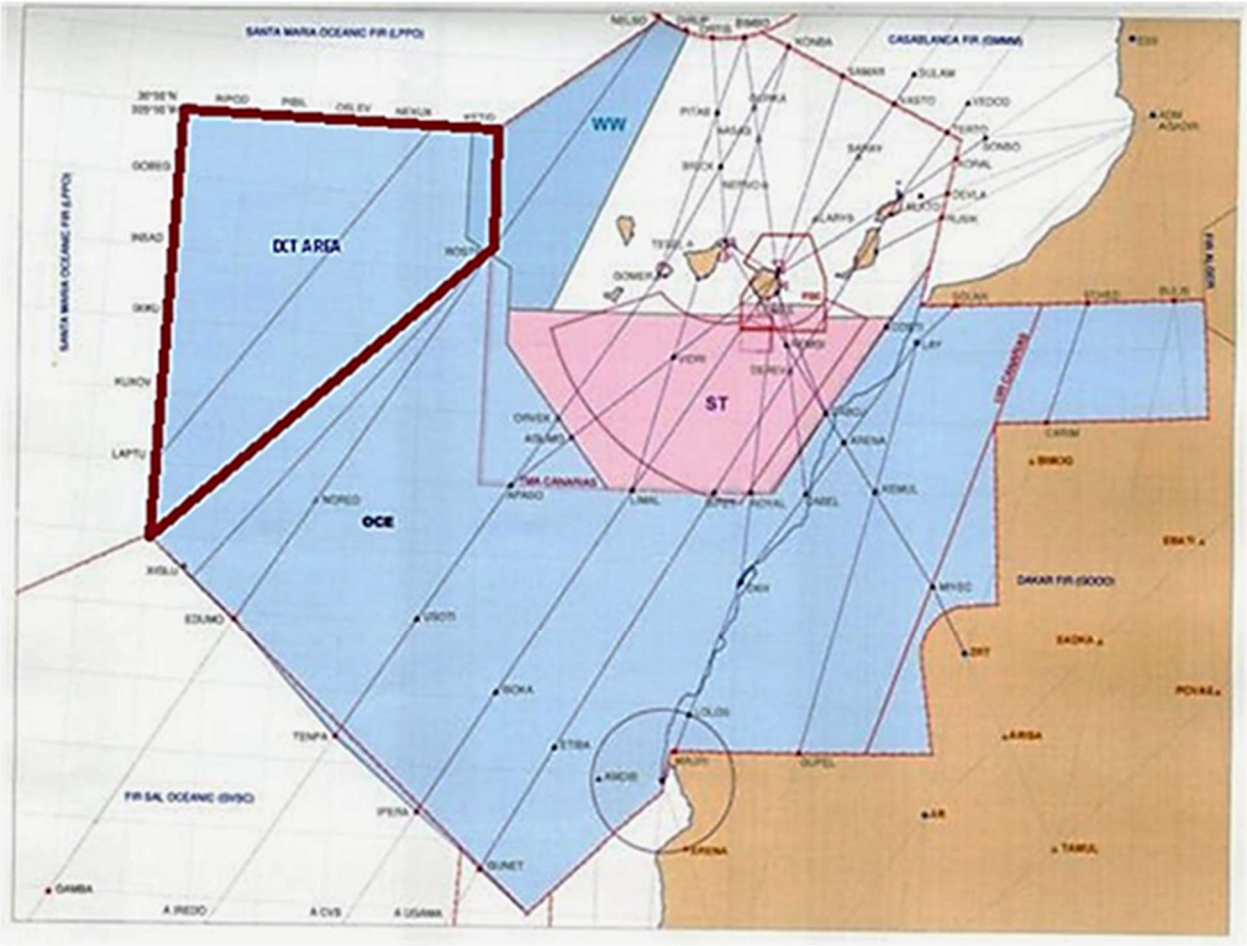


**Figure 1.**
**Canarias FIR / UIR**

## 2. Traffic Analysis

This section presents data of traffic flying in the EUR/SAM Corridor[1] and making use of FANS1/A services.

Table 1 shows a summary of the analysed traffic in the EUR/SAM Corridor, from January to December 2021. The table also presents 2021 and 2020 mean values.

| Month | Number of connected flights | Percentage referred to total number of flights in the EUR/SAM Corridor | Percentage referred to flights in the EUR/SAM Corridor indicating data link and ADS-C capacity in the Flight Plan | Number of different aircraft (aircraft registration) connecting to ENAIRE FANS Ground System |
|---|---|---|---|---|
| Jan 2021 | 932 | 85.43% | 97.69% | 241 |
| Feb 2021 | 635 | 83.44% | 95.49% | 208 |
| Mar 2021 | 779 | 82.96% | 95.82% | 236 |
| Apr 2021 | 718 | 80.76% | 92.88% | 214 |
| May 2021 | 943 | 79.71% | 94.30% | 267 |
| Jun 2021 | 966 | 84.29% | 96.31% | 279 |
| Jul 2021 | 1186 | 85.08% | 94.80% | 297 |
| Aug 2021 | 1335 | 83.54% | 92.77% | 323 |
| Sep 2021 | 1287 | 81.15% | 94.08% | 330 |
| Oct 2021 | 1543 | 78.60% | 94.55% | 374 |
| Nov 2021 | 1539 | 70.95% | 93.78% | 363 |
| Dec 2021 | 1880 | 74.43% | 94.90% | 392 |
| **Average (2021 Mean Value[2])** | 1032 | 79.69% | 94.65% | 277 |
| **Average (2020 Mean Value[2])** | 923 | 73.20% | 96.21% | 239 |

**Table 1.**
**Traffic Data Summary (2021)**

*[1] It must be borne in mind that, wherever data are presented throughout this document, "EUR/SAM Corridor" means "EUR/SAM Corridor part within Canarias airspace".*
*[2] Monthly average in the case of 'Number of connected flights' and 'Number of different aircraft' connected to ENAIRE FANS Ground System.*

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As it can be inferred from the table above, almost 80% (79.69%) of the total flights within the EUR/SAM Corridor connect to ENAIRE FANS Ground System, having connected most of FANS equipped aircraft (around 95%). The percentage of connected flights referred to total number of flights has increased from 2020 but the percentage referred to equipped flights has decreased slightly. Finally, the number of airframes (i.e. number of different aircraft registrations) flying over the EUR/SAM Corridor and making use of FANS services has begun its recovery from the 2020 dramatic decrease due to COVID-19 impact on mobility.

The following table (Table 2) and figure (Figure 2) show the percentage of connected flights for the most significant airlines.

| Month | Airline (% referred to connected flights) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TAP Portugal | Iberia | Air Europa | Air France | TAM Brazil | Azul Brazilian Airlines | Lufthansa | KLM | Cargolux |
| Jan 2021 | 28.69% | 18.95% | 10.39% | 9.21% | 5.03% | 3.21% | 4.18% | 4.39% | 1.39% |
| Feb 2021 | 22.45% | 19.78% | 7.69% | 10.05% | 5.34% | 0.00% | 6.44% | 2.98% | 3.61% |
| Mar 2021 | 21.13% | 20.36% | 6.79% | 8.58% | 3.84% | 0.26% | 8.07% | 3.33% | 3.71% |
| Apr 2021 | 31.25% | 12.78% | 6.94% | 6.25% | 3.33% | 3.89% | 7.22% | 3.75% | 3.89% |
| May 2021 | 28.89% | 17.25% | 5.82% | 4.87% | 5.50% | 5.82% | 4.66% | 3.60% | 2.54% |
| Jun 2021 | 28.75% | 17.99% | 7.34% | 5.79% | 6.00% | 7.34% | 3.00% | 3.93% | 2.17% |
| Jul 2021 | 32.24% | 16.58% | 7.24% | 5.05% | 4.38% | 5.81% | 2.61% | 2.69% | 1.85% |
| Aug 2021 | 34.70% | 15.56% | 6.88% | 4.71% | 3.14% | 5.24% | 2.09% | 3.37% | 2.09% |
| Sep 2021 | 31.11% | 13.96% | 6.44% | 6.21% | 2.95% | 5.74% | 2.87% | 3.65% | 2.95% |
| Oct 2021 | 32.56% | 13.40% | 6.86% | 6.28% | 3.11% | 4.47% | 2.85% | 2.98% | 2.78% |
| Nov 2021 | 31.86% | 13.50% | 7.85% | 5.91% | 5.91% | 4.09% | 3.24% | 3.83% | 2.40% |
| Dec 2021 | 28.53% | 12.45% | 8.36% | 5.91% | 7.03% | 3.73% | 3.51% | 3.14% | 2.02% |
| **Type of airplane (average)** | 42.13% A320neo<br>55.81% A330<br>2.06% Other | 0.19% A320<br>63.72% A330<br>2.64% A340<br>33.46% A350 | 100% B787 | 0.35% A330<br>47.11% A350<br>33.60% B777<br>18.94% B787 | 0.15% A350<br>38.12% B767<br>61.73% B777 | 100% A330 | 6.30% A340<br>26.53% A350<br>67.18% B747 | 55.18% B777<br>44.61% B787<br>0.21% Other | 100% B747 |

**Table 2.**
**Most significant airlines data (2021)**

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As it is shown, airlines with the highest number of connections in the EUR/SAM Corridor are TAP Portugal, Iberia and Air Europa. These three airlines comprise almost 53% out of the total connected flights. The next ones are Air France, TAM Brazil, Azul Brazilian Airlines, Lufthansa, KLM and Cargolux. Adding these six airlines to the previous three ones, they comprise around 78% out of the total connected flights.

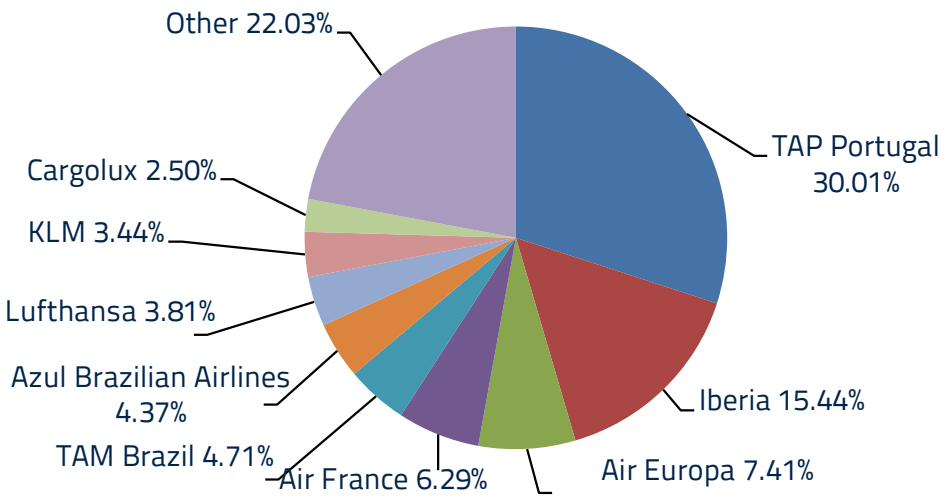


**Figure 2.**
**Average percentage of the most significant airlines (2021)**

In Table 2, the percentage of different types of connected aircraft from each airline (averaged along the analysed year) is also represented, being the connected aircraft Airbus A320neo, A330, A340 or A350 or Boeing B747, B767, B777 or B787. These aircraft percentages are also shown in Figure 3.

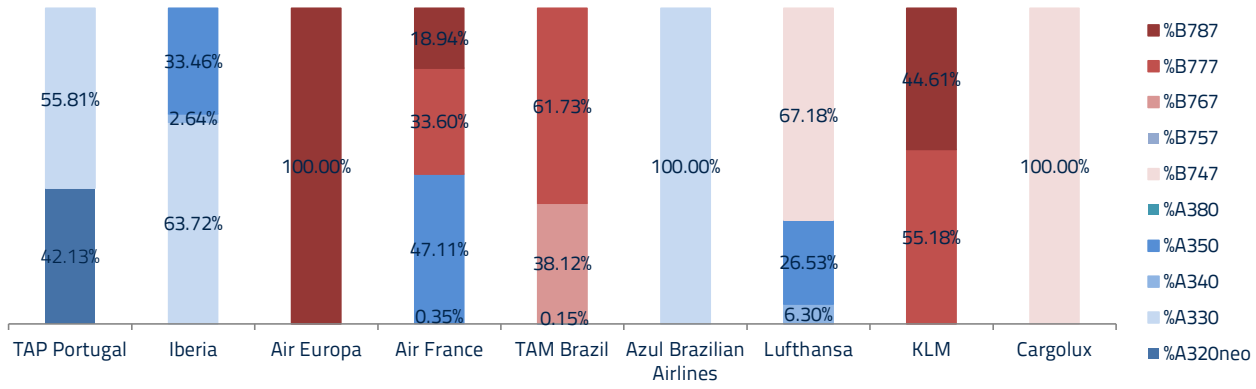


**Figure 3.**
**Different types of connected aircraft for the most significant airlines (2021)**

In addition, Figure 4 illustrates the total percentage of each long range type of connected aircraft flying in the EUR/SAM Corridor.

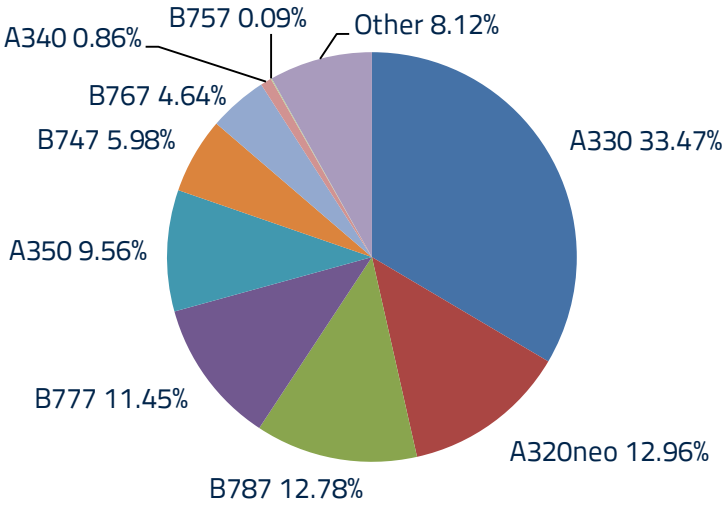


**Figure 4.**
**Total percentage of different types of connected aircraft (2021)**

# 3. Communications Network performance

The following subsections present the communications network performance, showing the message delay percentages obtained for the months under study.

## 3.1. Air-to-ground messages delays

Data related to downlink messages delays and maximum and minimum values during the analysed period are shown in Table 3, providing indication of the time elapsed in surveillance (ADS-C) and communications (CPDLC) downlink messages delivery. This table presents delay values for which 95% and 99% of air-to-ground transit times (calculated from message time stamp and message reception time in ENAIRE FANS Ground System) remain below, grouped by message type (AFN messages, ADS-C reports and CPDLC messages in an individual approach, as well as all messages altogether) and data link media (VHF, Satellite and VHF, Satellite and HF[3] together). As it is seen in Table 3, Figure 5 and Figure 6, 95% of the calculated delays are usually below 60 seconds (except for July values for AFN and ADS-B SAT messages) whilst 99% of calculated delays are below 180 seconds. As expected, values depend largely on data link media, being satellite delays greater than VHF delays. For monthly data regarding downlink messages delays, see "Attachment 1: Air-to-Ground Messages Delays per Month".

| Parameter | Max value [month] | Min value [month] |
|---|---|---|
| **AFN Messages** | | |
| 95% VHF delay | 26s [May, Sep & Oct] | 22s [Nov] |
| 95% SAT delay | 71s [Jul] | 45s [Nov] |
| 95% Global delay | 56s [Jul] | 38s [Nov] |
| 99% VHF delay | 137s [Jan] | 47s [Apr] |
| 99% SAT delay | 149s [Mar] | 93s [Jun] |
| 99% Global delay | 149s [Mar] | 94s [Jun] |

[3] *The amount of messages received via HF is not big enough to perform statistical studies associated to this link separately.*

| Parameter | Max value [month] | Min value [month] |
|---|---|---|
| **ADS-C reports** | | |
| 95% VHF delay | 17s [Mar] | 10s [Jan, Feb & Nov] |
| 95% SAT delay | 61s [Jul] | 43s [Jan] |
| 95% Global delay | 38s [Jul] | 31s [Dec] |
| 99% VHF delay | 69s [Mar] | 43s [Nov] |
| 99% SAT delay | 138s [Jul] | 97s [Jan] |
| 99% Global delay | 114s [Jul] | 86s [Nov & Dec] |
| **CPDLC AT** | | |
| 95% VHF delay | 24s [Mar] | 12s [Apr] |
| 95% SAT delay | 42s [May, Jun, Jul & Oct] | 33s [Feb] |
| 95% Global delay | 32s [Mar, Jun & Oct] | 26s [Feb] |
| 99% VHF delay | 66s [Mar] | 36s [Aug] |
| 99% SAT delay | 116s [Mar] | 88s [Jan] |
| 99% Global delay | 101s [Mar] | 72s [Apr] |
| **AFN, ADS-C reports and CPDLC AT** | | |
| 95% Global delay | 38s [Jul] | 32s [Feb, Nov & Dec] |
| 99% Global delay | 116s [Mar] | 87s [Nov] |

**Table 3.**
**Delay parameters 2021 (Max & Min)**

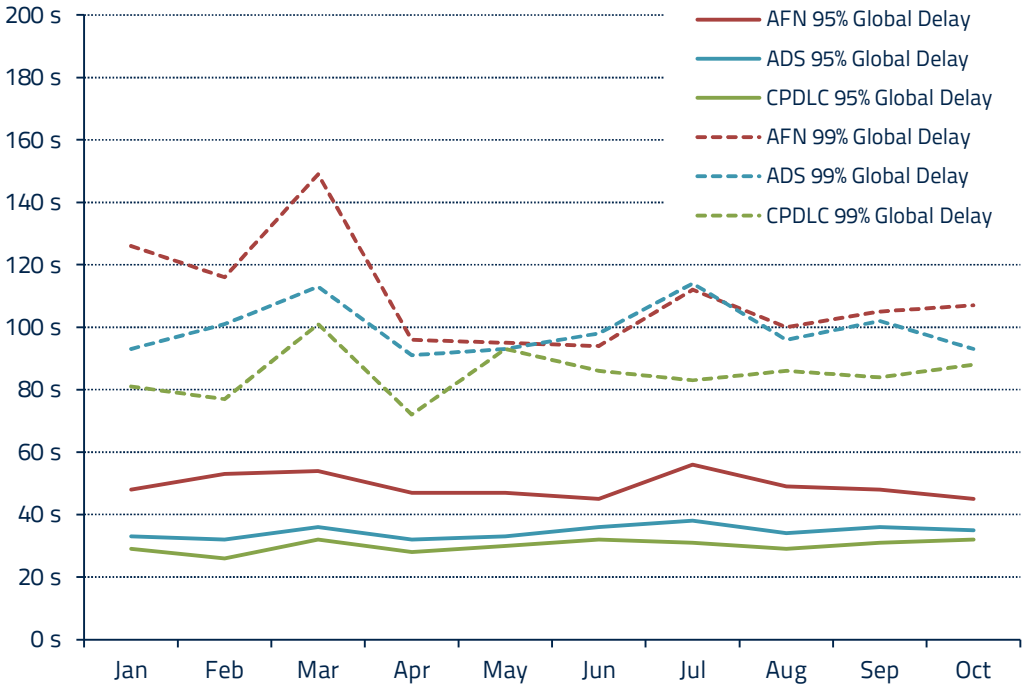


**Figure 5.**
**2021 Monthly Delays per application**

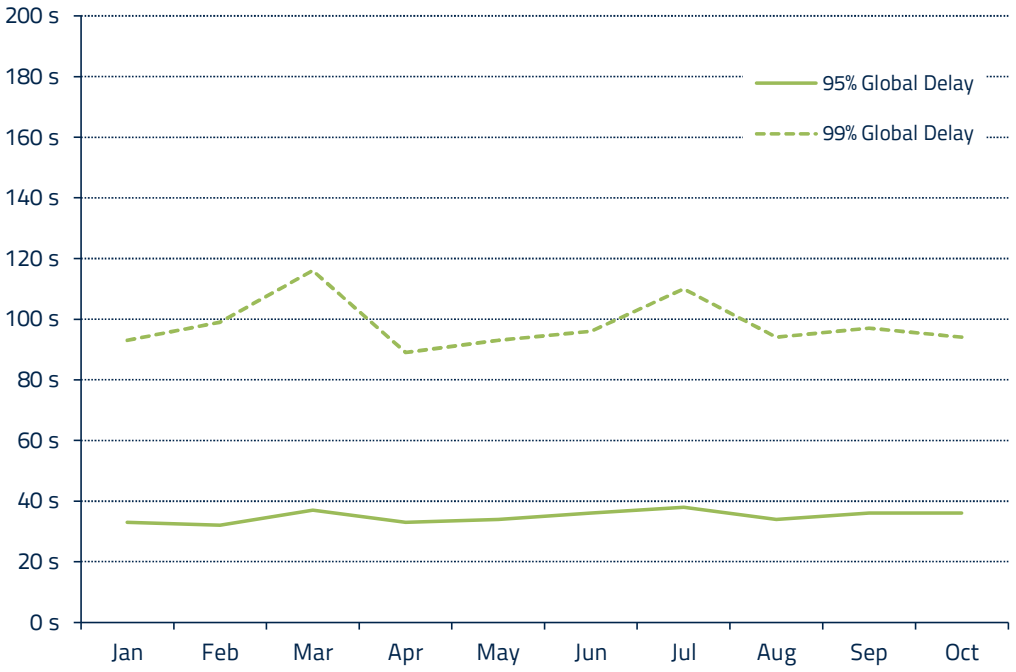


**Figure 6.**
**2021 Global monthly delays**

# 4. Automatic Dependent Surveillance

## 4.1. ADS-C contract requests

In the Canaries FIR, initial ADS-C contracts are automatically set with every logged-on aircraft. These initial contracts consist of a 15-minute periodic contract, requesting the transmission of flight identification, predicted route, earth reference and air reference with every periodic report, and an event contract including vertical rate change, altitude range, waypoint change and lateral deviation events, the latter with a 5 nautical miles threshold. After the initial contract, new periodic or event contracts are requested subsequently, as it is shown in Table 4. Demand contracts are also requested.

| Initial contracts (monthly average) | Non initial contracts (monthly average)[4] | | |
|---|---|---|---|
| | Periodic | Event | Demand |
| 1227 | 1278 | 4287 | 166 |

**Table 4.**
**ADS-C contract request (2021 monthly average)**

In addition, in 2021 emergency contracts have been requested to 8 flights (16 emergency periodic contracts and 9 emergency demand contracts in total). The CPDLC link was active in all of these 8 flights, but the dialogues did not reflect any unusual or emergency situation.

## 4.2. Figure of Merit (FOM) analysis

This subsection presents the Figure of Merit parameter (FOM) analysis from ADS-C messages transmitted by aircraft and received by ENAIRE FANS Ground System. FOM is a parameter included in every ADS-C report that provides information about how precise the notified aircraft position is and, therefore, of the quality of the ADS-C surveillance data.

The cumulative percentage values per FOM figures in 2021 are shown in Table 5. The complete cumulative percentage values corresponding to FOM figures received for each month in 2021 are indicated in "Attachment 2: FOM Values per Month".

[4] *Including system automatic requests.*

| FOM Figure | Annual cumulative percentage |
|---|---|
| FOM = 7 (Error < 0,05 NM) | 30.51% |
| FOM ≥ 6 (Error < 0,25 NM) | 99.98% |
| FOM ≥ 5 (Error < 1 NM) | 99.99% |
| FOM ≥ 4 (Error < 4 NM) | 99.99% |
| FOM ≥ 3 (Error < 8 NM) | 99.99% |
| FOM ≥ 2 (Error < 15 NM) | 99.99% |
| FOM ≥ 1 (Error < 30 NM) | 99.99% |
| FOM ≥ 0 | 100.00% |

**Table 5.**
**FOM cumulative percentages (2021)**

As shown on the table above, 99.98% of ADS-C reports received on ground reported a FOM value equal to 6 or 7, meaning that the position error is always estimated as being either lower than 0.25NM (FOM = 6) or lower than 0.05 NM (FOM = 7) with a probability of 95%.

## 5. Controller - Pilot data link communications

In areas of Canarias airspace where appropriate VHF coverage does not exist, CPDLC (Controller - Pilot Data Link Communications) is used as a communication means between ATCos and suitable trained flight crews of FANS equipped aircraft.

This section provides a snapshot of CPDLC utilization by pilots and controllers, indicating the CPDLC message elements interchanged.

Table 6 and Table 7 show the percentage of the most frequently transmitted uplink and downlink CPDLC message elements with respect to the total of transmitted elements. For a complete table of transmitted CPDLC message elements see "Attachment 3: Transmitted CPDLC Message Elements per Month".

| Month | Most frequently used UL message elements (percentage referred to total) | | | | | |
|---|---|---|---|---|---|---|
| | [freetext] | CONTACT [icaounitname] [frequency] | NEXT DATA AUTHORITY [icaofacilitydesignation] | MONITOR [icaounitname] [frequency] | END SERVICE | SQUAWK [beaconcode] |
| Jan 2021 | 20.31% | 20.70% | 11.52% | 11.22% | 10.88% | 11.15% |
| Feb 2021 | 21.41% | 20.58% | 12.79% | 12.37% | 12.06% | 9.25% |
| Mar 2021 | 22.10% | 20.63% | 11.73% | 11.85% | 11.32% | 10.34% |
| Apr 2021 | 20.98% | 22.16% | 11.51% | 13.52% | 11.35% | 9.50% |
| May 2021 | 21.77% | 21.79% | 11.71% | 12.94% | 11.08% | 10.33% |
| Jun 2021 | 21.60% | 21.02% | 11.88% | 13.66% | 11.02% | 10.30% |
| Jul 2021 | 21.20% | 21.05% | 13.85% | 14.29% | 13.03% | 8.18% |
| Aug 2021 | 20.89% | 21.45% | 12.62% | 13.57% | 12.15% | 9.48% |
| Sept 2021 | 22.56% | 19.97% | 11.31% | 14.93% | 10.78% | 9.84% |
| Oct 2021 | 21.62% | 21.10% | 12.10% | 13.29% | 11.82% | 9.44% |
| Nov 2021 | 22.43% | 20.44% | 11.21% | 13.47% | 11.22% | 10.15% |
| Dec 2021 | 22.45% | 20.55% | 11.25% | 13.03% | 10.88% | 10.14% |

**Table 6.**
**Most frequent uplink message elements transmitted (2021)**

| Month | Most frequently used DL message elements (percentage referred to total) | | | |
|---|---|---|---|---|
| | WILCO | ROGER | [freetext] | POSITION REPORT [positionreport] |
| Jan 2021 | 60.97% | 11.56% | 7.66% | 4.42% |
| Feb 2021 | 61.69% | 12.04% | 9.05% | 4.01% |
| Mar 2021 | 60.30% | 12.61% | 9.83% | 4.07% |
| Apr 2021 | 67.36% | 10.15% | 6.87% | 4.31% |
| May 2021 | 64.47% | 11.78% | 7.68% | 3.79% |
| Jun 2021 | 65.79% | 10.67% | 7.63% | 3.59% |
| Jul 2021 | 66.43% | 10.05% | 7.27% | 4.47% |
| Aug 2021 | 66.10% | 9.94% | 6.94% | 5.21% |
| Sept 2021 | 62.75% | 10.07% | 7.81% | 6.26% |
| Oct 2021 | 63.92% | 11.24% | 7.68% | 4.36% |
| Nov 2021 | 62.65% | 11.58% | 8.65% | 4.08% |
| Dec 2021 | 61.14% | 11.89% | 8.27% | 4.71% |

**Table 7.**
**Most frequent downlink message elements transmitted (2021)**

As it can be seen, after "freetext" element, among the most frequent uplink message elements are the "contact message" (uM117) and those related to the CPDLC communications transfer ("NEXT DATA AUTHORITY [icaofacilitydesignation]" and "END SERVICE"). The MONITOR message and the SQUAWK message are also used frequently.

For downlink elements, the most common ones are the responses "WILCO" and "ROGER", followed by the "freetext" element and the "Position Report" message.

## 6. Potential problems identified

No reports from involved SAT states or airlines have been received with regard to operational (operative) or technical or related to interoperability issues detected during the analysed period.

As a reminder, Figure 7 shows FANS/CFRA Notification Form to be filled and forwarded to SATMA-CFRA in case of detection of any potential problem.

| | | | |
|---|---|---|---|
| **1. Reporting Date:** | **2. Reporting Unit:** | | |
| **3. Operator Name:** | **4. Call Sign:** | **5. Aircraft Type:** | **6. FANS EQUIPE** |
| **7. Date of Occurrence:** | **8. Time UTC:** | **9. Occurrence Position** | |
| **15. Description and Action Followed:** | | | |

**CLASIFICATION**

1. Log-On received from aircraft not flying your airspace
2. A/C Log-On with incorrect flight identification
3. Log-On from Aircraft not declaring ADS-C capacity in FP
4. Unknown ADS-C messages are received.
5. A/Cs remain ADS-C connected after exiting airspace
6. A/Cs remain ADS-C connected after landing
7. Different reports in the same ADS-C message.
8. Identical reports of Waypoint Change received in an ADS-C message
9. CPDLC Message: "Not Current Data Authority"
10. Incorrect downlink CPDLC messages have been received:
11. Other (describe) : _____

**Crew/Controller comments (if any)**

When complete please forward the report(s) to: South Atlantic Monitoring Agency (SATMA-CFRA)
E-Mail: satma@aena.es

**Figure 7.**
**FANS/CFRA Notification Form**

# 7. Conclusions

From the analysis of 2021 data, it can be concluded that:

- The analysed data register the beginning of the recovery from the impact on air travelling of COVID-19 pandemic.
- As far as aircraft using FANS services are concerned, almost 80% (79.69%) of the EUR/SAM Corridor flights (Canarias area) connect to ENAIRE FANS Ground System (around 95% of flights notifying FANS equipage in its flight plan connect to ENAIRE FANS Ground System). It represents an increase from 2020.
- Major users of FANS services are TAP Portugal, Iberia, Air Europa, Air France and TAM Brazil. Same top five than in 2020 but in different order. Iberia and Air Europa have climbed to second and third position from previous third and fifth position respectively. TAM Brazil has fallen from the second to the fifth position.
- Regarding ADS-C:
  - Initial ADS-C contracts are currently established in the Canaries FIR (consisting of a 15-minute periodic contract, requesting the transmission of flight identification, predicted route, earth reference and air reference with every periodic report, and an event contract including vertical rate change, altitude range, waypoint change and lateral deviation events, the latter with a 5 nautical miles threshold).
  - Position accuracy notified in ADS-C reports is not worse than 0.25 NM 99.98% of the times (i.e. 99.98% of the times FOM 6 or 7 is notified, being FOM 6 the most common value).
- Regarding CPDLC message elements used:
  - For uplink messages, those message elements related to the process of CPDLC communications transfer (NEXT DATA AUTHORITY and END SERVICE) are among the most used by controllers, representing a percentage of around 23% of the total. Along with the CONTACT message, these three represent a percentage around 44% of the total. Above them, the normal priority free text is the most frequently used element.
  - For downlink elements, response message elements WILCO and ROGER represent almost 75% of the received message elements.
- With regard to downlink messages delay, on average 95% of the calculated delays are usually not greater than 60 seconds, whilst 99% of calculated delays are usually well below 180 seconds..
- No issues (neither operative, nor technical or involving interaction between aircraft and ground systems), have been notified during the analysed period.

## 8. Acronyms

| | |
|---|---|
| A/C | Aircraft |
| ACARS | Aircraft Communication Addressing and Reporting System |
| ACC | Area Control Centre |
| ACK | Acknowledgement |
| ADS | Automatic Dependent Surveillance |
| ADS-C | Automatic Dependent Surveillance – Contract |
| AFN | ATS Facilities Notification |
| AO | Atlantic Ocean |
| ASECNA | Agence pour la Sécurité de la Navigation Aérienne en Afrique et Madagascar |
| ARF | Air Reference Group |
| ATCo | Air Traffic Controller |
| ATSP | Air Traffic Service Provider |
| ATS | Air Traffic Services |
| CFRA | Central FANS Reporting Agency |
| CPDLC | Controller to Pilot Data Link Communications |
| DL | Downlink |
| DM | CPDLC Downlink Message Element |
| DSP | Datalink Service Provider |
| ETA | Estimated Time of Arrival |
| EUR | Europe |
| FANS | Future Air Navigation System |
| FID | Flight Identification |
| FIR | Flight Information Region |
| FIT | FANS-1/A Interoperability Team |
| FOM | Figure of Merit |
| HMI | Human Machine Interface |
| MET | Meteorological Group |
| NM | Nautical Mile |
| NW | Next Waypoint |
| SAM | South America |
| SAT | Satellite |
| SATMA | South Atlantic Monitoring Agency |
| UL | Uplink |
| UIR | Upper Information Region |
| UM | CPDLC Uplink Message Element |
| VGS | VHF Ground Station |
| VHF | Very High Frequency |

# 9. Annex A: Cape Verde, Dakar and Canarias Data Comparison

This Annex presents a brief analysis of 2021 data received from ASA Cape Verde and ASECNA Dakar.

Data received consists of the following information:

- Cape Verde DSP (SITA) ATS Performance Reports from January to December 2021. Since ENAIRE receives from the DSP (SITA) the same type of reports monthly, these data could be compared with the corresponding ATS Performance Reports of ENAIRE.
- Dakar information related to ADS-C/CPDLC equipped aircraft from January to December 2021;

The analysed data of the different FIR/UIR seem to be in line and no major differences in the main conclusions have been observed.

## A. Percentage of ADS-C & CPDLC Equipped Flights

Figure 8 shows the percentage of equipped flights in the EUR/SAM Corridor part within Dakar Oceanic[5] airspace and within Canarias airspace.

As it can be observed, the percentage of equipped flights within Dakar Oceanic airspace (92.82% on average) is higher than the percentage of equipped flights within the Canarias airspace (79.69% on average) with respect to their respective total traffic.

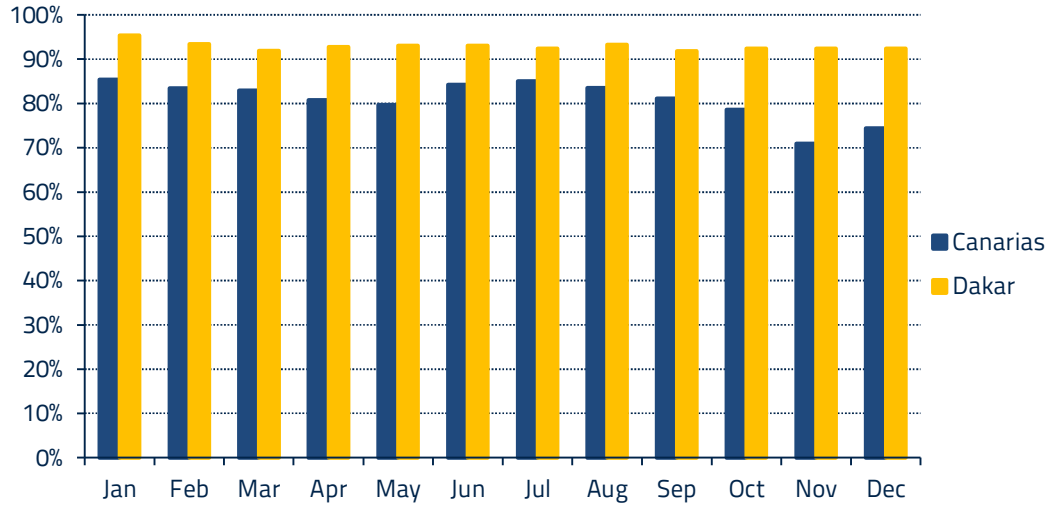


**Figure 8.**
**Dakar and Canarias percentages of ADS-C &CPDLC equipped flights (2021)**

*[5] For the sake of consistency with Canarias data analysis, for the calculation of the equipped flights in the EUR/SAM Corridor part within Dakar Oceanic airspace, the following routes have been considered: UN741, UN866, UN873, UN857 and those flights corresponding to the RANDOM zone with entry and exit points located at the left of AORRA.*

### B. FANS Traffic by Airlines

With regard to FANS traffic by airlines, the two most significant airlines in the case of both Cape Verde and Canarias are TAP Portugal and Iberia. The next three airlines are KLM, Air France and Lufthansa in the case of Cape Verde and Air Europa, Air France and TAM Brazil in the case of Canarias.

### C. FANS Datalink Traffic

Figure 9 and Figure 10 show available FANS Datalink air-ground traffic (uplink and downlink) of Cape Verde and Canarias for 2021, being this datalink air-ground traffic the blocks exchanged between the aircraft and the RGS/VGS (including the repeated and duplicated blocks).

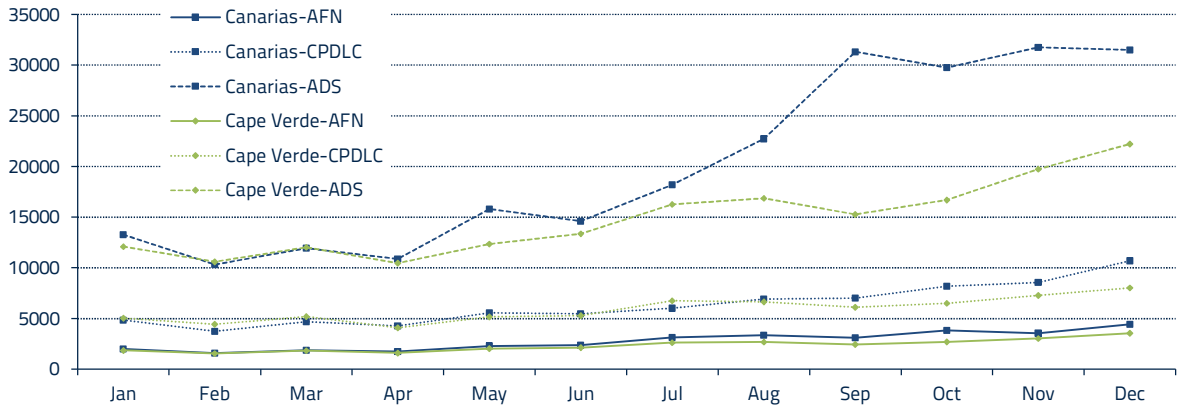


**Figure 9.**
**FANS Datalink Air-Ground Traffic –number of messages- (Uplink and Downlink)**

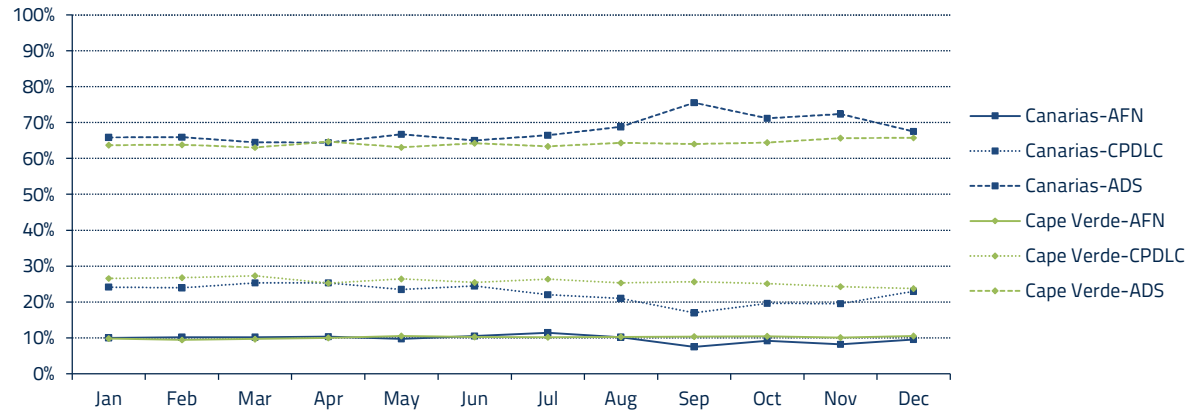


**Figure 10.**
**FANS Datalink Air-Ground Traffic Distribution (Uplink and Downlink)**

With regard to the distribution of datalink traffic, Figure 10 shows a similar distribution among applications for both States.

### D. FANS Service Performance

Figure 11 shows downlink delivery times for 2021, extracted from the corresponding ATS Performance Reports.

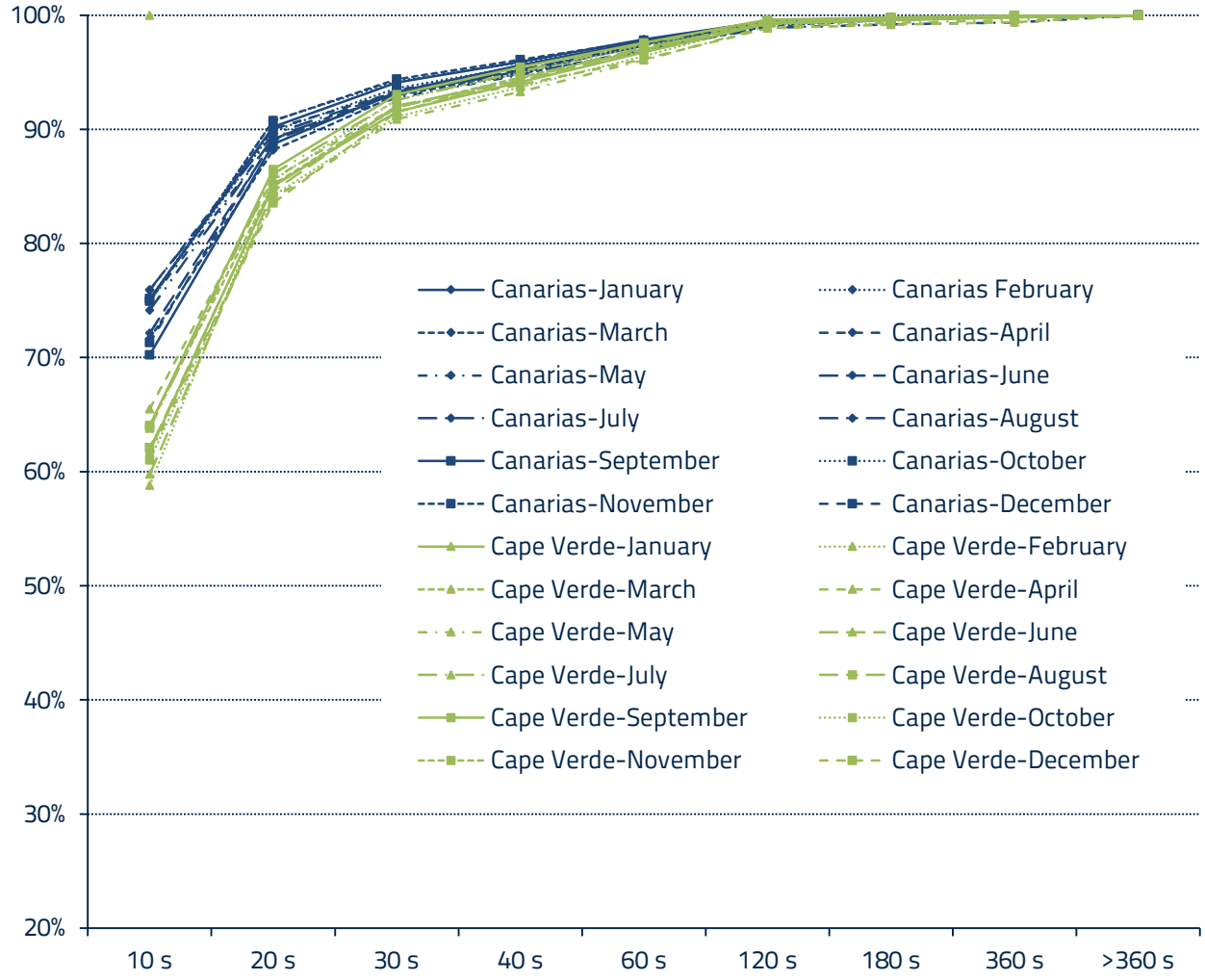


**Figure 11.**
**ASA Cape Verde and ENAIRE Global Downlink Delivery Time**

As it is shown, in general there are no significant differences related to downlink message delivery times registered for Cape Verde and Canarias for the studied months.

## 10. Attachment 1: Air-to-Ground Messages Delays per Month

The following table shows the delay values splitted up into each month of 2021.

| Parameter | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AFN Messages** | | | | | | | | | | | | |
| 95% VHF delay (s) | 24 | 23 | 25 | 23 | 26 | 25 | 23 | 24 | 26 | 26 | 22 | 24 |
| 95% SAT delay (s) | 60 | 63 | 66 | 63 | 57 | 51 | 71 | 62 | 58 | 56 | 45 | 56 |
| 95% ALL delay (s) | 48 | 53 | 54 | 47 | 47 | 45 | 56 | 49 | 48 | 45 | 38 | 46 |
| 99% VHF delay (s) | 137 | 61 | 131 | 47 | 64 | 126 | 57 | 74 | 120 | 96 | 50 | 62 |
| 99% SAT delay (s) | 116 | 118 | 149 | 118 | 98 | 93 | 130 | 102 | 101 | 110 | 104 | 101 |
| 99% ALL delay (s) | 126 | 116 | 149 | 96 | 95 | 94 | 112 | 100 | 105 | 107 | 96 | 99 |

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| Parameter | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ADS-C Reports** | | | | | | | | | | | | |
| 95% VHF delay (s) | 10 | 10 | 17 | 11 | 13 | 12 | 12 | 14 | 11 | 13 | 10 | 11 |
| 95% SAT delay (s) | 43 | 46 | 56 | 49 | 47 | 52 | 61 | 50 | 54 | 52 | 44 | 45 |
| 95% ALL delay (s) | 33 | 32 | 36 | 32 | 33 | 36 | 38 | 34 | 36 | 35 | 32 | 31 |
| 99% VHF delay (s) | 67 | 48 | 69 | 49 | 52 | 55 | 54 | 56 | 48 | 50 | 43 | 45 |
| 99% SAT delay (s) | 97 | 103 | 130 | 102 | 100 | 104 | 138 | 106 | 117 | 103 | 104 | 101 |
| 99% ALL delay (s) | 93 | 101 | 113 | 91 | 93 | 98 | 114 | 96 | 102 | 93 | 86 | 86 |
| **CPDLC AT** | | | | | | | | | | | | |
| 95% VHF delay (s) | 14 | 14 | 24 | 12 | 17 | 18 | 16 | 15 | 17 | 19 | 14 | 15 |
| 95% SAT delay (s) | 36 | 33 | 41 | 38 | 42 | 42 | 42 | 38 | 40 | 42 | 36 | 40 |
| 95% ALL delay (s) | 29 | 26 | 32 | 28 | 30 | 32 | 31 | 29 | 31 | 32 | 30 | 31 |
| 99% VHF delay (s) | 52 | 38 | 66 | 47 | 48 | 49 | 47 | 36 | 47 | 54 | 43 | 51 |
| 99% SAT delay (s) | 88 | 89 | 116 | 96 | 98 | 96 | 96 | 98 | 96 | 101 | 103 | 103 |
| 99% ALL delay (s) | 81 | 77 | 101 | 72 | 93 | 86 | 83 | 86 | 84 | 88 | 86 | 90 |

| Parameter | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AFN, ADS-C reports and CPDLC AT** | | | | | | | | | | | | |
| 95% ALL delay (s) | 33 | 32 | 37 | 33 | 34 | 36 | 38 | 34 | 36 | 36 | 32 | 32 |
| 99% ALL delay (s) | 93 | 99 | 116 | 89 | 93 | 96 | 110 | 94 | 97 | 94 | 87 | 88 |

**Table 8.**
**Monthly delay parameters (2021)**

## 11. Attachment 2: FOM Values per Month

This table presents the cumulative percentages for the FOM parameter for each month of 2021.

| FOM | Percentage referred to total | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
| FOM = 7 (Error < 0,05 NM) | 33.71% | 37.45% | 41.93% | 33.89% | 30.12% | 27.92% | 28.62% | 26.71% | 29.26% | 27.09% | 29.68% | 30.08% |
| FOM ≥ 6 (Error < 0,25 NM) | 99.99% | 99.99% | 99.98% | 100.00% | 100.00% | 99.97% | 99.98% | 99.98% | 99.99% | 99.98% | 99.95% | 99.99% |
| FOM ≥ 5 (Error < 1 NM) | 99.99% | 99.99% | 99.98% | 100.00% | 100.00% | 99.98% | 99.98% | 99.99% | 99.99% | 99.98% | 99.97% | 99.99% |
| FOM ≥ 4 (Error < 4 NM) | 99.99% | 99.99% | 99.98% | 100.00% | 100.00% | 99.98% | 99.98% | 99.99% | 99.99% | 99.98% | 99.98% | 99.99% |
| FOM ≥ 3 (Error < 8 NM) | 99.99% | 99.99% | 99.98% | 100.00% | 100.00% | 99.98% | 99.99% | 99.99% | 99.99% | 99.98% | 99.98% | 99.99% |
| FOM ≥ 2 (Error < 15 NM) | 99.99% | 99.99% | 99.98% | 100.00% | 100.00% | 99.98% | 99.99% | 99.99% | 99.99% | 99.98% | 99.99% | 99.99% |
| FOM ≥ 1 (Error < 30 NM) | 99.99% | 99.99% | 99.98% | 100.00% | 100.00% | 99.98% | 99.99% | 99.99% | 99.99% | 99.98% | 99.99% | 99.99% |
| FOM ≥ 0 | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

**Table 9.**
**Monthly FOM values (2021)**

## 12. Attachment 3: Transmitted CPDLC Message Elements per Month

Table 10 and Table 11 show the percentage of the transmitted uplink and downlink CPDLC message elements with respect to the total of transmitted elements.

| Uplink message element | Percentage referred to total uplink message elements in the month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
| [freetext] | 20.31% | 21.41% | 22.10% | 20.98% | 21.77% | 21.60% | 21.20% | 20.89% | 22.56% | 21.62% | 22.43% | 22.45% |
| CONTACT [icaounitname] [frequency] | 20.70% | 20.58% | 20.63% | 22.16% | 21.79% | 21.02% | 21.05% | 21.45% | 19.97% | 21.10% | 20.44% | 20.55% |
| MONITOR [icaounitname] [frequency] | 11.22% | 12.37% | 11.85% | 13.52% | 12.94% | 13.66% | 14.29% | 13.57% | 14.93% | 13.29% | 13.47% | 13.03% |
| NEXT DATA AUTHORITY [icaofacilitydesignation] | 11.52% | 12.79% | 11.73% | 11.51% | 11.71% | 11.88% | 13.85% | 12.62% | 11.31% | 12.10% | 11.21% | 11.25% |
| END SERVICE | 10.88% | 12.06% | 11.32% | 11.35% | 11.08% | 11.02% | 13.03% | 12.15% | 10.78% | 11.82% | 11.22% | 10.88% |
| SQUAWK [beaconcode] | 11.15% | 9.25% | 10.34% | 9.50% | 10.33% | 10.30% | 8.18% | 9.48% | 9.84% | 9.44% | 10.15% | 10.14% |
| ERROR [errorInformation] | 3.53% | 2.75% | 3.01% | 2.81% | 2.52% | 2.90% | 2.09% | 2.24% | 3.22% | 2.74% | 3.03% | 3.13% |
| REPORT LEVEL [altitude] | 3.55% | 2.82% | 2.96% | 2.39% | 2.39% | 2.11% | 1.86% | 2.48% | 2.27% | 2.38% | 2.54% | 2.77% |
| CLIMB TO AND MAINTAIN [altitude] | 3.34% | 2.68% | 2.81% | 2.33% | 2.37% | 2.02% | 1.75% | 2.33% | 2.21% | 2.18% | 2.42% | 2.48% |
| STANDBY | 1.44% | 1.36% | 1.18% | 1.40% | 0.92% | 0.81% | 0.77% | 0.86% | 0.94% | 0.84% | 0.73% | 1.01% |
| UNABLE | 1.12% | 0.94% | 0.86% | 0.83% | 1.02% | 0.93% | 0.68% | 0.64% | 0.88% | 0.97% | 1.05% | 1.03% |
| CONFIRM SPEED | 0.49% | 0.45% | 0.27% | 0.35% | 0.51% | 0.37% | 0.85% | 0.56% | 0.37% | 0.58% | 0.33% | 0.35% |

| Uplink message element | Percentage referred to total uplink message elements in the month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
| PROCEED DIRECT TO [position] | 0.34% | 0.28% | 0.65% | 0.38% | 0.41% | 0.72% | 0.19% | 0.44% | 0.40% | 0.32% | 0.56% | 0.37% |
| CLEARED TO DEVIATE UP TO [distanceoffset] [direction] OF ROUTE | 0.00% | 0.00% | 0.03% | 0.29% | 0.07% | 0.37% | 0.00% | 0.00% | 0.10% | 0.22% | 0.12% | 0.08% |
| DESCEND TO AND MAINTAIN [altitude] | 0.10% | 0.07% | 0.03% | 0.00% | 0.00% | 0.00% | 0.00% | 0.05% | 0.00% | 0.09% | 0.07% | 0.21% |
| CLIMB TO REACH [altitude] BY [position] | 0.05% | 0.00% | 0.06% | 0.06% | 0.02% | 0.05% | 0.09% | 0.05% | 0.07% | 0.06% | 0.04% | 0.03% |
| CONFIRM ALTITUDE | 0.05% | 0.07% | 0.00% | 0.03% | 0.02% | 0.05% | 0.04% | 0.13% | 0.07% | 0.06% | 0.04% | 0.02% |
| MAINTAIN [speed] | 0.05% | 0.07% | 0.12% | 0.03% | 0.00% | 0.02% | 0.00% | 0.00% | 0.07% | 0.06% | 0.03% | 0.06% |
| MAINTAIN [altitude] | 0.05% | 0.03% | 0.06% | 0.00% | 0.00% | 0.02% | 0.02% | 0.03% | 0.00% | 0.04% | 0.01% | 0.05% |
| ROGER | 0.00% | 0.00% | 0.00% | 0.00% | 0.05% | 0.02% | 0.02% | 0.00% | 0.00% | 0.01% | 0.00% | 0.00% |
| DESCEND TO REACH [altitude] BY [position] | 0.02% | 0.00% | 0.00% | 0.00% | 0.00% | 0.02% | 0.00% | 0.02% | 0.00% | 0.01% | 0.00% | 0.00% |
| AT [position] CONTACT [icaounitname] [frequency] | 0.05% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.04% | 0.01% |
| REQUEST POSITION REPORT | 0.02% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.02% | 0.00% | 0.00% | 0.01% | 0.00% | 0.02% |

**Table 10.**
**Percentage of uplink message elements transmitted for each month in the studied period (2021)**

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| Downlink message element | Percentage referred to total downlink message elements in the month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
| WILCO | 60.97% | 61.69% | 60.30% | 67.36% | 64.47% | 65.79% | 66.43% | 66.10% | 62.75% | 63.92% | 62.65% | 61.14% |
| ROGER | 11.56% | 12.04% | 12.61% | 10.15% | 11.78% | 10.67% | 10.05% | 9.94% | 10.07% | 11.24% | 11.58% | 11.89% |
| [freetext] | 7.66% | 9.05% | 9.83% | 6.87% | 7.68% | 7.63% | 7.27% | 6.94% | 7.81% | 7.68% | 8.65% | 8.27% |
| POSITION REPORT [positionreport] | 4.42% | 4.01% | 4.07% | 4.31% | 3.79% | 3.59% | 4.47% | 5.21% | 6.26% | 4.36% | 4.08% | 4.71% |
| REQUEST CLIMB TO [altitude] | 5.06% | 4.26% | 3.95% | 3.68% | 3.66% | 3.42% | 3.17% | 3.23% | 3.56% | 3.30% | 3.79% | 4.01% |
| LEVEL [altitude] | 4.22% | 3.38% | 3.52% | 3.28% | 3.06% | 2.90% | 2.69% | 3.40% | 2.97% | 3.16% | 3.24% | 3.44% |
| DEVIATING [distanceoffset] [direction] OF ROUTE | 1.75% | 1.52% | 1.53% | 1.26% | 1.46% | 1.01% | 1.25% | 1.07% | 1.71% | 1.43% | 1.58% | 1.68% |
| NOT CURRENT DATA AUTHORITY | 1.62% | 1.27% | 1.49% | 0.36% | 0.90% | 1.57% | 1.81% | 1.07% | 1.74% | 0.96% | 1.51% | 1.74% |
| REQUEST DIRECT TO [position] | 0.39% | 0.44% | 0.59% | 0.36% | 0.93% | 0.75% | 0.40% | 0.62% | 0.59% | 1.15% | 0.48% | 0.50% |
| PRESENT SPEED [speed] | 0.55% | 0.64% | 0.27% | 0.40% | 0.63% | 0.46% | 1.02% | 0.76% | 0.41% | 0.72% | 0.30% | 0.40% |
| REQUEST [altitude] | 0.52% | 0.49% | 0.31% | 0.40% | 0.17% | 0.33% | 0.40% | 0.40% | 0.46% | 0.22% | 0.43% | 0.40% |
| DUE TO AIRCRAFT PERFORMANCE | 0.36% | 0.20% | 0.16% | 0.18% | 0.30% | 0.10% | 0.28% | 0.19% | 0.25% | 0.26% | 0.41% | 0.37% |
| STANDBY | 0.19% | 0.05% | 0.16% | 0.22% | 0.23% | 0.16% | 0.28% | 0.24% | 0.23% | 0.24% | 0.22% | 0.25% |
| REQUEST WEATHER DEVIATION UP TO [distanceoffset] [direction] OF ROUTE | 0.16% | 0.00% | 0.08% | 0.40% | 0.13% | 0.55% | 0.00% | 0.00% | 0.14% | 0.34% | 0.22% | 0.16% |
| REQUEST CRUISE CLIMB TO [altitude] | 0.10% | 0.05% | 0.27% | 0.13% | 0.20% | 0.03% | 0.03% | 0.14% | 0.14% | 0.10% | 0.11% | 0.11% |

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| Downlink message element | Percentage referred to total downlink message elements in the month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
| ERROR [errorInformation] | 0.00% | 0.10% | 0.00% | 0.00% | 0.13% | 0.33% | 0.11% | 0.10% | 0.18% | 0.14% | 0.11% | 0.12% |
| REQUEST VOICE CONTACT | 0.13% | 0.00% | 0.23% | 0.04% | 0.07% | 0.03% | 0.06% | 0.05% | 0.09% | 0.10% | 0.06% | 0.14% |
| REQUEST [speed] | 0.06% | 0.10% | 0.23% | 0.13% | 0.00% | 0.10% | 0.00% | 0.05% | 0.14% | 0.06% | 0.09% | 0.08% |
| DUE TO WEATHER | 0.00% | 0.05% | 0.20% | 0.13% | 0.13% | 0.07% | 0.00% | 0.02% | 0.16% | 0.00% | 0.04% | 0.19% |
| REQUEST DESCENT TO [altitude] | 0.06% | 0.10% | 0.04% | 0.00% | 0.03% | 0.00% | 0.00% | 0.07% | 0.02% | 0.10% | 0.06% | 0.12% |
| PRESENT ALTITUDE [altitude] | 0.03% | 0.10% | 0.00% | 0.04% | 0.03% | 0.07% | 0.06% | 0.17% | 0.09% | 0.08% | 0.06% | 0.03% |
| BACK ON ROUTE | 0.00% | 0.00% | 0.00% | 0.04% | 0.00% | 0.16% | 0.03% | 0.00% | 0.02% | 0.12% | 0.07% | 0.05% |
| AT PILOTS DISCRETION | 0.00% | 0.10% | 0.00% | 0.00% | 0.13% | 0.00% | 0.06% | 0.10% | 0.00% | 0.06% | 0.06% | 0.02% |
| UNABLE | 0.03% | 0.05% | 0.00% | 0.04% | 0.00% | 0.03% | 0.00% | 0.00% | 0.00% | 0.04% | 0.02% | 0.09% |
| AT [position] REQUEST CLIMB TO [altitude] | 0.00% | 0.10% | 0.08% | 0.00% | 0.03% | 0.07% | 0.00% | 0.00% | 0.02% | 0.02% | 0.02% | 0.02% |
| REQUEST OFFSET [distanceoffset] [direction] OF ROUTE | 0.03% | 0.05% | 0.00% | 0.00% | 0.00% | 0.10% | 0.03% | 0.00% | 0.02% | 0.02% | 0.02% | 0.00% |
| WHEN CAN WE EXPECT HIGHER ALTITUDE | 0.03% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.04% | 0.06% | 0.03% |
| REQUEST BLOCK [altitude] TO [altitude] | 0.03% | 0.00% | 0.00% | 0.00% | 0.00% | 0.03% | 0.03% | 0.00% | 0.00% | 0.00% | 0.02% | 0.00% |
| REQUEST [routeclearance] | 0.00% | 0.00% | 0.00% | 0.04% | 0.00% | 0.00% | 0.00% | 0.00% | 0.07% | 0.04% | 0.00% | 0.00% |
| REQUEST CLEARANCE | 0.00% | 0.00% | 0.00% | 0.04% | 0.00% | 0.00% | 0.00% | 0.02% | 0.02% | 0.00% | 0.00% | 0.00% |

| Downlink message element | Percentage referred to total downlink message elements in the month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 |
| CLIMBING TO [altitude] | 0.00% | 0.00% | 0.00% | 0.04% | 0.00% | 0.00% | 0.00% | 0.05% | 0.02% | 0.04% | 0.00% | 0.00% |
| PASSING [position] | 0.00% | 0.00% | 0.04% | 0.04% | 0.00% | 0.00% | 0.03% | 0.00% | 0.00% | 0.02% | 0.02% | 0.00% |
| ASSIGNED ROUTE [routeclearance] | 0.00% | 0.05% | 0.00% | 0.00% | 0.03% | 0.00% | 0.03% | 0.02% | 0.00% | 0.00% | 0.00% | 0.03% |
| REQUEST HEADING [degrees] | 0.03% | 0.00% | 0.00% | 0.00% | 0.00% | 0.03% | 0.00% | 0.00% | 0.02% | 0.02% | 0.00% | 0.00% |

**Table 11.**
**Percentage of downlink message elements transmitted for each month in the studied period (2021)**