International Civil Aviation Organization

Ninth Meeting of the FANS I/A Interoperability Team (SAT/FIT/9)
Buenos Aires, Argentina, 4 to 5 August 2014

Agenda Item 4: ***System performance monitoring and maintenance***

Analysis of the FANS services in the EUR/SAM Corridor

(Presented by Spain)

SUMMARY

This paper presents to SAT CFRA analysis (and conclusions) of the FANS services in the EUR/SAM corridor according with information available

1.DISCUSSION

On the conclusion SAT-FIT7-9 for the establishment of the "Central FANS Reporting Agency (CFRA)", a request was established for the support of the member States to be provided to SATMA in order to meet and perform the CFRA functions.

Under the terms of reference of the CFRA, FIT States members are requested to provide SATMA with support to perform CFRA functions; In that sense, periodic delivery of required information regarding ADS/CPDL incidents should be a formal compromise for CFRA Monitored States. In that sense, the following Conclusion was agreed in FIT 8

Conclusion SAT FIT 8/01 **Data Collection for FANS services performance analysis and CFRA functions**
That:
a) In order to perform the Analysis of FANS services in the EUR/SAM Corridor and the South Atlantic, involved SAT States to provide SATMA the required data (listed in **Appendix C** to this report)
b) Data related shall be forwarded to SATMA at the latest, on the last working day of each month.
c) SAT States to notify to SATMA (as example in **Appendix D** to this report) any problem detected along the corridor/South Atlantic

Despite of RPN-4 implementation schedule, the aim to achieve a 50M separation service based on ADS/CPDLC in the whole corridor means a proactive implication to understand and avoid any FANS1 System atypical or unexpected behavior. Find out exceptions and malfunctions should be an essential step in order to recommend and enhance proper actions or even initiate coordinated surveys. According to that, SATMA presents in the next point a resume of exceptions occurred in ADS/CPDLC system (Canarias) that should be focused under common study. That Section of the study runs into Generic Potential Problem identified in the system, classifying them into Operatives (Air sided-Ground sided),

Technical and ADS/CPDL issues. A deep and comprehensive lecture of Annex I should be of the main interest of all parts involved, and a point to be regularly debated in FIT meetings. So, a proposal to add a specific point in FIT Agenda from now on should be taken into consideration.

Anticipating the importance of this part of the study, an email was forwarded to States within SAT/FIT schedule:

> *Good morning*
>
> *Please let me ask you for some information on Annex documents presented in last FIT.*
>
> *In order CFRA continue with FIT reports regarding ADS/CPDLC*
>
> - *States to present (in next FIT) some analysis regarding the issues commented in the document "Issues_CFRA_FANS_Services2012"*
>
> - *CFRA Focal Points start sending information (CFRA Data.doc) starting after next FIT*
>
> *Regards*
> *SATMA coordination*

2.POTENTIAL PROBLEMS IDENTIFIED

This section presents a brief summary of those issues identified during data analysis of aircraft connected to SACCAN (Canarias ACC) during 2013 and that should be further analyzed by the relevant stakeholders in the context of the CFRA. Though issues have been detected through SACCAN records analysis, they are considered of generic nature. The different issues are presented in a totally anonymous manner; therefore, no company, aircraft type, etc. are mentioned in any way. It is to be noticed that almost all of them were already identified during previous analysis (2011 and/or 2012).Issues have been allocated to the following categories: operational (operative) and technical or related to interoperability. However, it must be taken into account that, as only a basic analysis on these issues has been carried out such a classification should be considered as preliminary.

2.1 OPERATIVE ISSUES

The following subsections list identified aspects which, in principle, only deal with the operation of FANS services, subdivided in two categories: "Air side" (i.e. those which probably deal with flight crew actions) and "Ground side" (i.e. those which probably deal with ATSPs).

- **<u>"Air side" issues</u>**

- Log-On received from aircraft that are not flying towards Canarias airspace. Different situations have been observed:
  - A/C Log-On received from aircraft that do not overfly Canarias airspace (i.e. during flight Canarias airspace is never overflown).
  - A/C Log-On received after aircraft have left Canarias airspace. Some of them did not connect to SACCAN during Canarias airspace overflight.

  According to the current ground system (SACCAN) configuration, all these cases imply the appearance in the HMI of flights that are not and will not be under the responsibility of the controller.

- A/C Log-On received when aircraft are flying far away from Canarias airspace (various hours before estimated time of entering Canarias airspace), prior to enter an airspace where ADS/CPDLC is operational. Afterwards, ADS and CPDLC applications are disconnected. Not in all cases aircraft logon again to SACCAN before entering Canarias airspace.

  Due to this, flights that are not under the responsibility of the controller appear in the HMI (due to current SACCAN configuration). Besides, taking into account that aircraft sent these Log-On prior to enter an airspace where ADS/CPDLC is operational, it might have happened that the connection with the corresponding control center had not been established.

- A/C Log-On with incorrect identification: It is detected that some aircraft log-on to SACCAN with incorrect identification. The following situations have been identified:
  - Aircraft that log-on with a two-letter company code in the Flight Identification instead of the expected three-letter code, as contained in the flight plan (i.e. "AAnnnn" instead of "AAAnnnn");
  - Aircraft that log-on with an incorrect three-letter company code in the Flight Identification;
  - Aircraft that log-on with an erroneous Flight Number;
  - Aircraft that log-on with an erroneous aircraft registration (one case detected during the year of the study).

  With a different SACCAN configuration, such situations would lead to a rejection of the corresponding Log-On. With the current one, it prevents involved flights from an appropriate flight plan correlation, leading to the appearance in the controller situation display of an ADS track with an incorrect identification along with a synthetic track (based on flight plan data) with the correct one.

- Reception of character-oriented applications messages (i.e. applications other than AFN, ADS CPDLC or "ACARS Free Text" messages) from aircraft, such as “Request Oceanic Clearance”(Oceanic Clearance application) or “Request ATIS Report” (ATIS application). This situation occurs in a monthly basis.

  SACCAN treats these messages as if they were “ACARS Free Text” messages. Consequently, if the message is the first one from the concerned aircraft, SACCAN records the aircraft with the flight ID associated to the message. This may lead to the rejection of any subsequent Log-On received while the aircraft is still registered in such a way, if the flight identification notified in the Log-On does not coincides with the one associated to the character-oriented application message.

- Aircraft not declaring ADS capacity in their flight plans have been detected connecting to SACCAN;

  Additionally, flights without CPDLC capability in the flight plan have established a CPDLC connection with SACCAN (Spanish AIC 7/12 requests the notification of ADS and CPDLC capabilities in the flight plan). Additionally, since the Amendment 1 to PANS-ATM (Doc. 4444) came into force, a significant number of aircraft declaring ADS capacity with ATN capabilities in their flight plans has been detected. As most of these aircraft have connected to SACCAN, in the analyses performed it has been considered that the ADS-C ATN declaration is in fact an error and it corresponds to ADS-C FANS aircraft actually Some aircraft remain ADS connected after exiting Canarias airspace and some of them even after landing (out of Canarias FIR), still sending reports when on ground.

➢ **“Ground side” issues**

- Flight Plans with incorrect aircraft registration (i.e. it does not match the one notified in the A/C Log-On), without any aircraft registration or with an incorrect Flight Identification (one case detected during the year of the study) are found in ground flight plan database. Log-On for such aircraft are currently accepted but, with a different SACCAN configuration, such situations would lead to their rejection.

- Uplink CPDLC connect requests replied by aircraft with a CPDLC disconnect request message notifying the aircraft is CPDLC connected to another ATS authority. This means that the authority requesting the CPDLC connection is neither the current data authority nor the authorized next data authority for the concerned aircraft when it receives the CPDLC connect request; therefore, the request is rejected. This situation may lead in some cases to the impossibility of having a timely CPDLC connection. Besides, it seems to evince that, sometimes, CPDLC connection termination when aircraft leave a FIR/UIR, where data link services are being provided, are not being properly managed.

- To minimize the occurrence of such situations it is important to follow bilateral agreements about data link transfers, or even review them if needed, in order to ensure an appropriate CPDLC connection with the next center during transfers.

- Sending of ACARS Free Text messages by controllers; in the considered year, almost always to FANS equipped aircraft with CPDLC link active and connected. Almost half of them have been notified as undelivered within the aircraft (a Type B message with Standard Message Identifier "REJ" (Undelivered Uplink Report) is received from the DSP for the corresponding ACARS message).

- "END SERVICE" CPDLC messages have been sent with additional message elements which response attribute is not Wilco/Unable. This should have resulted in an aircraft disconnection of the inactive CPDLC data link (next ATC center), if it existed, apart from the disconnection of the active CPDLC data link, as it is stated in paragraph 2.2.4.8.3.1 of "Global Operational Data Link Document", Second Edition.

2.2 TECHNICAL OR INTEROPERABILITY ISSUES

This subsection presents those issues that may entail some technical aspects or that concern the interaction of aircraft and ground systems. As former subsection, they are subdivided in categories: general (issues related to the global process or which are not specific to an application), ADS (those ones regarding the ADS functionality) and CPDLC (those ones concerning CPDLC). For issues in which avionics may be involved, no pattern (regarding e.g. aircraft model) has been identified for the time being.

➢ **General issues**

- Some AFN and CPDLC downlink messages are received including an issuing time stamp incoherent with ground clock: message time stamp is later than the time of reception. Some affected messages are CPDLC "Position Report" messages, in which "timeatpositioncurrent" field does not seem to be incoherent with ground clock. In the same way, there have been detected "AFN Response" messages with time stamp sooner than the time stamp of their corresponding "AFN Contact Advisory" message (which is set by the ground system). This is probably due to the same problem as the issue stated before.

- Uplink and downlink messages are being probably sent more than once by the Datalink Service Provider (DSP): around 0,5% of the downlink messages received on ground are duplicated downlink messages and, in the same way, some of the received downlink messages seem to be the consequence of uplink messages received on board more than once. The different situations observed have been discussed with SITA and the issue is periodically monitored by means of the coordination between SITA and Aena.

- In some cases, received Service Messages (SVCs) or Message Assurance (MAS) Failure messages do not seem to have a justification:
  - SVCs or MAS Failure of reason code 234, indicating that some messages can't be transmitted via SATCOM link because aircraft is not logged on, despite previous messages from aircraft having been received via SATCOM. This situation occurs in a monthly basis. The issue is periodically monitored by means of the coordination between SITA and Aena.
  - Some SVCs or MAS Failure were received to messages that require a subsequent response, being this response received afterwards. This situation occurs in a monthly basis.

- Messages with excessively high delays have been received for a limited number of aircraft. There have also been identified some intervals of time during which messages with excessively high delays have been received from almost all connected flights.

- Some communication/connection problems detected for some flights. SVCs or MAS Failure messages received for all uplink messages, preventing from a correct air/ground communication either totally or in some areas (e.g. where VHF coverage does not exist). These situations are periodically monitored by means of the coordination between SITA and Aena.

➢ **ADS issues**

- Different reports with different time stamps, even sometimes with a difference of some minutes, are sent together in the same ADS message, instead of being sent in different messages.
- Identical reports of Waypoint Change event are received within an ADS message (i.e. the same Waypoint Change event report appears more than once within the ADS message).
- ADS Acknowledgement messages (ACK messages) with a contract number not corresponding to any contract request demanded by the concerned ground system are received.
- ADS messages containing unasked optional groups, such as Air Reference and Meteorological, are received without being included by the ground system in the requested contract.
- ADS reports notifying FOM equal to zero (0) are received, coming either from aircraft already on ground or in flight. In this last case, there was always only one report with a FOM equal to zero (0) during the whole flight, reporting the rest of reports FOM values equal to 6 or 7.

➢ **CPDLC issues**

- Incorrect downlink CPDLC messages have been received:
- A CPDLC message element (DM48) with illogical data;
- A CPDLC message with more data than those indicated in the header of the message (header notifies the containment of a single CPDLC element, but after it more data are present).

- After sending a CPDLC Disconnect Request to some aircraft (after that, SACCAN considers the aircraft is CPDLC disconnected), it is detected that they continue sending downlink messages which correspond to the CPDLC application. The analysis of these situations has concluded that all of them correspond to B747-400 aircraft, which ignore uplink CPDLC Disconnect Request messages. It is an already known and documented behavior.

- Aircraft that do not accept CPDLC connection request messages after receiving an uplink CPDLC disconnect request message. The aircraft rejects the CPDLC connection by sending a downlink disconnect request message instead of a connection confirm message.

- "Insufficient Message Storage Capacity" error messages are received from B747-400 aircraft due to the reception on board of uplink CPDLC Freetext messages containing a text string superior to 80 characters. B747-400 aircraft do not accept text length over 80 characters, so they answer with a CPDLC error message. It is an already known and documented behavior.

A detailed document for the year 2013, based on records from the ADS/CPDLC System of the Canarias FIR (as there is no more data available) has been performed and titled “Analysis of FANS services in the EUR/SAM corridor 2013”. This document will be attached (Annex I) with a resumed presentation during FIT meeting.

The “Analysis of FANS services in the EUR/SAM corridor (Canarias Airspace) 2013 Report” will be also uploaded to SATMA web page (www.satmasat.com).

3. ACTION BY THE MEETING

The SAT/FIT/9 Meeting is invited to:

a) Analyze and discuss data to be send to the CFRA;
b) Follow scheduled periods for the data collection;
c) Discuss and establish actions regarding Annex I “Potential Problems Identified”;
d) Comment the “Analysis of FANS services in the EUR/SAM corridor 2013 Report”.

ANNEX I - ANALYSIS OF FANS SERVICES IN EUR/SAM 2013”

ANALYSIS OF FANS SERVICES IN THE EUR/SAM CORRIDOR (CANARIAS AIRSPACE) 2013 REPORT

APPROVALS

Prepared by:	Reviewed by:	Approved by:
Susana González Benito **Department of Research and Definition of Advanced Air Navigation Systems**	Mª. Mar Tabernero Serrano **Head of Department of Research and Definition of Advanced Air Navigation Systems**	Miguel Ángel Salamanca Bueno **Head of Navigation and Surveillance Division**

CHANGE RECORD

Issue	Date	Affected Pages	Changes
0.1	30/01/14	All	First draft version.
0.2	26/02/14	All	Second draft after internal review.
0.3	28/02/14	All	Third draft after internal review.
1.0	19/03/14	All	First Edition.

The Change Record reflects, at least, the last three modifications made in the document.

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4			
5			

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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., as well as a brief description of potential issues, to be further investigated and for which actions might be agreed, identified during the period of research.

This report is based on records from the ADS/CPDLC System of the Canarias FIR (SACCAN). For this analysis, data from January 2013 to December 2013 has been used in the study.
Data from SAL ACC and the FIR of ATLANTICO were also received. However, as they did not comprise a complete set of data[1], they could not be used in the statistics. Nevertheless, these data have been compared with those corresponding to Aena's and no major discrepancies have been detected. (For more details, see Appendix A: Cape Verde and Canarias Data Comparison).

For Canarias data analysis, "EUR/SAM Corridor flights" are considered as those flights either overflying EDUMO, TENPA, IPERA or GUNET, or flying those RANDOM routes with NELSO and/or ROSTA as route waypoints and with exit points at the south of Canarias airspace defined by coordinates.

Traffic data in this period are depicted in Table ES-1, where it can be appreciated that the amount of air traffic making use of FANS services (ADS/CPDLC) is quite stable and that nearly all FANS equipped aircraft connect to SACCAN, most of them performing CPDLC exchange. This table also evinces that traffic in the EUR/SAM Corridor using FANS services in 2013 was more than 55% of total traffic.

	2013 Mean Value	Max Value	Min Value
Number of connected flights (Monthly average)	1400	1518 [Jul]	1271 [Feb]
Percentage referred to total number of flights in the EUR/SAM Corridor	55,13%	57,66% [May]	52,80% [Nov]
Percentage referred to flights in the EUR/SAM Corridor indicating data link and ADS capacity in the Flight Plan	95,36%	97,80% [Sep]	93,42% [Jun]
Number of flights with CPDLC connection (Monthly average)	1335	1460 [Jul]	1204 [Nov]
Number of different aircraft (aircraft registration) connecting to SACCAN (Monthly average)	251	271 [Jul]	226 [Feb]

Table ES-1
Traffic data summary (2013)

Figure ES-1 shows, for the most significant airlines, 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.

[1] The data received from SAL ACC correspond to the Traffic and Performance Reports from the DSP (SITA) for the months of February and April. The data received from the FIR of ATLANTICO correspond to the total number of aircraft as well as the number of logged-on aircraft for each month and for each airway.

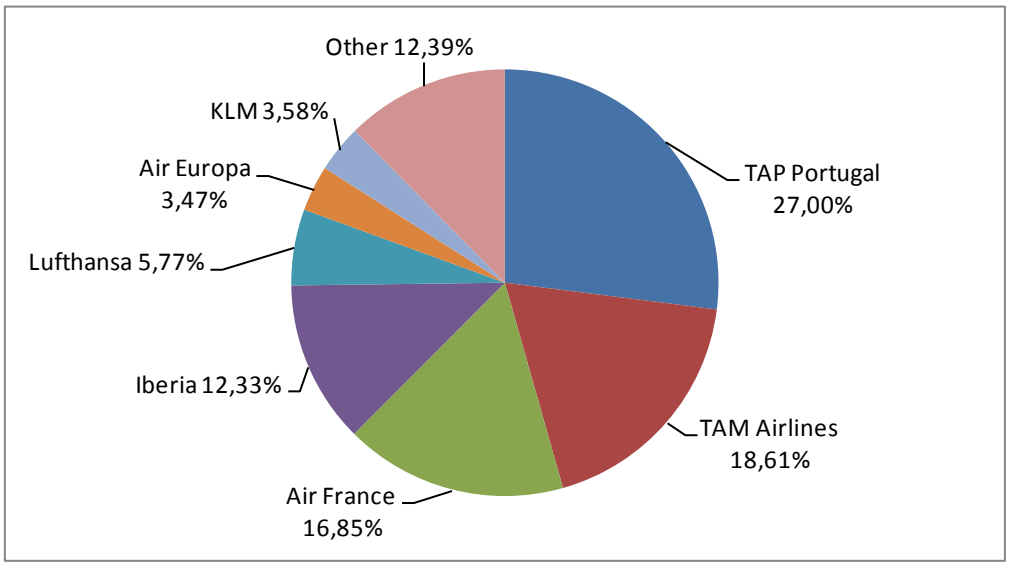

Figure ES-1
Average percentage of most significant airlines

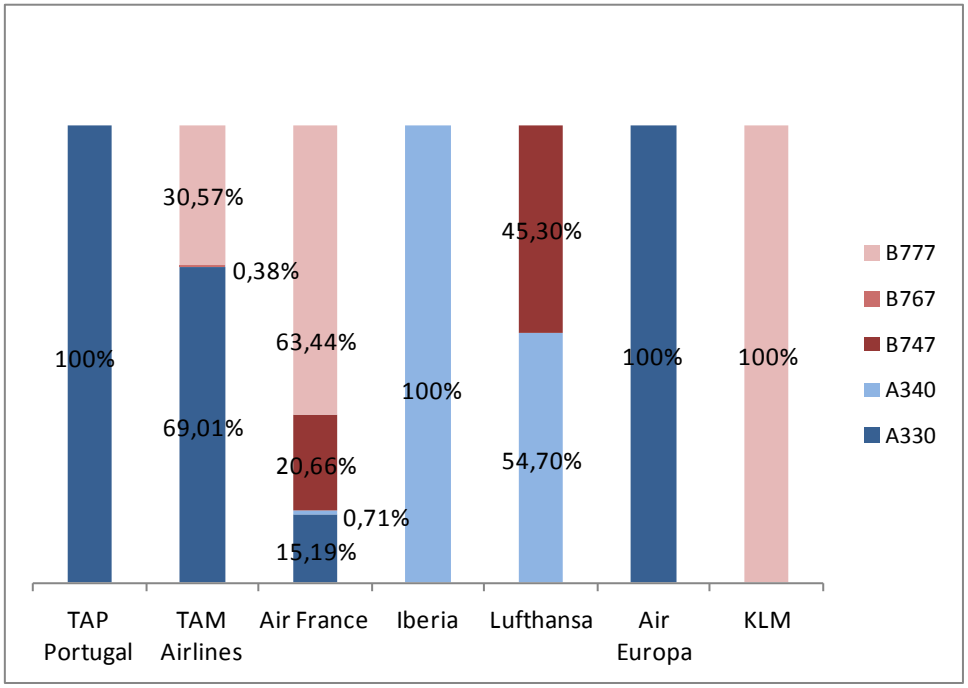

Figure ES-2
Different types of connected aircraft for the most significant airlines

With respect to ADS functionality, in the Canaries FIR a 15 minute periodic contract and an event contract (for waypoint change and 5 NM lateral deviation) are requested to all logged aircraft. Occasionally demand contracts, and non initial periodic and event contracts (very rarely including vertical rate change or altitude range events) have been also requested.

As far as ADS surveillance data accuracy is concerned, almost all (99,95%) of the analyzed ADS 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 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 (those representing more than 5% from the total number of transmitted elements in, at least, one month), on both uplink and downlink directions.

Type	Message element	Percentage referred to total		
		2013 Mean Value	Max Value	Min Value
UPLINK	NEXT DATA AUTHORITY [icaofacilitydesignation]	23,82%	25,82% [Jun]	21,35% [Dec]
	END SERVICE	18,91%	21,93% [Jan]	16,13% [Dec]
	CONTACT [icaounitname] [frequency]	18,87%	21,05% [Sep]	16,51% [Apr]
	[freetext][2]	16,32%	18,97% [Dec]	12,47% [Jan]
	SQUAWK [beaconcode]	10,75%	13,33% [Dec]	7,91% [Aug]
DOWNLINK	WILCO	43,52%	47,41% [Sep]	41,04% [Feb]
	ROGER	17,71%	20,80% [Jul]	13,84% [Jan]
	POSITION REPORT [positionreport]	12,71%	14,84% [Feb]	10,78% [Jun]
	[freetext][3]	7,72%	9,34% [Feb]	6,43% [Jan]
	DEVIATING [distanceoffset] [direction] OF ROUTE	6,36%	8,49% [Jan]	5,03% [Aug]

Table ES-2
Most frequent CPDLC message elements (2013)

Regarding data link media use for air-to-ground communications, data analysis shows that similar percentages are obtained for the different data link during all the analyzed months, being the utilization of satellite link above 65% of the times whilst VHF link is used for around 30%-35% of the air-to-ground transmissions. The HF link has been slightly used (about 0,07%).

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

[2] Both UM169 and UM170 uplink message elements are included.
[3] Both DM67 and DM68 downlink message elements are included.

Month	Downlink messages delay (seconds)	
	95% delays	99% delays
Jan 2013	42,553 s.	97,776 s.
Feb 2013	42,806 s.	97,882 s.
Mar 2013	49,196 s.	114,998 s.
Apr 2013	46,032 s.	100,075 s.
May 2013	44,052 s.	101,656 s.
Jun 2013	44,704 s.	91,796 s.
Jul 2013	42,983 s.	92,328 s.
Aug 2013	38,621 s.	85,338 s.
Sept 2013	40,541 s.	89,856 s.
Oct 2013	44,482 s.	91,401 s.
Nov 2013	49,927 s.	97,552 s.
Dec 2013	40 s.	85,561 s.

Table ES-3
Downlink (Air-to-ground) delays (AFN, CPDLC and ADS) (2013)

Finally, concerning FANS system upgrades, it is worth mentioning that some technical upgrades regarding the ADS tracking function were introduced in the SACCAN system in June 2013.

1. INTRODUCTION

The present report shows data relative to the performance and use of FANS services for the year 2013, 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 those flights either overflying EDUMO, TENPA, IPERA or GUNET, or flying those RANDOM routes with NELSO and/or ROSTA as route waypoints and with exit points at the south of Canarias airspace defined by coordinates (see Figure 1).

Conclusion SAT FIT7/6 assigned to SATMA the CFRA functions for the EUR/SAM Corridor. AENA, on behalf of SATMA, has carried out this analysis for the year 2013, which results are depicted in the present report.

As the provider responsible for ATS in Canarias, AENA monthly oversees FANS 1/A service in Canarias airspace. This report is the data summary of such monitoring activities for 2013 (from January 2013 to December 2013, both included), focusing on traffic overflying the EUR/SAM Corridor part lying in Canarias. Consequently, it only takes into account records from the ADS/CPDLC System of the Canarias FIR (SACCAN). This report describes the FANS services performance and use in terms of traffic data, data link utilization by aircraft, CPDLC exchange, etc., and includes a brief description of issues found during the research period.

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 SAL ACC and the FIR of ATLANTICO 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 Aena's and no major discrepancies have been detected. (For more details, see Appendix A: Cape Verde and Canarias Data Comparison).

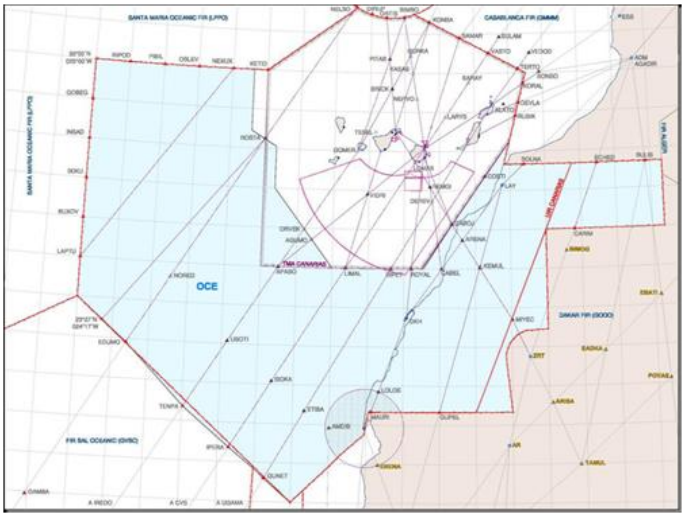

Figure 1
Canarias FIR / UIR

2. TRAFFIC ANALYSIS

This section presents data of traffic flying in the EUR/SAM corridor[4] and making use of FANS1/A services.

Table 1 shows a summary of the analyzed traffic in the EUR/SAM Corridor, from January to December 2013.

Traffic data					
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 capacity in the Flight Plan[5]**	**Number of flights with CPDLC connection**	**Number of different aircraft (aircraft registration) connecting to SACCAN**
Jan 2013	1508	54,34%	94,84%	1426	245
Feb 2013	1271	53,16%	96,29%	1214	226
Mar 2013	1449	54,43%	94,09%	1375	238
Apr 2013	1377	55,57%	94,06%	1330	249
May 2013	1426	57,66%	94,44%	1344	249
Jun 2013	1405	55,82%	93,42%	1333	252
Jul 2013	1518	56,43%	95,05%	1460	271
Aug 2013	1482	56,98%	95,98%	1431	250
Sep 2013	1422	57,38%	97,80%	1355	258
Oct 2013	1335	53,87%	93,88%	1271	252
Nov 2013	1273	52,80%	97,25%	1204	265
Dec 2013	1335	53,17%	97,23%	1282	257
Average (2013 Mean Value[6])	**1400**	**55,13%**	**95,36%**	**1335**	**251**

Table 1
Traffic data summary (2013)

As it can be inferred from the table above, more than 55% out of the total flights within the EUR/SAM Corridor connect to SACCAN (though percentage dropped down the first and the last trimester of the year), having connected nearly all of FANS equipped aircraft (around 95%). Also, the vast majority of logged-on flights connect to CPDLC application (between 94% and 96% of the logged-on flights). Finally,

[4] 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".

[5] It is to be noted that Flight Plan format was changed in November 2012 according to ICAO Amendment 1 to PANS-ATM. It has been detected that ADS-C capacity has not always been correctly reported since then (see section 6.1.1 for further details).

[6] Monthly average in the case of 'Number of connected flights', 'Number of flights with CPDLC connection' and 'Number of different aircraft connected to SACCAN'.

the number of aircraft (i.e. number of different aircraft registrations) flying over the EUR/SAM Corridor and making use of FANS services is between 226 and 271 per month.

The following table (Table 2) shows the percentage of connected flights for the most significant airlines. As it is shown, airlines with the highest number of connections in the EUR/SAM Corridor are TAP Portugal (about 25% in the first semester and raising up to a 27%-28% on average for the rest of the year) and TAM Airlines (around 20% in the first five months of the year, falling to a 14-17% during the next six months and with a slight recovery (around 18%) in the last month of the year), comprising near 50% out of the total connected flights between the two of them. The next ones, Air France and Iberia, are about 16% and 12% respectively. These four airlines (TAP Portugal, TAM Airlines, Air France and Iberia) comprise about 75% of the total number of connected flights. Adding Lufthansa, Air Europa and KLM to the previous four ones, percentage increases up to about 87%.

Month	Airline (% referred to connected flights)						
	TAP Portugal	TAM Airlines	Air France	Iberia	Lufthansa	Air Europa	KLM
Jan 2013	25,13%	24,40%	15,65%	12,67%	4,58%	2,06%	4,44%
Feb 2013	25,55%	21,62%	19,10%	12,26%	4,17%	3,77%	4,01%
Mar 2013	25,12%	20,43%	17,60%	12,97%	5,45%	3,04%	3,59%
Apr 2013	26,80%	21,06%	14,81%	13,73%	4,28%	2,90%	4,14%
May 2013	24,12%	20,48%	16,41%	12,62%	6,52%	2,52%	3,37%
Jun 2013	26,33%	17,15%	17,15%	13,31%	6,48%	3,84%	3,20%
Jul 2013	27,08%	17,79%	16,21%	12,65%	6,52%	4,74%	2,96%
Aug 2013	31,44%	15,72%	16,80%	10,46%	6,41%	4,18%	4,12%
Sep 2013	28,83%	14,21%	16,74%	12,03%	7,59%	4,01%	3,87%
Oct 2013	27,57%	16,03%	16,48%	13,03%	6,67%	3,60%	3,22%
Nov 2013	28,28%	15,71%	17,91%	11,39%	4,79%	3,30%	3,30%
Dec 2013	27,79%	18,43%	17,75%	10,79%	5,47%	3,67%	2,62%
Type of airplane (Average)	100% A330	69,01% A330 0,03% A340 30,57% B777 0,38% B767	15,19% A330 0,71% A340 20,66% B747 63,44% B777	100% A340	54,70% A340 45,30% B747	100% A330	100% B777

Table 2
Most significant airlines data (2013)

In the previous table, the percentage of different types of connected aircraft from these airlines (averaged along the analyzed year) is also represented, being all their connected aircraft either Airbus A330, Airbus A340, Boeing B747, Boeing B767 or Boeing B777. These airlines and aircraft percentages are also shown in Figure 2 and Figure 3.

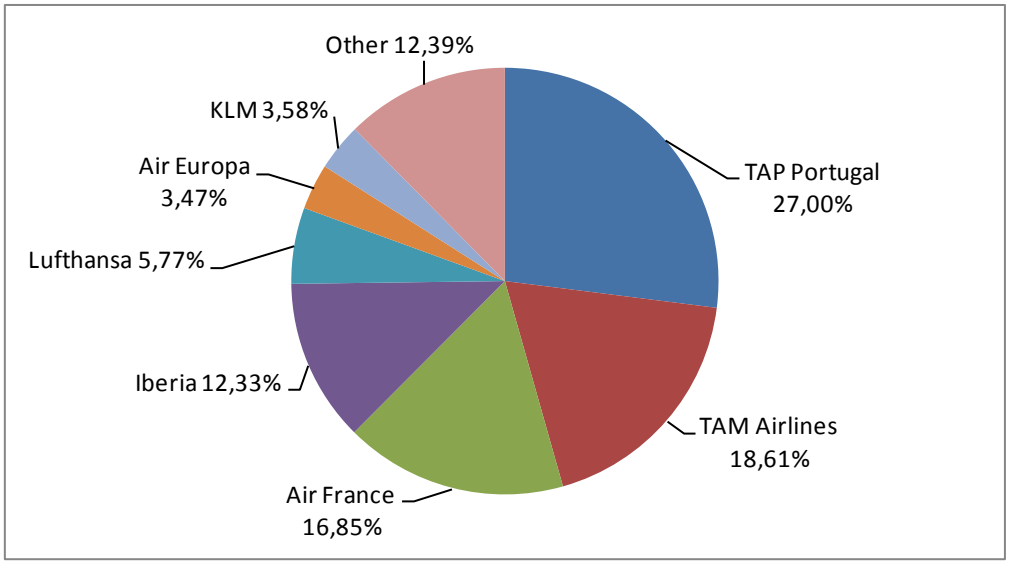

Figure 2
Average percentage of the most significant airlines

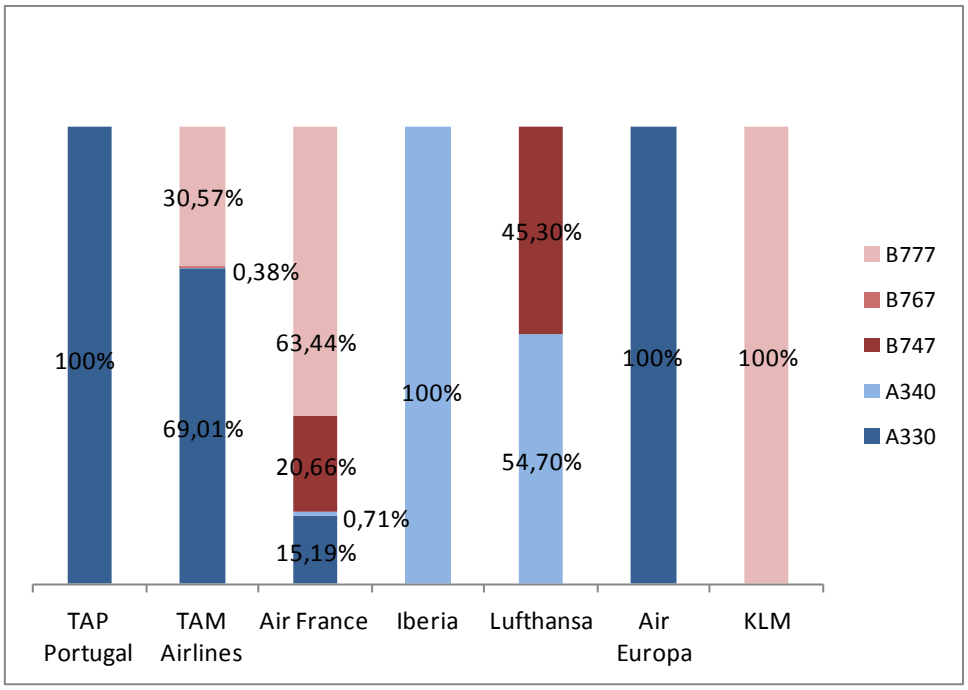

Figure 3
Different types of connected aircraft for the most significant airlines

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

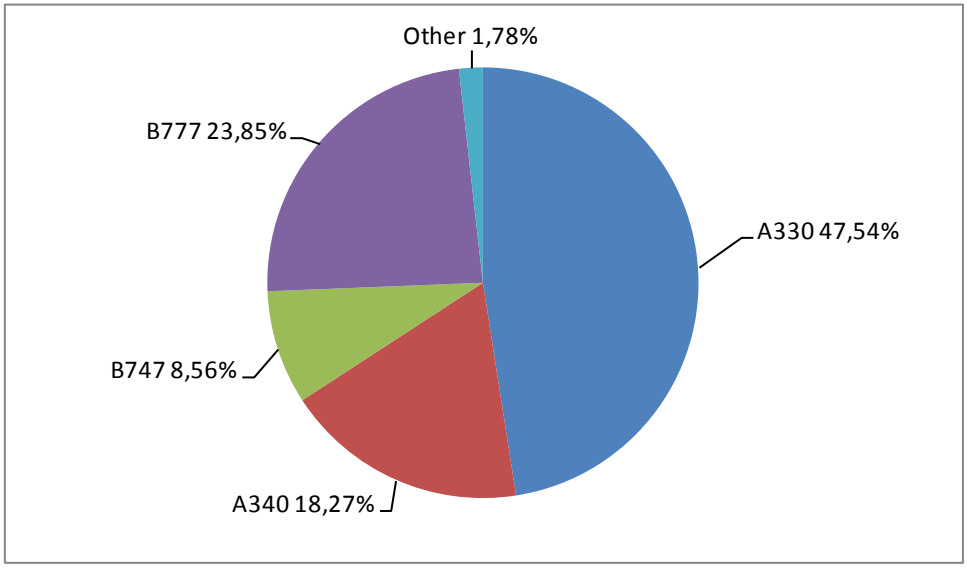

Figure 4
Total percentage of different types of connected aircraft

3. COMUNICATIONS NETWORK PERFORMANCE

The following subsections present the communications network performance, showing the data link media used, as well as the message delay percentages obtained for the months under study.

3.1 DATA LINK MEDIA

The percentage utilization value per data link media used for air-to-ground (i.e. downlink) communications is depicted in Table 3. It shows that the satellite link is primarily used (around 65% of the times), being the percentage of satellite usage slightly bigger at the beginning of the year.

Month	Percentage of utilization of data link media		
	Satellite Link	VHF Link	HF Link
Jan 2013	70,23%	29,68%	0,09%
Feb 2013	69,03%	30,91%	0,06%
Mar 2013	69,32%	30,64%	0,04%
Apr 2013	66,91%	32,93%	0,16%
May 2013	67,90%	32,03%	0,07%
Jun 2013	66,10%	33,82%	0,08%
Jul 2013	66,69%	33,17%	0,15%
Aug 2013	64,29%	35,66%	0,05%
Sept 2013	65,19%	34,74%	0,07%
Oct 2013	65,25%	34,73%	0,02%
Nov 2013	64,87%	35,08%	0,06%
Dec 2013	66,22%	33,73%	0,05%
Total Average	**66,86%**	**33,06%**	**0,07%**

Table 3
Percentage of data link utilization in 2013

3.2 AIR-TO-GROUND MESSAGES DELAYS

Percentage data for annual downlink messages delays, and annual maximum and minimum values are shown in Table 4, providing indication of the time elapsed in surveillance (ADS) 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 SACCAN) remain below, grouped by message type (AFN messages, ADS reports and CPDLC messages in an individual approach, as well as all messages altogether) and data link media (VHF, Satellite and Satellite, VHF and HF[7] together). As it is seen in Table 4 and Figure 5, 95% of calculated times are almost never greater than 60 seconds whilst 99% of calculated delays are usually well below 180 seconds. Figures are

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

not constant throughout the analyzed year but, generally speaking, there are not major differences from mean values except in rare cases. As expected, data largely depend on data link media, being satellite delays greater than VHF delays. For monthly percentage data for downlink messages delays, see "ANNEX I: Air-to-Ground Messages Delays per Month".

Parameter	2013 value	Max value [month]	Min value [month]
AFN messages			
95% VHF delay	20,882 s.	30,784 s. [Feb]	20,797 s. [Dec]
95% SAT delay	54,955 s.	61,271 s. [Sep]	46,426 s. [Feb]
95% Global delay	41,826 s.	51,056 s. [May]	37,118 s. [Aug]
99% VHF delay	53,567 s.	200,433 s. [Mar]	47,28 s. [Sep]
99% SAT delay	84,733 s.	115,237 s. [Sep]	84,766 s. [Dec]
99% Global delay	82,091 s.	107,026 s. [Mar]	81,818 s. [Aug]
ADS reports			
95% VHF delay	13,925 s.	25,601 s. [Jan]	13,926 s. [Dec]
95% SAT delay	61,784 s.	72,58 s. [Nov]	51,263 s. [Jan]
95% Global delay	40,037 s.	52,832 s. [Nov]	39,998 s. [Aug]
99% VHF delay	44,131 s.	104,307 s. [Mar]	44,136 s. [Dec]
99% SAT delay	90,090 s.	162,024 s. [Nov]	90,216 s. [Dec]
99% Global delay	86,823 s.	117,564 s. [Mar]	86,634 s. [Aug]
CPDLC AT			
95% VHF delay	23,972 s.	41,744 s. [Feb]	17,432 s. [Aug]
95% SAT delay	34,001 s.	43,694 s. [Oct]	27,225 s. [Aug]
95% Global delay	32,797 s.	40,48 s. [Oct]	25,374 s. [Aug]
99% VHF delay	52,161 s.	1611,467 s. [Feb]	40,52 s. [Sep]
99% SAT delay	83,168 s.	99,642 s. [Mar]	75,05 s. [Aug]
99% Global delay	82,853 s.	99,522 s. [Mar]	72,896 s. [Aug]

Parameter	2013 value	Max value [month]	Min value [month]
AFN, ADS reports and CPDLC AT			
95% VHF delay	16,079 s.	25,664 s. [Jan]	16,1 s. [Dec]
95% SAT delay	57,689 s.	68,096 s. [Nov]	49,768 s. [Jan]
95% Global delay	39,985 s.	49,927 s. [Nov]	38,621 s. [Aug]
99% VHF delay	47,014 s.	104,307 s. [Mar]	46,809 s. [Aug]
99% SAT delay	88,414 s.	117,564 s. [Mar]	88,488 s. [Dec]
99% Global delay	85,557 s.	114,998 s. [Mar]	85,338 s. [Aug]

Table 4
Delay parameters (January to December 2013)

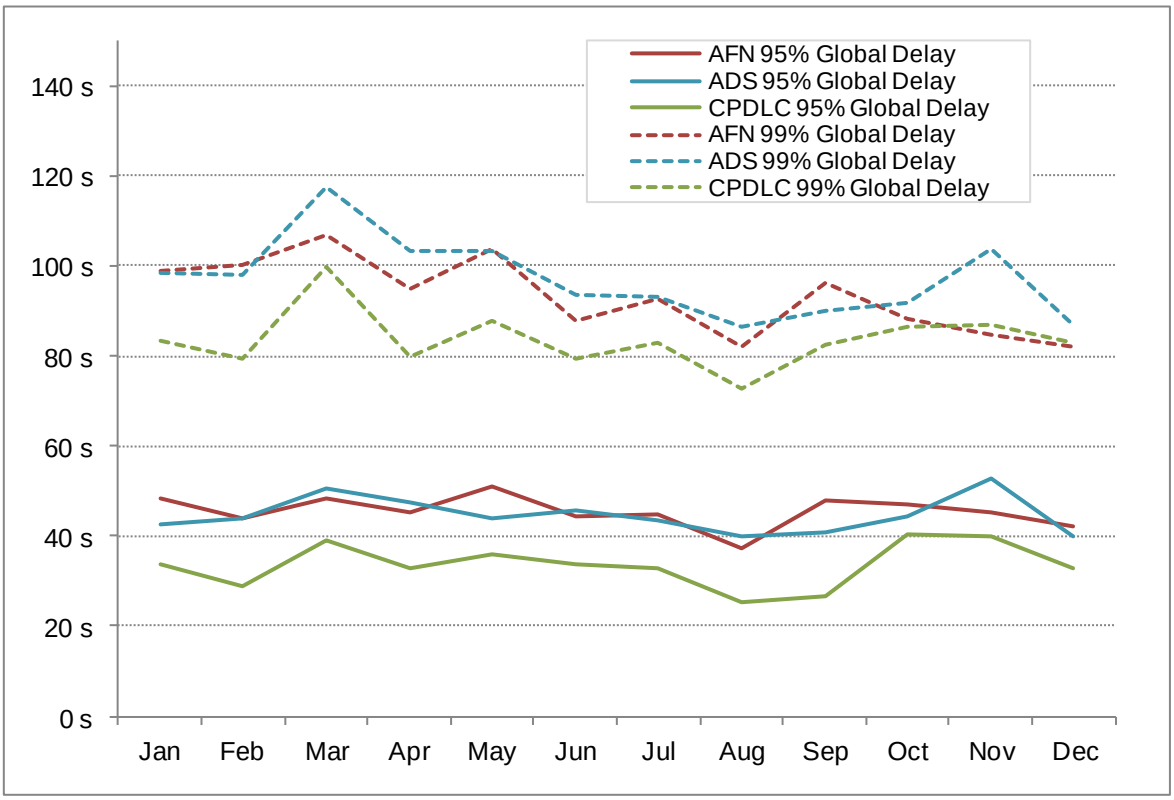

Figure 5
2013 Global monthly Delays

4. AUTOMATIC DEPENDENT SURVEILLANCE

4.1 ADS CONTRACT REQUESTS

In the Canaries FIR, initial ADS contracts are automatically set with every logged-on aircraft. These initial contracts consist of a 15 minute periodic contract, requesting the transmission of earth reference and predicted route groups with every periodic report, and an event contract including waypoint change and lateral deviation events, the latter with a 5 nautical miles threshold. Though new periodic or event contracts can be subsequently requested, it is seldom done. Event contracts including vertical rate change or altitude range events are very rarely established. Demand contracts are also requested (as part of 2013 SACCAN upgrades, new automatic demand contracts are requested. Therefore, 2013 figures for demand contract requests are larger than those for 2012).

Initial Contracts (monthly average)	Non initial contracts (monthly average)		
	Periodic	Event	Demand
1475	122	95	673

Table 5
ADS contract request (2013 monthly average)

Also, in 2013, an emergency contract has been requested to a flight (an emergency periodic contract). The CPDLC link was active and the dialogue did not show any unusual or emergency situation.

4.2 FIGURE OF MERIT (FOM) ANALYSIS

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

The cumulative percentage values per FOM figures in 2013 are shown in Table 6. The complete cumulative percentage values corresponding to FOM figures received for each month in 2013 are indicated in “ANNEX II: FOM Values per Month”.

FOM Figure	Annual cumulative percentage
FOM = 7 (Error < 0,05 NM)	2,48%
FOM ≥ 6 (Error < 0,25 NM)	99,95%
FOM ≥ 5 (Error < 1 NM)	99,96%
FOM ≥ 4 (Error < 4 NM)	99,97%
FOM ≥ 3 (Error < 8 NM)	100%
FOM ≥ 2 (Error < 15 NM)	100%
FOM ≥ 1 (Error < 30 NM)	100%
FOM ≥ 0[8]	100%

Table 6
FOM cumulative percentages (2013)

As can be seen on the table above, 99,95% of ADS 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%.

[8] Five reports with a FOM value equal to 0 have been received during the year of the study (see section 6.2.2).

5. CONTROLLER - PILOT DATA LINK COMUNICATIONS

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, as well as presenting the uplink and downlink percentage use per element types.

Table 7 and Table 8 show the percentage of the most frequently transmitted uplink and downlink CPDLC message elements with respect to the total of transmitted elements (only those elements with a usage greater than 5% in at least one month are presented in these two tables). For a complete table of the vast majority of transmitted CPDLC message elements (those that have been sent more than once at least in one month) see “ANNEX III: Transmitted CPDLC Message Elements per Month”.

Month	UL message element (percentage referred to total)				
	NEXT DATA AUTHORITY [icaofacilitydesignation]	END SERVICE	CONTACT [icaounitname] [frequency]	[freetext] (UMs 169 & 170)	SQUAWK [beaconcode]
Jan 2013	24,06%	21,93%	17,66%	12,47%	11,04%
Feb 2013	23,32%	21,60%	16,83%	16,23%	12,70%
Mar 2013	24,40%	17,98%	19,38%	15,91%	11,36%
Apr 2013	25,51%	16,71%	16,51%	17,30%	11,67%
May 2013	23,57%	18,00%	18,08%	18,63%	11,11%
Jun 2013	25,82%	20,65%	19,59%	14,58%	9,05%
Jul 2013	24,65%	20,01%	17,40%	17,43%	10,22%
Aug 2013	23,96%	19,56%	20,57%	15,72%	7,91%
Sept 2013	23,44%	17,82%	21,05%	14,75%	10,96%
Oct 2013	24,43%	18,76%	20,48%	16,38%	9,11%
Nov 2013	21,39%	17,98%	19,86%	17,70%	10,96%
Dec 2013	21,35%	16,13%	18,65%	18,97%	13,33%

Table 7
Uplink message elements transmitted (2013)

Month	DL message element (percentage referred to total)				
	WILCO	ROGER	POSITION REPORT [positionreport]	[freetext] (DMs 67 & 68)	DEVIATING [distanceoffset] [direction] OF ROUTE
Jan 2013	42,37%	13,84%	14,83%	6,43%	8,49%
Feb 2013	41,04%	14,95%	14,84%	9,34%	8,08%
Mar 2013	44,06%	15,71%	13,22%	8,43%	6,56%
Apr 2013	41,80%	18,30%	12,67%	8,45%	6,12%
May 2013	41,30%	20,29%	12,42%	7,25%	6,06%
Jun 2013	47,26%	18,44%	10,78%	6,84%	5,20%
Jul 2013	42,46%	20,80%	11,88%	7,20%	5,68%
Aug 2013	44,50%	18,41%	11,31%	8,71%	5,03%
Sept 2013	47,41%	16,42%	12,85%	6,47%	5,95%
Oct 2013	45,06%	19,99%	11,26%	6,82%	5,50%
Nov 2013	42,63%	18,24%	13,15%	7,84%	6,30%
Dec 2013	42,53%	17,34%	13,16%	8,61%	7,31%

Table 8
Downlink message elements transmitted (2013)

As it can be seen, the most frequent uplink message elements are those related to the address forwarding process ("NEXT DATA AUTHORITY [icaofacilitydesignation]" and "END SERVICE") followed by the "contact message" (uL117), the "freetext" element and the SQUAWK message.
For downlink elements, the most common ones are the responses "WILCO" and "ROGER", followed by the "Position Report"; the "freetext" element and the "lateral offset report" (dM80) are also usually transmitted though not as often as the other ones.

In addition to the aforementioned message elements, as shown in "ANNEX III: Transmitted CPDLC Message Elements per Month", "REQUEST [altitude]" and "REQUEST CLIMB TO [altitude]" are also frequent downlink message elements (2,77% and 3,23% on average, respectively). In the same line, "CLIMB TO AND MAINTAIN [altitude]" is consequently a frequent uplink message element (3,36% on average).

Tables of total percentage per types of message elements are shown below (Table 9 and Table 10).

Type	2013 value	Max value [month]	Min value [month]
Responses / Acknowledgements	1,06%	1,55% [Jan]	0,64% [Nov]
Vertical clearances	4,05%	4,55% [Mar]	3,22% [Sep]
Crossing constraints	0,02%	0,08% [Sep]	0,00% [8 months]
Lateral offsets	0,00%	0,04% [Dec]	0,00% [11 months]
Route modifications	0,26%	0,53% [Oct]	0,08% [Mar]
Speed Changes	0,06%	0,16% [Mar]	0,00% [4 months]
Contact / Monitor / Surveillance requests	30,56%	33,94% [Sep]	28,02% [Jul]
Report / Confirmation requests	2,90%	5,04% [Jan]	1,62% [Feb]
Negotiation requests	0,02%	0,07% [Jan]	0,00% [7 months]
Air Traffic advisories	0,01%	0,04% [Jan]	0,00% [9 months]
System management messages	44,60%	48,63% [Jun]	39,72% [Dec]
Additional messages	16,46%	19,11% [Dec]	12,62% [Jan]
TOTAL MESSAGE ELEMENTS	**2585 (monthly average)**	**2971 [Aug]**	**2157 [Feb]**

Table 9
Uplink message element type (2013)

Type	2013 value	Max value [month]	Min value [month]
Responses	61,57%	66,19% [Jun]	56,36% [Jan]
Vertical requests	6,54%	7,57% [Mar]	5,36% [Dec]
Lateral offsets requests	0,02%	0,16% [Oct]	0,00% [10 months]
Speed requests	0,14%	0,28% [Dec]	0,00% [Nov]
Voice contact requests	0,17%	0,47% [Nov]	0,00% [Jun]
Route modification requests	0,64%	1,26% [Dec]	0,33% [Feb]
Reports	21,44%	27,55% [Jan]	18,09% [Oct]
Negotiation requests	0,10%	0,26% [May]	0,00% [Oct]
Emergency messages	0,00%	N/A	N/A
System management messages	0,25%	0,43% [Aug]	0,10% [Jul]
Additional messages	9,11%	11,21% [Feb]	7,65% [Jan]
TOTAL MESSAGE ELEMENTS	**2072 (monthly average)**	**2462 [Dec]**	**1820 [Feb]**

Table 10
Downlink message element type (2013)

6. POTENTIAL PROBLEMS IDENTIFIED

This section presents a brief summary of those issues identified during data analysis of aircraft connected to SACCAN (Canarias ACC) during 2013 and that should be further analyzed by the relevant stakeholders in the context of the CFRA. Though issues have been detected through SACCAN records analysis, they are considered of generic nature. The different issues are presented in a totally anonymous manner; therefore, no company, aircraft type, etc. are mentioned in any way. It is to be noticed that almost all of them were already identified during previous analysis (2011 and/or 2012).

Issues have been allocated to the following categories: operational (operative) and technical or related to interoperability. However, it must be taken into account that, as only a basic analysis on these issues has been carried out, such a classification should be considered as preliminary.

6.1 OPERATIVE ISSUES

The following subsections list identified aspects which, in principle, only deal with the operation of FANS services, subdivided in two categories: “Air side” (i.e. those which probably deal with flight crew actions) and “Ground side” (i.e. those which probably deal with ATSPs).

6.1.1 “Air side” issues

- Log-On received from aircraft that are not flying towards Canarias airspace. Different situations have been observed:
  - A/C Log-On received from aircraft that do not overfly Canarias airspace (i.e. during flight Canarias airspace is never overflown).
  - A/C Log-On received after aircraft have left Canarias airspace. Some of them did not connect to SACCAN during Canarias airspace overflight.

  According to the current ground system (SACCAN) configuration, all these cases imply the appearance in the HMI of flights that are not and will not be under the responsibility of the controller.

- A/C Log-On received when aircraft are flying far away from Canarias airspace (various hours before estimated time of entering Canarias airspace), prior to enter an airspace where ADS/CPDLC is operational. Afterwards, ADS and CPDLC applications are disconnected. Not in all cases aircraft log on again to SACCAN before entering Canarias airspace.
  Due to this, flights that are not under the responsibility of the controller appear in the HMI (due to current SACCAN configuration). Besides, taking into account that aircraft sent these Log-On prior to enter an airspace where ADS/CPDLC is operational, it might have happened that the connection with the corresponding control center had not been established.

- A/C Log-On with incorrect identification: It is detected that some aircraft log-on to SACCAN with incorrect identification. The following situations have been identified:
  - Aircraft that log-on with a two-letter company code in the Flight Identification instead of the expected three-letter code, as contained in the flight plan (i.e. “AAnnnn” instead of “AAAnnnn”);
  - Aircraft that log-on with an incorrect three-letter company code in the Flight Identification;
  - Aircraft that log-on with an erroneous Flight Number;

- Aircraft that log-on with an erroneous aircraft registration (one case detected during the year of the study).

With a different SACCAN configuration, such situations would lead to a rejection of the corresponding Log-On. With the current one, it prevents involved flights from an appropriate flight plan correlation, leading to the appearance in the controller situation display of an ADS track with an incorrect identification along with a synthetic track (based on flight plan data) with the correct one.

- Reception of character-oriented applications messages (i.e. applications other than AFN, ADS, CPDLC or "ACARS Free Text" messages) from aircraft, such as “Request Oceanic Clearance” (Oceanic Clearance application) or “Request ATIS Report” (ATIS application). This situation occurs in a monthly basis.
  SACCAN treats these messages as if they were “ACARS Free Text” messages. Consequently, if the message is the first one from the concerned aircraft, SACCAN records the aircraft with the flight ID associated to the message. This may lead to the rejection of any subsequent Log-On received while the aircraft is still registered in such a way, if the flight identification notified in the Log-On does not coincides with the one associated to the character-oriented application message.

- Aircraft not declaring ADS capacity in their flight plans have been detected connecting to SACCAN; additionally, flights without CPDLC capability in the flight plan have established a CPDLC connection with SACCAN (Spanish AIC 7/12 requests the notification of ADS and CPDLC capabilities in the flight plan).
  Additionally, since the Amendment 1 to PANS-ATM (Doc. 4444) came into force, a significant number of aircraft declaring ADS capacity with ATN capabilities in their flight plans has been detected. As most of these aircraft have connected to SACCAN, in the analyses performed it has been considered that the ADS-C ATN declaration is in fact an error and it corresponds to ADS-C FANS aircraft actually,

- Some aircraft remain ADS connected after exiting Canarias airspace and some of them even after landing (out of Canarias FIR), still sending reports when on ground.

6.1.2 “Ground side” issues

- Flight Plans with incorrect aircraft registration (i.e. it does not match the one notified in the A/C Log-On), without any aircraft registration or with an incorrect Flight Identification (one case detected during the year of the study) are found in ground flight plan database. Log-On for such aircraft are currently accepted but, with a different SACCAN configuration, such situations would lead to their rejection.

- Uplink CPDLC connect requests replied by aircraft with a CPDLC disconnect request message notifying the aircraft is CPDLC connected to another ATS authority. This means that the authority requesting the CPDLC connection is neither the current data authority nor the authorized next data authority for the concerned aircraft when it receives the CPDLC connect request; therefore, the request is rejected. This situation may lead in some cases to the impossibility of having a timely CPDLC connection. Besides, it seems to evince that, sometimes, CPDLC connection termination

when aircraft leave a FIR/UIR, where data link services are being provided, are not being properly managed.
To minimize the occurrence of such situations it is important to follow bilateral agreements about data link transfers, or even review them if needed, in order to ensure an appropriate CPDLC connection with the next center during transfers.

- Sending of ACARS Free Text messages by controllers; in the considered year, almost always to FANS equipped aircraft with CPDLC link active and connected. Almost half of them have been notified as undelivered within the aircraft (a Type B message with Standard Message Identifier “REJ” (Undelivered Uplink Report) is received from the DSP for the corresponding ACARS message).

- “END SERVICE” CPDLC messages have been sent with additional message elements which response attribute is not Wilco/Unable. This should have resulted in an aircraft disconnection of the inactive CPDLC data link (next ATC center), if it existed, apart from the disconnection of the active CPDLC data link, as it is stated in paragraph 2.2.4.8.3.1 of “Global Operational Data Link Document”, Second Edition.

6.2 TECHNICAL OR INTEROPERABILITY ISSUES

This subsection presents those issues that may entail some technical aspects or that concern the interaction of aircraft and ground systems. As former subsection, they are subdivided in categories: general (issues related to the global process or which are not specific to an application), ADS (those ones regarding the ADS functionality) and CPDLC (those ones concerning CPDLC). For issues in which avionics may be involved, no pattern (regarding e.g. aircraft model) has been identified for the time being.

6.2.1 General issues

- Some AFN and CPDLC downlink messages are received including an issuing time stamp incoherent with ground clock: message time stamp is later than the time of reception. Some affected messages are CPDLC “Position Report” messages, in which “timeatpositioncurrent” field does not seem to be incoherent with ground clock.
  In the same way, there have been detected “AFN Response” messages with time stamp sooner than the time stamp of their corresponding “AFN Contact Advisory” message (which is set by the ground system). This is probably due to the same problem as the issue stated before.

- Uplink and downlink messages are being probably sent more than once by the Datalink Service Provider (DSP): around 0,5% of the downlink messages received on ground are duplicated downlink messages and, in the same way, some of the received downlink messages seem to be the consequence of uplink messages received on board more than once. The different situations observed have been discussed with SITA and the issue is periodically monitored by means of the coordination between SITA and Aena.

- In some cases, received Service Messages (SVCs) or Message Assurance (MAS) Failure messages do not seem to have a justification:
  - SVCs or MAS Failure of reason code 234, indicating that some messages can't be transmitted via SATCOM link because aircraft is not logged on, despite previous messages from aircraft having been received via SATCOM. This situation occurs in a monthly basis. The issue is periodically monitored by means of the coordination between SITA and Aena.
  - Some SVCs or MAS Failure were received to messages that require a subsequent response, being this response received afterwards. This situation occurs in a monthly basis.

- Messages with excessively high delays have been received for a limited number of aircraft. There have also been identified some intervals of time during which messages with excessively high delays have been received from almost all connected flights.

- Some communication/connection problems detected for some flights. SVCs or MAS Failure messages received for all uplink messages, preventing from a correct air/ground communication either totally or in some areas (e.g. where VHF coverage does not exist). These situations are periodically monitored by means of the coordination between SITA and Aena.

6.2.2 ADS issues

- Different reports with different time stamps, even sometimes with a difference of some minutes, are sent together in the same ADS message, instead of being sent in different messages.

- Identical reports of Waypoint Change event are received within an ADS message (i.e. the same Waypoint Change event report appears more than once within the ADS message).

- ADS Acknowledgement messages (ACK messages) with a contract number not corresponding to any contract request demanded by the concerned ground system are received.

- ADS messages containing unasked optional groups, such as Air Reference and Meteorological, are received without being included by the ground system in the requested contract.

- ADS reports notifying FOM equal to zero (0) are received, coming either from aircraft already on ground or in flight. In this last case, there was always only one report with a FOM equal to zero (0) during the whole flight, reporting the rest of reports FOM values equal to 6 or 7.

6.2.3 CPDLC issues

- Incorrect downlink CPDLC messages have been received:
  - A CPDLC message element (DM48) with illogical data;
  - A CPDLC message with more data than those indicated in the header of the message (header notifies the containment of a single CPDLC element, but after it more data are present).

- After sending a CPDLC Disconnect Request to some aircraft (after that, SACCAN considers the aircraft is CPDLC disconnected), it is detected that they continue sending downlink messages which

correspond to the CPDLC application. The analysis of these situations has concluded that all of them correspond to B747-400 aircraft, which ignore uplink CPDLC Disconnect Request messages. It is an already known and documented behavior.

- Aircraft that do not accept CPDLC connection request messages after receiving an uplink CPDLC disconnect request message. The aircraft rejects the CPDLC connection by sending a downlink disconnect request message instead of a connection confirm message.

- "Insufficient Message Storage Capacity" error messages are received from B747-400 aircraft due to the reception on board of uplink CPDLC Freetext messages containing a text string superior to 80 characters. B747-400 aircraft do not accept text length over 80 characters, so they answer with a CPDLC error message. It is an already known and documented behavior.

7. CONCLUSIONS

From the analysis of 2013 data, it can be concluded that:

- As far as aircraft using FANS services is concerned, more than 55% of the EUR/SAM Corridor flights (Canarias area) connect to SACCAN (95% of flights notifying FANS equipage in its flight plan connect to SACCAN). It represents a slight decrease from 2012.
- CPDLC information is interchanged with the vast majority of connected aircraft (about 95%).
- Major users of FANS services are TAP Portugal, TAM Airlines, Air France and Iberia: same top four with the same order than in 2012. During 2013 TAP Portugal has reinforced its first position.
- With regard to downlink messages delay, on average more than 95% of the times they are 60 second or below. 99% delays figures are usually well below 180s. In these two cases, both per media and globally.
- Position accuracy notified in ADS-C reports is not worse than 0.25 NM 99.95% of the times (i.e. 99.95% 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 address forwarding process (NEXT DATA AUTHORITY and END SERVICE) have been the most used by controllers, representing a percentage of about 43% of the total.
  - For downlink elements, more than 60% of message elements received belong to the response elements group (being the message elements WILCO and ROGER the most used by pilots). The second most used message group (Reports) is about 21%.
- Several issues (either operative, technical or involving interaction between aircraft and ground systems), have been detected and listed in the report. Most of them were already identified during previous analysis, but there are also some new ones. Coordination between stakeholders should be established in order to appropriately investigate them.

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
AENA	Aeropuertos Españoles y Navegación Aérea
AFN	ATS Facilities Notification
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
RGS	Remote Ground Station
SACCAN	Sistema ADS/CPDLC en el FIR Canarias (ADS/CPDLC System in the Canarias FIR)
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

ANNEX I: AIR-TO-GROUND MESSAGES DELAYS PER MONTH

The following table shows the delay values split up into each month of 2013.

Parameter	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
AFN messages												
95% VHF delay	25,915 s	30,784 s	29,866 s	22,368 s	24,080 s	24,928 s	28,404 s	24,424 s	25,456 s	24,754 s	24,524 s	20,797 s
95% SAT delay	54,576 s	46,426 s	57,724 s	56,448 s	60,620 s	52,908 s	51,134 s	46,552 s	61,271 s	58,048 s	57,092 s	55,308 s
95% ALL delay	48,292 s	43,872 s	48,354 s	45,176 s	51,056 s	44,271 s	44,775 s	37,118 s	47,988 s	46,845 s	45,442 s	42,113 s
99% VHF delay	149,240 s	98,416 s	200,433 s	58,363 s	98,264 s	58,532 s	52,916 s	48,908 s	47,28 s	53,028 s	52,181 s	54,216 s
99% SAT delay	98,928 s	104,368 s	100,916 s	95,064 s	105,464 s	90,851 s	96,548 s	84,99 s	115,237 s	91,401 s	86,82 s	84,766 s
99% ALL delay	98,938 s	100,144 s	107,026 s	94,998 s	103,919 s	87,676 s	92,771 s	81,818 s	96,16 s	88,18 s	84,88 s	82,112 s
ADS reports												
95% VHF delay	25,601 s	23,383 s	20,802 s	20,963 s	15,004 s	20,844 s	19,686 s	16,784 s	17,238 s	19,178 s	18,872 s	13,926 s
95% SAT delay	51,263 s	57,424 s	69,480 s	64,543 s	60,732 s	62,18 s	56,583 s	60,094 s	58,396 s	68,162 s	72,58 s	61,792 s
95% ALL delay	42,719 s	43,824 s	50,451 s	47,276 s	43,824 s	45,498 s	43,606 s	39,998 s	40,932 s	44,493 s	52,832 s	40,062 s
99% VHF delay	66,189 s	71,846 s	104,307 s	69,248 s	48,868 s	53,464 s	56,499 s	46,228 s	48,899 s	50,244 s	51,024 s	44,136 s
99% SAT delay	100,832 s	102,253 s	119,712 s	105,734 s	110,804 s	99,995 s	97,544 s	93,672 s	99,044 s	96,859 s	162,024 s	90,216 s
99% ALL delay	98,556 s	97,792 s	117,564 s	103,080 s	103,251 s	93,528 s	92,922 s	86,634 s	89,824 s	91,741 s	103,608 s	86,916 s

Parameter	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
CPDLC AT												
95% VHF delay	26,010 s	41,744 s	22,918 s	27,504 s	31,664 s	25,824 s	23,551 s	17,432 s	19,264 s	26,32 s	25,007 s	23,976 s
95% SAT delay	34,454 s	27,638 s	41,612 s	33,435 s	39,398 s	36,699 s	36,58 s	27,225 s	28,174 s	43,694 s	41,76 s	33,972 s
95% ALL delay	33,720 s	29,014 s	39,048 s	32,916 s	36,063 s	33,776 s	32,725 s	25,374 s	26,723 s	40,48 s	39,911 s	32,8 s
99% VHF delay	55,388 s	1611,467 s	86,257 s	49,740 s	84,038 s	54,044 s	62,86 s	47,534 s	40,52 s	54,916 s	61,04 s	52,587 s
99% SAT delay	84,824 s	76,712 s	99,642 s	85,241 s	87,816 s	80,684 s	84,135 s	75,05 s	83,168 s	95,132 s	88,061 s	83,159 s
99% ALL delay	83,502 s	79,236 s	99,522 s	79,912 s	87,568 s	79,395 s	82,862 s	72,896 s	82,648 s	86,27 s	87,092 s	83,033 s
AFN, ADS reports and CPDLC AT												
95% VHF delay	25,664 s	25,328 s	22,262 s	21,832 s	16,184 s	21,784 s	21,856 s	17,512 s	17,573 s	20,696 s	20,587 s	16,1 s
95% SAT delay	49,768 s	52,049 s	63,742 s	59,636 s	58,554 s	58,208 s	52,976 s	52,655 s	55,144 s	62,922 s	68,096 s	57,806 s
95% ALL delay	42,553 s	42,806 s	49,196 s	46,032 s	44,052 s	44,704 s	42,983 s	38,621 s	40,541 s	44,482 s	49,927 s	40 s
99% VHF delay	68,048 s	74,555 s	104,307 s	69,052 s	53,206 s	54,044 s	56,431 s	46,809 s	48,209 s	50,474 s	52,192 s	47,102 s
99% SAT delay	99,455 s	100,190 s	117,564 s	103,243 s	108,418 s	97,56 s	96,648 s	90,433 s	97,374 s	96,088 s	117,188 s	88,488 s
99% ALL delay	97,776 s	97,882 s	114,998 s	100,075 s	101,656 s	91,796 s	92,328 s	85,338 s	89,856 s	91,401 s	97,552 s	85,561 s

Table 11
Monthly delay parameters (January to December 2013)

ANNEX II: FOM VALUES PER MONTH

This table presents the cumulative percentages for the FOM parameter, divided into each month of 2013.

FOM	Percentage referred to total											
	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
FOM = 7 (Error < 0,05 NM)	1,50%	2,37%	4,10%	2,53%	3,70%	2,03%	2,06%	0,62%	1,22%	2,77%	4,08%	3,14%
FOM ≥ 6 (Error < 0,25 NM)	99,90%	99,85%	99,96%	99,98%	100,00%	100,00%	99,80%	99,90%	99,99%	99,99%	99,99%	99,99%
FOM ≥ 5 (Error < 1 NM)	99,92%	99,93%	99,96%	99,99%	100,00%	100,00%	99,82%	99,95%	99,99%	100,00%	99,99%	99,99%
FOM ≥ 4 (Error < 4 NM)	99,95%	99,95%	99,99%	100,00%	100,00%	100,00%	99,84%	99,99%	99,99%	100,00%	99,99%	99,99%
FOM ≥ 3 (Error < 8 NM)	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	99,99%	99,99%	99,99%	100,00%	99,99%	99,99%
FOM ≥ 2 (Error < 15 NM)	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	99,99%	99,99%	99,99%	100,00%	99,99%	99,99%
FOM ≥ 1 (Error < 30 NM)	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	99,99%	100,00%	99,99%	100,00%	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 12
Monthly FOM values (January to December 2013)

ANNEX III: TRANSMITTED CPDLC MESSAGE ELEMENTS PER MONTH

Table 13 and Table 14 show the percentage of the vast majority of transmitted uplink and downlink CPDLC message elements with respect to the total of transmitted elements (the message elements presented are those that have been utilized more than once at least in one month).

Uplink message element	Percentage referred to total uplink message elements in the month											
	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
UNABLE	0,26%	0,19%	0,27%	0,20%	0,17%	0,20%	0,22%	0,30%	0,04%	0,33%	0,24%	0,14%
STANDBY	0,63%	0,56%	0,51%	0,86%	0,46%	0,27%	0,51%	0,47%	0,49%	0,41%	0,28%	0,57%
ROGER	0,55%	0,19%	0,16%	0,31%	0,38%	0,27%	0,07%	0,07%	0,08%	0,12%	0,08%	0,43%
AFFIRM	0,04%	0,09%	0,12%	0,08%	0,04%	0,00%	0,04%	0,00%	0,00%	0,04%	0,00%	0,11%
NEGATIVE	0,07%	0,14%	0,16%	0,00%	0,08%	0,04%	0,04%	0,03%	0,11%	0,08%	0,04%	0,00%
EXPECT CLIMB AT [position]	0,04%	0,00%	0,00%	0,04%	0,13%	0,00%	0,00%	0,00%	0,00%	0,00%	0,04%	0,00%
MAINTAIN [altitude]	0,37%	0,37%	0,62%	0,90%	0,72%	0,27%	0,36%	0,44%	0,42%	0,45%	0,64%	0,74%
CLIMB TO AND MAINTAIN [altitude]	3,83%	3,20%	3,77%	3,34%	3,51%	3,45%	3,55%	3,77%	2,58%	3,08%	3,13%	3,05%
DESCEND TO AND MAINTAIN [altitude]	0,04%	0,09%	0,04%	0,08%	0,00%	0,04%	0,00%	0,03%	0,04%	0,04%	0,08%	0,07%
CRUISE CLIMB TO [altitude]	0,00%	0,00%	0,08%	0,00%	0,08%	0,00%	0,04%	0,10%	0,11%	0,00%	0,08%	0,04%
PROCEED DIRECT TO [position]	0,11%	0,09%	0,08%	0,12%	0,08%	0,16%	0,47%	0,34%	0,34%	0,45%	0,48%	0,18%
CONTACT [icaounitname] [frequency]	17,66%	16,83%	19,38%	16,51%	18,08%	19,59%	17,40%	20,57%	21,05%	20,48%	19,86%	18,65%
AT [position] CONTACT [icaounitname] [frequency]	0,22%	0,28%	0,31%	0,75%	0,08%	0,67%	0,36%	0,88%	1,18%	0,37%	0,20%	0,21%
MONITOR [icaounitname] [frequency]	0,37%	0,23%	1,05%	0,94%	0,17%	0,12%	0,04%	0,47%	0,76%	0,57%	0,48%	0,43%
SQUAWK [beaconcode]	11,04%	12,70%	11,36%	11,67%	11,11%	9,05%	10,22%	7,91%	10,96%	9,11%	10,96%	13,33%

Uplink message element	Percentage referred to total uplink message elements in the month											
	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
REPORT LEVEL [altitude]	0,04%	0,00%	0,04%	0,00%	0,00%	0,00%	0,00%	0,10%	0,00%	0,00%	0,00%	0,07%
REPORT PASSING [position]	4,12%	0,88%	0,35%	0,51%	1,48%	1,21%	1,63%	1,11%	1,78%	0,99%	2,25%	1,49%
CONFIRM ALTITUDE	0,07%	0,09%	0,12%	0,28%	0,04%	0,00%	0,18%	0,20%	0,00%	0,00%	0,16%	0,07%
CONFIRM SPEED	0,40%	0,32%	0,74%	1,38%	0,76%	0,94%	0,58%	1,55%	0,76%	0,37%	0,44%	0,50%
CONFIRM ASSIGNED ROUTE	0,04%	0,14%	0,00%	0,04%	0,04%	0,04%	0,00%	0,03%	0,00%	0,00%	0,00%	0,04%
CONFIRM NEXT WAYPOINT ETA	0,04%	0,00%	0,00%	0,12%	0,00%	0,00%	0,00%	0,03%	0,08%	0,00%	0,04%	0,00%
REQUEST POSITION REPORT	0,29%	0,19%	0,66%	0,12%	0,21%	0,31%	0,36%	0,40%	0,80%	0,45%	0,36%	0,60%
WHEN CAN YOU ACCEPT [altitude]	0,07%	0,00%	0,04%	0,00%	0,00%	0,00%	0,00%	0,03%	0,00%	0,04%	0,00%	0,00%
ERROR [errorInformation]	0,92%	1,81%	1,36%	1,81%	1,94%	2,16%	1,63%	1,48%	1,90%	2,75%	2,65%	2,23%
NEXT DATA AUTHORITY [icaofacilitydesignation]	24,06%	23,32%	24,40%	25,51%	23,57%	25,82%	24,65%	23,96%	23,44%	24,43%	21,39%	21,35%
END SERVICE	21,93%	21,60%	17,98%	16,71%	18,00%	20,65%	20,01%	19,56%	17,82%	18,76%	17,98%	16,13%
DUE TO TRAFFIC	0,15%	0,19%	0,12%	0,08%	0,00%	0,08%	0,04%	0,17%	0,08%	0,08%	0,20%	0,07%
DISREGARD	0,00%	0,09%	0,04%	0,04%	0,08%	0,04%	0,04%	0,03%	0,00%	0,00%	0,04%	0,00%
[freetext]	12,47%	16,23%	15,91%	17,30%	18,63%	14,58%	17,43%	15,72%	14,75%	16,38%	17,70%	18,97%
REPORT REACHING [altitude]	0,04%	0,00%	0,00%	0,08%	0,00%	0,00%	0,00%	0,07%	0,08%	0,00%	0,04%	0,11%
REPORT DISTANCE [tofrom] [position]	0,00%	0,00%	0,08%	0,00%	0,04%	0,00%	0,04%	0,03%	0,00%	0,00%	0,00%	0,00%

Table 13
Percentage of uplink message elements transmitted for each month in the phase of study (2013)

Downlink message element	Percentage referred to total downlink message elements in the month											
	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
WILCO	42,37%	41,04%	44,06%	41,80%	41,30%	47,26%	42,46%	44,50%	47,41%	45,06%	42,63%	42,53%
UNABLE	0,05%	0,16%	0,05%	0,10%	0,10%	0,22%	0,10%	0,09%	0,19%	0,05%	0,14%	0,16%
STANDBY	0,09%	0,27%	0,14%	0,19%	0,31%	0,27%	0,14%	0,09%	0,29%	0,32%	0,33%	0,28%
ROGER	13,84%	14,95%	15,71%	18,30%	20,29%	18,44%	20,80%	18,41%	16,42%	19,99%	18,24%	17,34%
REQUEST [altitude]	3,99%	3,19%	3,45%	3,30%	2,80%	2,08%	3,53%	2,82%	1,95%	2,43%	1,77%	1,99%
REQUEST BLOCK [altitude] TO [altitude]	0,00%	0,00%	0,10%	0,00%	0,05%	0,00%	0,05%	0,00%	0,00%	0,00%	0,00%	0,00%
REQUEST CRUISE CLIMB TO [altitude]	0,38%	0,33%	0,48%	0,49%	0,36%	0,44%	0,52%	0,26%	0,62%	0,53%	0,47%	0,32%
REQUEST CLIMB TO [altitude]	3,10%	3,30%	3,45%	2,86%	3,99%	3,56%	3,05%	3,16%	2,67%	3,49%	3,50%	2,88%
AT [position] REQUEST CLIMB TO [altitude]	0,00%	0,11%	0,10%	0,05%	0,00%	0,11%	0,00%	0,04%	0,10%	0,00%	0,14%	0,12%
AT [time] REQUEST CLIMB TO [altitude]	0,00%	0,00%	0,00%	0,00%	0,00%	0,11%	0,05%	0,00%	0,00%	0,00%	0,00%	0,00%
REQUEST OFFSET [distanceoffset] [direction] OF ROUTE	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,16%	0,00%	0,12%
REQUEST [speed]	0,09%	0,22%	0,19%	0,24%	0,10%	0,05%	0,05%	0,09%	0,19%	0,16%	0,00%	0,24%
REQUEST VOICE CONTACT	0,14%	0,27%	0,19%	0,15%	0,10%	0,00%	0,05%	0,04%	0,14%	0,11%	0,47%	0,20%
REQUEST VOICE CONTACT [frequency]	0,05%	0,11%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
REQUEST DIRECT TO [position]	0,28%	0,27%	0,53%	0,34%	0,31%	0,55%	0,48%	0,35%	0,29%	0,63%	0,42%	0,45%
REQUEST WEATHER DEVIATION UP TO [distanceoffset] [direction] OF ROUTE	0,09%	0,05%	0,10%	0,00%	0,05%	0,00%	0,33%	0,04%	0,19%	0,48%	0,33%	0,77%

Downlink message element	Percentage referred to total downlink message elements in the month											
	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
CLIMBING TO [altitude]	0,05%	0,00%	0,00%	0,15%	0,05%	0,00%	0,00%	0,00%	0,05%	0,00%	0,00%	0,00%
PASSING [position]	3,43%	0,49%	0,43%	0,53%	1,45%	0,98%	1,29%	0,91%	1,38%	0,74%	1,59%	1,02%
PRESENT ALTITUDE [altitude]	0,09%	0,16%	0,14%	0,39%	0,05%	0,00%	0,19%	0,26%	0,00%	0,00%	0,09%	0,08%
PRESENT SPEED [speed]	0,47%	0,38%	0,72%	1,55%	0,83%	1,20%	0,62%	1,69%	0,81%	0,53%	0,47%	0,61%
LEVEL [altitude]	0,05%	0,00%	0,05%	0,00%	0,00%	0,00%	0,00%	0,09%	0,00%	0,00%	0,00%	0,08%
ASSIGNED ROUTE [routeclearance]	0,05%	0,11%	0,00%	0,15%	0,05%	0,11%	0,00%	0,04%	0,05%	0,00%	0,00%	0,12%
BACK ON ROUTE	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,04%	0,00%	0,05%	0,05%	0,08%
NEXT WAYPOINT ETA [time]	0,05%	0,00%	0,00%	0,15%	0,00%	0,00%	0,00%	0,04%	0,00%	0,00%	0,00%	0,00%
POSITION REPORT [positionreport]	14,83%	14,84%	13,22%	12,67%	12,42%	10,78%	11,88%	11,31%	12,85%	11,26%	13,15%	13,16%
WHEN CAN WE EXPECT HIGHER ALTITUDE	0,05%	0,05%	0,05%	0,10%	0,26%	0,05%	0,19%	0,04%	0,05%	0,00%	0,09%	0,04%
WHEN CAN WE EXPECT CRUISE CLIMB TO [altitude]	0,09%	0,05%	0,05%	0,00%	0,00%	0,00%	0,00%	0,04%	0,00%	0,00%	0,00%	0,00%
ERROR [errorInformation]	0,19%	0,27%	0,24%	0,34%	0,41%	0,16%	0,10%	0,43%	0,29%	0,16%	0,19%	0,24%
DUE TO WEATHER	0,05%	0,33%	0,05%	0,05%	0,00%	0,00%	0,00%	0,00%	0,00%	0,26%	0,23%	0,20%
DUE TO AIRCRAFT PERFORMANCE	1,13%	1,48%	1,44%	1,31%	1,24%	1,42%	1,15%	1,30%	1,52%	1,16%	1,45%	0,73%
[freetext]	6,43%	9,34%	8,43%	8,45%	7,25%	6,84%	7,20%	8,71%	6,47%	6,82%	7,84%	8,61%
REACHING [altitude]	0,05%	0,00%	0,00%	0,10%	0,00%	0,00%	0,00%	0,09%	0,10%	0,00%	0,09%	0,12%
AT PILOTS DISCRETION	0,05%	0,05%	0,00%	0,05%	0,05%	0,11%	0,05%	0,00%	0,00%	0,00%	0,00%	0,00%

Downlink message element	Percentage referred to total downlink message elements in the month											
	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013
DEVIATING [distanceoffset] [direction] OF ROUTE	8,49%	8,08%	6,56%	6,12%	6,06%	5,20%	5,68%	5,03%	5,95%	5,50%	6,30%	7,31%

Table 14
Percentage of downlink message elements transmitted for each month in the phase of study (2013)

APPENDIX A: CAPE VERDE AND CANARIAS DATA COMPARISON

This Appendix presents a brief analysis of data received from Cape Verde.

Data received from Cape Verde consisted of DSP (SITA) ATS Performance Reports of two months (February and April 2013). Since Aena receives from the DSP (SITA) the same type of reports monthly, Cape Verde data could be compared with the corresponding ATS Performance Reports of Aena. Data from Cape Verde and from Canarias seem to be in line and no major differences in the main conclusions have been observed.

Only those data considered of interest for this Annual Report have been included in this Appendix.

A. FANS Traffic by Airlines

With regard to FANS traffic by airlines, the four most significant airlines for ASA Cape Verde and Aena are the same; TAP Portugal, TAM Airlines, Air France and Iberia have the highest number of connections during the studied months.

B. FANS Datalink Traffic

Figure 6 and Figure 7 show FANS Datalink ground traffic (uplink and downlink) for ASA Cape Verde and Aena for the months of February and April 2013, being this datalink ground traffic the blocks exchanged between the aircraft and the RGS/VGS (including the repeated and duplicated blocks).

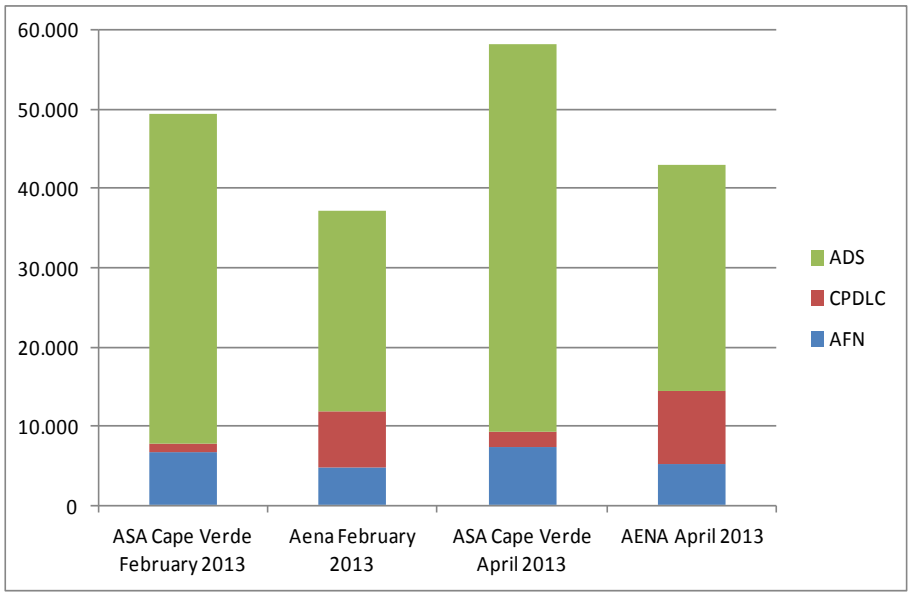

Figure 6
ASA Cape Verde and Aena FANS Datalink Ground Traffic (Uplink and Downlink)

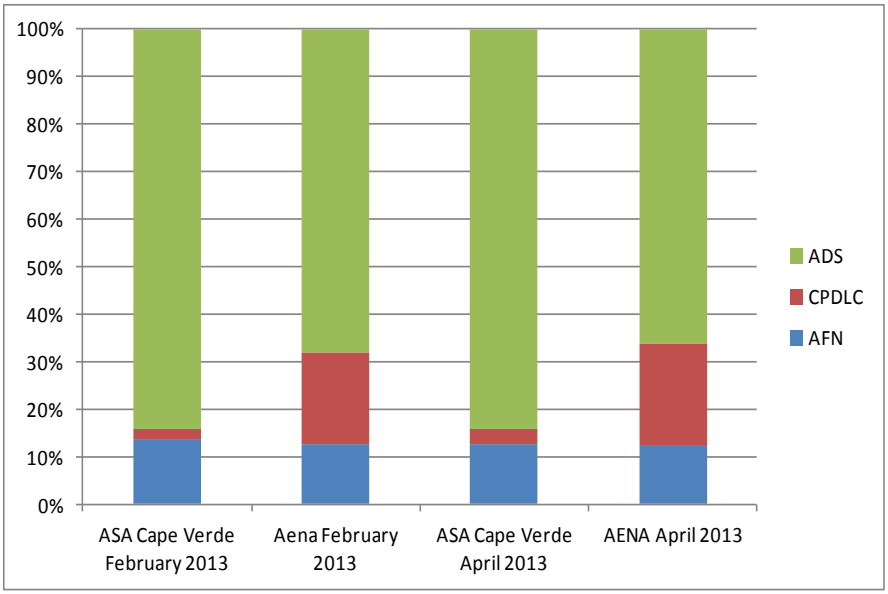

Figure 7
ASA Cape Verde and Aena FANS Datalink Ground Traffic Distribution (Uplink and Downlink)

According to Figure 6, AFN and ADS traffic is larger in Cape Verde than in Canarias, in contrast to CPDLC traffic which is larger in Canarias. In the same line, the distribution of datalink traffic (Figure 7) shows that the CPDLC use is higher in Canarias airspace than in Cape Verde. The different operational environment could explain this difference.

C. FANS Service Performance

Figure 8 shows downlink delivery times for ASA Cape Verde and Aena for the months of February and April 2013.

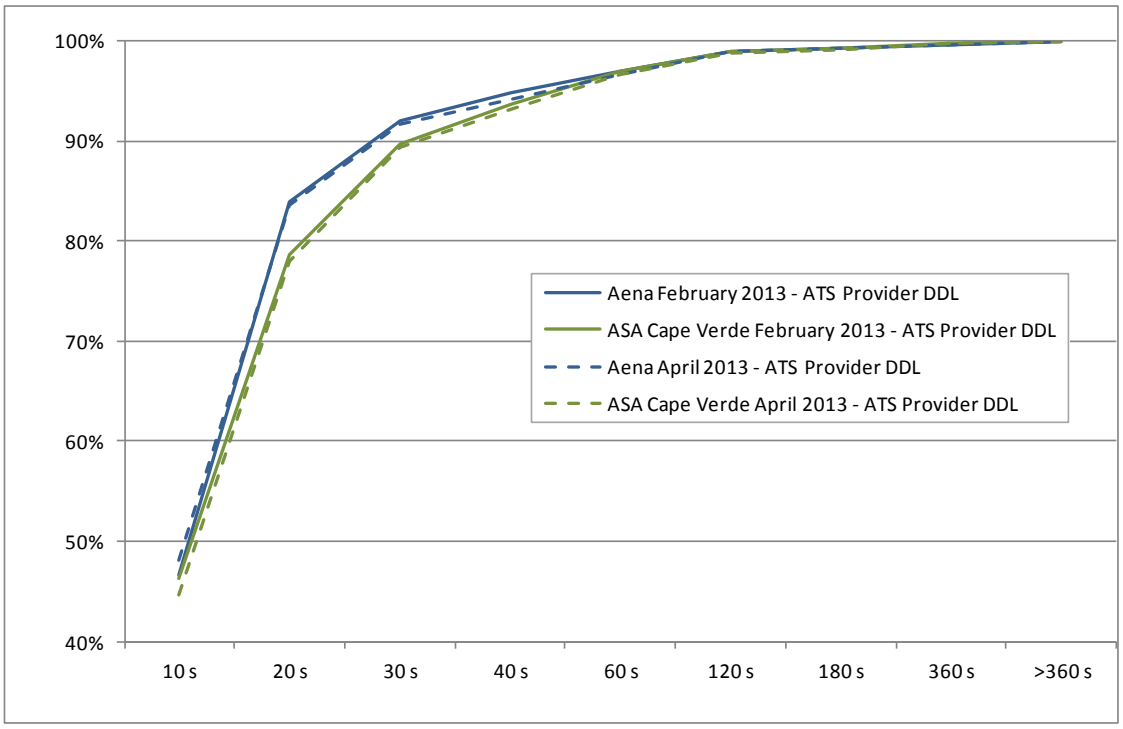

Figure 8
ASA Cape Verde and Aena Global Downlink Delivery Time

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