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**SITE MONITOR DEMONSTRATOR**

**EEC Note No. 28/96**

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## **Site Monitor Demonstrator**

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### Summary

This report describes the software architectural design and user manual of the Site Monitor Demonstrator

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## 1. Acronyms and Abbreviations Definitions

<b>AAC</b>	Advanced ARINC Card
<b>ACAS</b>	Aircraft Collision Avoidance System
<b>ADLP</b>	Aircraft Data Link Processor Unit
<b>ATN</b>	Aeronautical Telecommunication Network
<b>BDS</b>	Binary Data Store. Register number with 56 bit in the Mode S transponder.
<b>CTS</b>	Clear to send
<b>DLPU</b>	Data Link Processor Unit
<b>ELM</b>	Extended Length Message
<b>GDLP</b>	Ground Data Link Processor
<b>GICB</b>	Ground Initiated Comm-B Messages
<b>IIMSES</b>	Initial Implementation Mode-S in Enhanced Surveillance
<b>RTS</b>	Request to send
<b>SLM</b>	Short Length Message
<b>SMD</b>	Site Monitor Demonstrator
<b>SNTF</b>	Sub-Network Test Facility
<b>TUB</b>	Technische Universität Braunschweig
<b>XPDR</b>	Mode S Transponder

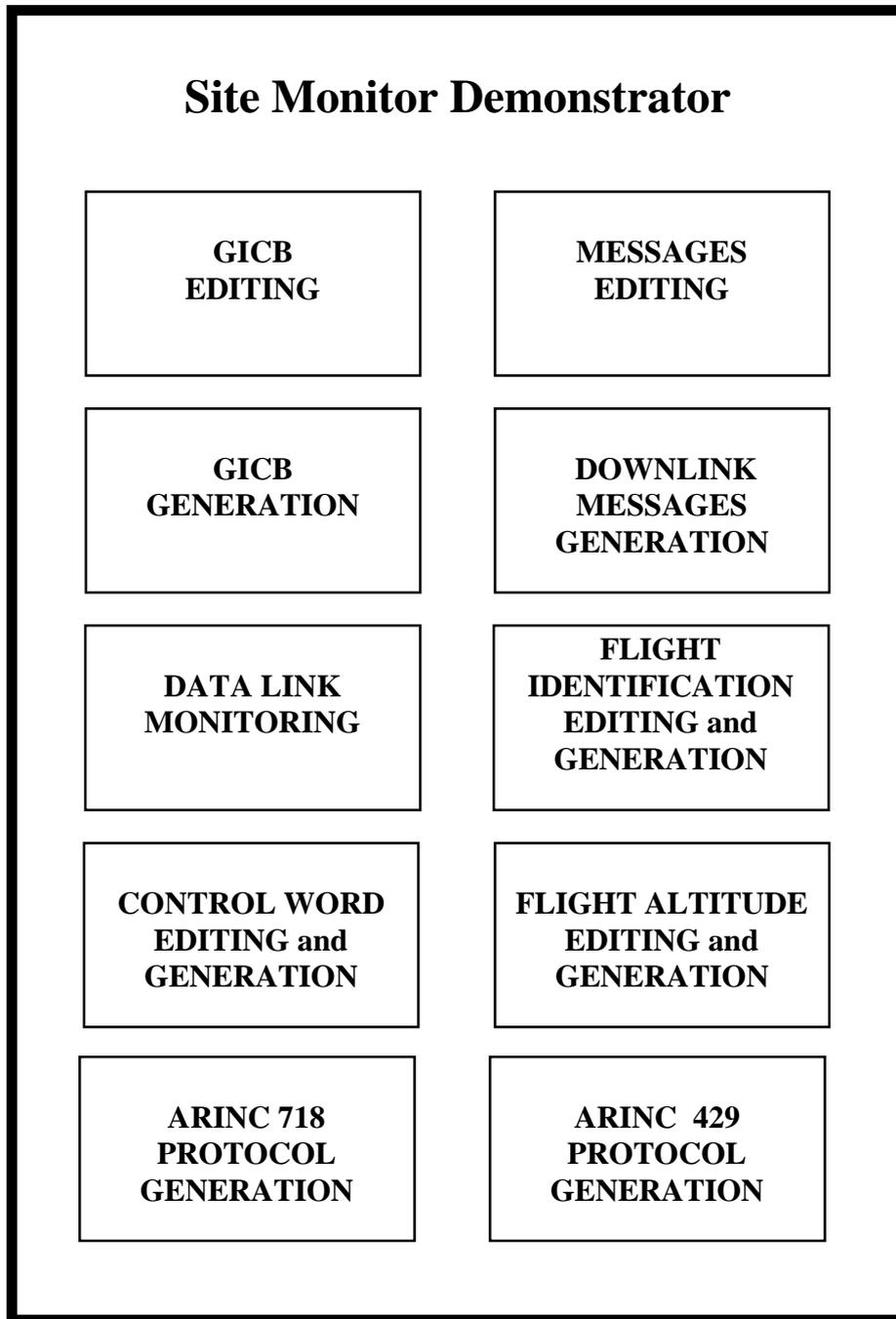
## **2. Purpose and Scope**

The purpose of this document is to provide an overall description of the software architectural design and user manual of the Site Monitor Demonstrator test tool developed at the EUROCONTROL Experimental Centre.

## **3. Introduction**

The Site Monitor Demonstrator is part of the IIMSES programme and is a test tool for the radar stations involved in this programme. This will be an industrial product, the EEC produces it only as a demonstrator.

4. Major Features of the Site Monitor Demonstrator



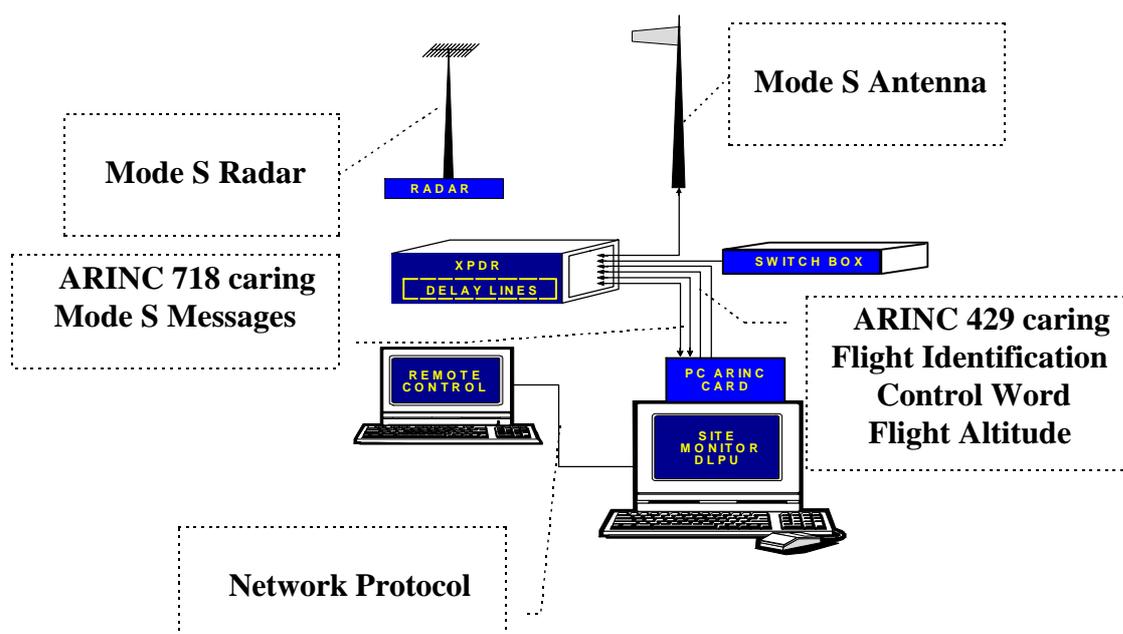
**Figure no. 1 - Major features of the Site Monitor Demonstrator**

The Site Monitor Demonstrator test tool is a software device Installed in a HP-UX workstation and using an Advanced ARINC Card version 2 /1/.

The SMD software has two major functionalities.

The first, is the capacity of generate and monitor Mode-S data link messages, using an ARINC 718 protocol, and the second, is the capacity of generate flight identification, control word and flight altitude broadcast messages using an ARINC 429 protocol.

## 5. General Overview



**Figure no. 2 - General overview of a SMD environment**

There are two differences between normal grounded aircraft equipment and the SMD :

The first, is a delay line installed in a parrot transponder near the radar to put it at a longer distance /2/.

The second, is the existence of a special device, a DLPU or a ADLP, which can also execute the functions of the transponder control box and the altimeter. This device can be realised by a workstation with a PC ARINC card /1/. Installed in a network environment it can be used in a remote mode.

The ARINC card has two receivers and 4 multiplexed transmitters. It uses a Harris ARINC processor which allows different transmission speeds for reception and transmission.

Two high speed receivers and two high speed transmitters are used for the ARINC 718 interface between the (American) transponder and the SMD. The two remaining transmission channels are used in the following way: one, for the transmission of the control word, channel 3, and the other, for the transmission of the altitude and flight identification, channel 4. Both channels use low speed transmission.

The firmware on the AAC can implement a single ARINC 718 channel with the transponder, "xpdrx.exe", or a double "xpdrdax.exe". The software of the workstation is an upgraded version of TDLP including control box and altimeter functions.

In the EEC Mode S avionics test chain, a switch is installed to take the ARINC 429 broadcast for control word, altitude and flight identification either from the control box and altimeter, or from the SMD.

The objective of the site monitor is to allow a radar operator or the ground control, the variation of all aircraft parameters sent to the parrot transponder including control word, altitude and flight identification. Further, all data link applications must be available for test purposes, including special cases as the transmission of 10 COMM-B between two radar beam hits, and verify whether the transponder has lost any data.

Users for the site monitor are radar constructors and radar users. It is not excluded that the material of the EEC (delay lines and ARINC cards) will be used for the industrial SMD production.

The SMD is a simple test tool and has nothing to do with the end to end test chain for data link applications foreseen in the ATN program, the Sub Network Test Facility SNTF. Nevertheless, the SMD upgraded by an interface to the GDLP could be a part of the end to end test chain mention above. If this option is accepted, the workstation of the SMD could house the software to be developed.

In the moment the SMD is compatible with actual used DLPU, but in a near future, it must be slightly modified to be compatible with the ADLP. This is due to the implementation of the GDLP.

## 6. Site Monitor Demonstrator Software Architectural Design

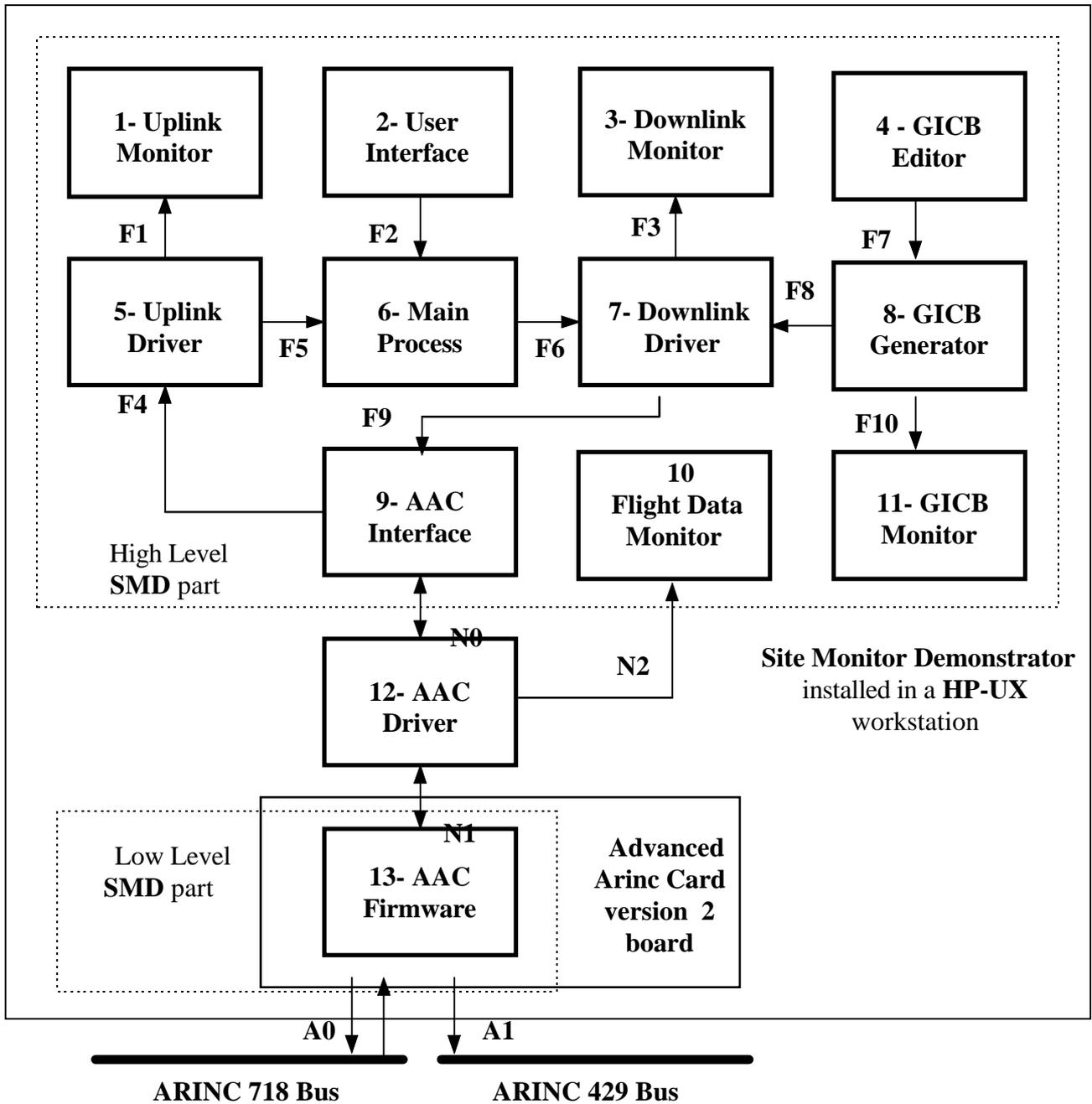


Figure no. 3 - SMD software architectural design

- Notes :**
1. F1 to F10 are System V IPC facilities, shared memory and semaphores
  2. N0 to N2 are HP-UX kernel data transfer blocks
  3. A0 and A1 are ARINC channels

As shown above the SMD is basically an upgraded version of the UNIX based TDLP /3/. This software device can be split in three parts, the high level running in the HP-UX workstation, the HP-UX driver to access the AAC and finally, the low level software running in the card, the firmware.

The high level part performs the following tasks: AAC driver interface, user interfacing for editing downlink messages, GICBs generation, and finally data link monitoring including surveillance messages, flight identification, altitude and control word. This part was written in HP-UX C programming language.

Since the application is running in a HP-UX operating system it became necessary to implement a HP-UX driver to access the card.

This driver, developed by Hewlett-Packard France, can be configured accordingly with the chosen AAC interrupt level and memory address. The configuration manual of this driver is not included in this document but can be supplied by EUROCONTROL.

Finally, the low level software running in the card, the firmware, implementing the high speed ARINC 718 /4/ and the low speed 429-14 /5/.

For the firmware the following considerations about time and load processing can be made:

The DLPU/ADLP of the SMD has to answer a RTS from the transponder within 4.0 milliseconds with a CTS.

The answer may be delayed by 2.88 milliseconds if a low speed broadcast word has to be sent. The normal reaction time of the ARINC card to answer a RTS with a CTS is, on average, 0.7 milliseconds. So, the worse case delay for a CTS is 3.58 milliseconds, which is less than 4.0 milliseconds.

There is only one ARINC transmitter with 4 multiplexed drivers and all information has to go through this transmitter. The following table shows the permanent data flow of the transmitter in milliseconds per second.

<b>Transmitter occupancy</b>	
<b>Control word update</b>	86.4
<b>Altitude update</b>	86.4
<b>Flight identification update</b>	57.6
<b>BDS (normal) update</b>	54.0
<b>Maximum update time</b>	284.4

**Figure no. 4 - ARINC transmitter permanent data flow**

More than 60% of the transmitter time is available for data link. The firmware architectural design and functional description are not included in this document but can be supplied by EUROCONTROL.

## 7. Site Monitor Demonstrator User Manual

### 7.1. Introduction

The purpose of this chapter is to give a general overview of how a user can install and implement this software package and, at the same time, to describe how to use all the SMD software facilities.

### 7.2. Installing the Site Monitor Demonstrator

The SMD software is archived in the file "site.tar". In the subdirectory "users/jma/site" use the command "tar -xvf site.tar" to extract all related files. In the subdirectory "site/site.bin" execute the file "make0" to compile the source files which are located in the subdirectory "site/site.src". After successful compiling the following executable files should be found.

*"sitemain"	Main process.
"sitefldat"	Flight data monitor.
*"siteaac"	AAC interface.
*"siteup"	Uplink driver.
"sitedown"	Downlink driver.
*"sitedownmon"	Downlink monitor.
*"siteupmon"	Uplink monitor.
"siteuser"	User main interface.
"site"	File script to start running the SM
*"sitegigen"	GICB generation.
"sitegiedit"	GICB editor.
"sitegimon"	GICB monitor.
"gicb.dat"	Default file with AVIONICS data
"sem.ftok.site"	IPC semaphores facilities reference file
"shm.ftok.site"	IPC shared memory facilities reference file .
"xpdr cx.exe"	AAC firmware

\* Note : All screen output messages are recorded in a file with extension “.rec”.

The complete list of files necessary to run the SMD should also include the HP-UX driver necessary to establish the connection between the AAC firmware and this software application.

### 7.3. Running the Site Monitor Demonstrator

To start running the user should type "site". This script file before activating the 11 processes mentioned below asks the name of the GICB file used.

If nothing is written, after having pressed <ENTER> key, the file “gicb.dat” is read by default, see **Photo1**. Each of the 11 processes activated are running in a single « hpterm » visual window, see **Photo 2**.

SITE_FLIGHT_DATA_MONITOR	⇒	“sitefldat”
SITE_DOWNLINK_DRIVER	⇒	“sitedown”
SITE_UPLINK_DRIVER	⇒	“siteup”
SITE_DOWNLINK_MONITOR	⇒	“sitedownmon”
SITE_UPLINK_MONITOR	⇒	“siteupmon”
SITE_AAC_INTERFACE	⇒	“siteaac”
SITE_USER_MAIN_INTERFACE	⇒	“siteuser”
SITE_MAIN_PROCESS	⇒	“sitemain”
SITE_GICB_GENERATOR	⇒	“sitegigen”
SITE_GICB_EDITOR	⇒	“sitegiedit”
SITE_GICB_MONITOR	⇒	“sitegimon”

Use the mouse to select the correspondent « hpterm » window. How to operate with all processes will be described in the next chapter.

## 7.4. Site Monitor Demonstrator Operating Instructions

### 7.4.1. GICB Editor

The GICB editor is an on line editor of simulated AVIONICS data. Data can be introduced having as parameters the BDS number, the resolution and the minimum and maximum value accepted.

BDS	DATA	RANGE	RESOLUTION
5	Airborne Format Surveillance Status Turn Indicator Bit Barometric Altitude	0, 7..14 0..3 0..1 50,175 ft	----- ----- ----- 25 ft
	Time Bit Latitude Longitude	0..1 $\pm 90^\circ$ $\pm 180^\circ$	----- 0.0007 ° 0.0014 °
6	Type Movement MOV_SPM Track Barometric Altitude	0, 5,6 0..128 $\pm 180^\circ$ 50,175 ft	----- ----- 2.816 ° 25 ft
	Time Bit Latitude Longitude	0..1 $\pm 90^\circ$ $\pm 180^\circ$	----- 0.0007 ° 0.0014 °
10	Capability Report	Use hexadecimal data to fill	
20	Aircraft Identification	Defined in the user main interface (Flight Data - <F1>)	
30	Reserved for ACAS	Use hexadecimal data to fill	

<b>BDS</b>	<b>DATA</b>	<b>RANGE</b>	<b>RESOLUTION</b>
40	Flight Path Angle Flight Path Acceleration Corrected Angle of Attack Barometric Correction Altitude	$\pm 180^\circ$ 4 g $\pm 180^\circ$ 131,072 ft	0.18° 0.001 g 0.044° 8 ft
50	Mach Number Computed Air Speed Track Angle True Track Angle Magnetic	4.096 Mach 1,024 Kt $\pm 180^\circ$ $\pm 180^\circ$	0.001 Mach 0.5 Kt 0.044° 0.044°
60	Track Angle Magnetic Ground Speed Altitude Rate Static Air Temperature	$\pm 180^\circ$ 2,048 Kt $\pm 16,384$ ft/min $\pm 512^\circ$	0.044° 0.5 Kt 64 ft/min 0.5°
70	Selected Altitude Range Selected Heading Status Word 1 Status Word 2	65,536 ft $\pm 180^\circ$ 270 271	16 ft 0.8° Binary Input Binary Input
80	Selected Airspeed Selected Altitude Rate Selected Altitude Status Word 1	512 Kt 16,384 ft/min 45,536 ft Label 270	0.25 Kt 16 ft/min 16 ft Binary Input
90	Selected Mach Number Selected Altitude Rate Selected Altitude Status Word 2	4.096 Mach 16,834 ft/min 65,536 ft Label 271	0.002 Mach 16 ft/min 16 ft Binary Input
AO	Cross Track Error Vertical Deviation Acceleration	128 nm 2,048 ft $\pm 1$ g	0.004 nm 1 ft 0.016 g
BO	Computer Airspeed True Airspeed Mach Heading (magnetic)	1,024 Kt 2,048 Kt 4.096 Mach $\pm 180^\circ$	0.25 Kt 0.5 Kt 0.00025 Mach 0,18°

BDS	DATA	RANGE	RESOLUTION
CO	Radio Height Average Static Pressure Altitude	8,192 ft 1,024 mb 131,072 ft	1 ft 0.25 mb 1 ft
31	Bearing to Waypoint Time to Go Distance to go	$\pm 180^\circ$ 399.9 min 399.9 nm	0.18° 0.1 min 0.1 nm
41	Active Waypoint 1 Active Waypoint 2 Desired Track	3 characters 3 characters $\pm 180^\circ$	ISO 5 ISO 5 0.18°
51	Latitude Longitude Altitude	$\pm 90^\circ$ $\pm 180^\circ$ 131,072 ft	0.00035° 0.0007° 8 ft
61	G.M.T. Flight Number	HHMMSS xxxx	
71	Roll Angle Altitude Rate Wind Speed Wind Angle	$\pm 90^\circ$ $\pm 8,192$ ft/min 256 Kt $\pm 180^\circ$	0,35° 128 ft/min 1 Kt 0.703°
24	Centre of Gravity Gross Weight	99.9 % 131,072 lbs	0.1 % 160 lbs

<b>BDS</b>	<b>DATA</b>	<b>RANGE</b>	<b>RESOLUTION</b>
17	N1 Actual Engine # 1 Fuel Flow Engine # 1 Total Air Temperature Static Air Temperature	256 % rpm 32,768 lb/hr ± 512°C ± 512°C	0.13 % rpm 8 lb/hr 0.5°C 0.5°C
27	N1 Actual Engine # 2 Fuel Flow Engine # 2 Total Air Temperature Static Air Temperature	256 % rpm 32,768 lb/hr ± 512°C ± 512°C	0.13 % rpm 8 lb/hr 0.5°C 0.5°C
37	N1 Actual Engine # 3 Fuel Flow Engine # 3 Total Air Temperature Static Air Temperature	256 % rpm 32,768 lb/hr ± 512°C ± 512°C	0.13 % rpm 8 lb/hr 0.5°C 0.5°C
47	N1 Actual Engine # 4 Fuel Flow Engine # 4 Total Air Temperature Static Air Temperature	256 % rpm 32,768 lb/hr ± 512°C ± 512°C	0.13 % rpm 8 lb/hr 0.5°C 0.5°C
1A	Aircraft Identification Aircraft Identification Aircraft Identification	2 char. ISO5 2 char. ISO5 2 char. ISO5	Label 233 Label 234 Label 235
1B	Aircraft Identification	2 char. ISO5	Label 236

## 7.4.2. Main User Interface

This process allows the user to terminate a session and to edit or to send downlink messages including aircraft flight data.

### 7.4.2.1. Flight Data

To chose this option type function key <F1>.

#### 7.4.2.1.1. Low Security Level

To chose this option type function key <F1> and complete the following displayed table. Type <ENTER> to finish.

LOW SECURITY LEVEL	
<b>FLIGHT IDENTIFICATION</b> ( max. 8 alfan. char.)	
<b>FLIGHT ALTITUDE</b> (min. value of 43000 ft)	

Confirm it by typing <y>, <Y> or <ENTER>. To cancel it type <N> or <n>.

#### 7.4.2.1.2. High Security Level

To chose this option type function key <F2>. To proceed, a password must be enter. Type <ENTER> to finish.

WRITE PASSWORD

If an incorrect password is entered, the following message will be displayed and the process will return to the main menu.

<b>SORRY, BUT YOU HAVE A WRONG PASSWORD ! TRY AGAIN.</b>
--

If a correct password is entered, complete the following displayed table. Type <ENTER> to finish.

HIGH SECURITY LEVEL	
<b>FLIGHT IDENTIFICATION</b> ( max. 8 alfan. char.)	
<b>FLIGHT ALTITUDE</b>	
<b>CONTROL WORD CODE</b> ( 4 octal char.)	

Confirm it by typing <y>, <Y> or <ENTER>. To cancel it type <N> or <n>.

### 7.4.2.1.3. Change Password

To chose this option type function key <F3>. Complete the following displayed table.

<b>WRITE OLD PASSWORD</b>

If an incorrect password is introduced , the following message will be displayed and the process will return to the main menu.

<b>SORRY, BUT YOU HAVE A WRONG PASSWORD ! TRY AGAIN.</b>
--

If a correct password is introduced, complete the following displayed table with the new password.

<b>WRITE NEW PASSWORD</b> ( max. 8 alfan. char.)

Confirm it by typing <y>, <Y> or <ENTER>. To cancel it type <N> or <n>. The new password will be written in file "paswr.txt".

### 7.4.2.2. Downlink Messages

To chose this option type function key <F2>.

#### 7.4.2.2.1. On Line Messages

To chose this option, type <F1>. Complete the following displayed table and type <ENTER> to finish. Confirm it by typing <y>, <Y> or <ENTER>.The maximum size of each message is 208 characters, which corresponds to a COMD of 16 segments (mode "atc" and 6 bit code) /6/.

<b>DOWNLINK MESSAGE</b> ( max. 208 alfan. char.)

If you want to send this message more then once, confirm it, by writing the correspondent number.

For a single time, type <ENTER> or <1>. To quit type <0>.

#### 7.4.2.2.2. Pre-defined Messages

The file "mes.txt" contain all the pre-defined messages. These messages can be on line written or modified. The general format for these messages is:

#	x	x		y	y	...	...	...	...	...	y	#
---	---	---	--	---	---	-----	-----	-----	-----	-----	---	---

- Start message indicator.
- Message number (decimal char. or function key).
- Message number (decimal char. or function key)..
- Space .
- Message (alph. char.) .
- Stop message indicator.

In file "mes.txt" there are already 15 messages. They can be activated by typing the corresponding number, as follows:

- #1 COMB#
- #2 COMMB LINKED 2#
- #3 TEST COMM-B LINKED 3#
- #4 TEST COMM-B LINKED 4#
- #5 .....TEST ELM COMM-D MESSAGE WITH 6 SEGMENTS .....#
- #6 ..... TEST ELM COMM-D MESSAGE WITH 10 SEGMENTS .....  
TEST ELM COMM-D MESSAGE WITH 10 SEGMENTS#
- #7 ..... THIS IS A DOWNLINK MESSAGE FOR TESTING AN ELM WITH  
16 SEGMENTS WITH APN = 1 ..... THIS IS A DOWNLINK  
MESSAGE FOR TESTING AN ELM WITH 16 SEGMENTS WITH APN = 1#
- #8 AFR405 REQUEST FL345 AT NANTES WAYPOINT#
- #9 SAB546 REQUEST DIRECT ROUTING ON FL240 AT PARIS/ORLY#
- #10 TAP420 REQUEST METEO REPORT FOR EDDF#
- #11 LUF345 REQUEST ATIS INFORMATION FOR LPPO#
- #12 BRI345 REPORTING CB TURBULENCE AT FL300#
- #13 THY345 REPORTING UFO AT BRETIGNY REGION#
- #14 AFR345 REPORTING ALL FREQUENCIES OFF LINE INCLUDING  
EMERGENCY 119.1#
- #15 TEST MESSAGE#

#F1 REQUEST VOLMET AT ZONE LFPG #  
 #F2 REQUEST TAF AT ZONE LFPG #  
 #F3 REQUEST METAR AT ZONE LFPG #  
 #F4 REQUEST PRELDG AT ZONE LFPG #  
 #F5 REQUEST SIGMET AT ZONE LFPG #  
 #F6 REQUEST ATIS INFORMATION LFPG #  
 #F7 REQUEST ATIS INFORMATION FROM LFPG LFLY#

All the messages activated by a function key are phrase coded /6/. These messages examples were used in PARIS region.

The file "mes.txt" contain also the downlink radar identification which is on line modifiable. The format is:

#	D	I	I		I	D	E	N	T	I	F	I	C	A	T	I	O	N	x	x	x	x	#
---	---	---	---	--	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

x
---

 Downlink radar identification ( use decimal char., max.=16, min.=1)

#### 7.4.2.3. Quit Site Monitor Demonstrator

To chose this option type function key <F3>. Confirm it by typing <y>, <Y> or <ENTER>. To cancel it type <N> or <n>.

#### 7.4.3. Final Considerations

All the other processes do not require any user operation.

## 8. References

- [1] EEC Note No. 17/94 - "Advanced PC-ARINC Card version 2"  
by H.P. ENGLMEIER.
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by H.P. ENGLMEIER.
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