



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

MINIMUM AVIATION SYSTEM PERFORMANCE SPECIFICATION FOR CNS/ATM MESSAGE RECORDING SYSTEMS

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FOREWORD

1. This document, prepared by EUROCAE Working Group 50 "Recording Requirements for ATM" was accepted by the Council of EUROCAE on October 1998.
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CHAPTER 1

INTRODUCTION1.1 PURPOSE AND SCOPE

The fundamental airborne flight recorder regulatory framework developed in the late 1950's and early 1960's addressed voice based communications to and from aircraft, consistent with the technology of the time. The Communications, Navigation, Surveillance (CNS) and Air Traffic Management (ATM) concepts, endorsed by ICAO, rely extensively on new technology which replaces many of these communications with digital messages. CNS/ATM operations have already become and will continue to be more dependent upon these digital communications. The accident investigation community believes that the fundamental recording requirements have not substantially changed, but that the regulatory framework needs to be revisited in light of new technology and concepts introduced with CNS/ATM. In particular, the replacement of traditional voice messages with digital messaging technology creates a need to consider new systems to ensure that the information necessary for incident and accident investigation continues to be recorded *on-board* the aircraft.

The ICAO FLIREC PANEL which convened in 1993, recommended that;

"All aeroplanes equipped to utilise digital ATS communications and required to carry a cockpit voice recorder shall record the digital communications messages on the cockpit voice recorder."

This document contains minimum aviation system performance specifications for Communication, Navigation, Surveillance, Air Traffic Management (CNS/ATM) Message Recording System. They specify characteristics that should be useful as guidance material to regulatory authorities, designers, installers, manufacturers, service providers and users of systems intended for operational. Where systems are global in nature, the system may have international applications which are taken into consideration.

Compliance with these specifications is recommended as one means of assuring that the system and each subsystem will perform its intended function(s) satisfactorily under conditions normally encountered in routine aeronautical operations for the environments intended. The MASPS may be implemented by one or more regulatory documents and/or advisory documents (for example certifications, authorisations, approvals, commissioning, advisory circulars, notices) and may be implemented in part or in total. Any regulatory application of this document is the sole responsibility of appropriate governmental authorities.

While this MASPS does not specify where the information is to be recorded on board the aircraft, there may be advantages to adapting Cockpit Voice Recorders to handle many of these requirements. However, for some information, such as navigation parameters, it may be better to use the Flight Data Recorder. This MASPS does not preclude the development of new architecture recorders.

Chapter 1 of this document describes the CNS/ATM Message Recording System and provides information helpful to understand the rationale for the system characteristics and requirements. This chapter describes typical applications, operational goals and establishes the basis for the specifications developed in Chapters 2 through 4 of the document. Definitions and assumptions essential to a proper understanding of this document are also provided in this chapter.

Chapter 2 describes the overall CNS/ATM system architecture.

Chapter 3 contains the minimum performance specifications for each subsystem/function that is a required element of minimum system performance in Chapter 2. These standards specify the required performance under the standard environmental conditions described.

Chapter 4 describes the minimum system test procedures to verify system performance compliance (for example end-to-end performance verification) and that subsystem performance meets the minimum performance requirements in Chapters 2 and 3.

Chapter 5 links the contents of the previous four chapters to future equipment performance specifications. These new documents will define airborne and ground recorder requirements for CNS/ATM technology.

The word “subsystem” as used in this document includes all components that make up a major independent, necessary and essential functional part of the system so that the system can properly perform its intended function(s). The guidelines contained in the latest version of EUROCAE ED-12/RTCA DO-178 should be considered, even for non-airborne applications, for systems and subsystems containing software.

1.2

SYSTEM OVERVIEW

In the 1960's, accident and incident investigations began to have the benefit of Cockpit Voice recordings to complement investigative information. The recorded information has proved invaluable and there is no doubt that aviation safety has advanced as a result. Traditional information recorded on board the aircraft includes internal communications on the flight deck, communications to and from the aircraft for air traffic control, automatic weather and airport information (ATIS), communications with the company, communications with other aircraft, and the aural environment on the flight deck. It is not uncommon for flight crews to communicate directly with agencies such as emergency fire and rescue services. All of this time-sequentially recorded information has enabled investigators to develop a comprehensive understanding of complex flight deck interactions and human factors issues such as the effects of crew workload and the activity/task levels and distribution in the cockpit. Information of this nature has to be put into context and it must be readily related to aircraft behaviour (recorded flight data) in order to gain a full appreciation of all of the circumstances that may have affected the operation of the aircraft. It has been and continues to be important to correlate aircraft behaviour and the activities the crew were engaged in precisely at the times communications were taking place. The on-board CVR has given this ability to investigators, and this fundamental need remains with the advent of digital messaging technology.

With new ways of passing messages by digital means, what was once audible information recorded on the traditional on-board recording system will be lost unless new systems are addressed. With the emergence of the technology and concepts for CNS/ATM, accident investigators have been increasingly concerned about this potential recording problem.

The total system enabling the transmission of digital communications has also opened up new possibilities for the navigation and control of aircraft. The combination of enhanced communication and very precise means of position measurement will allow ATS providers to reduce separation between suitably equipped aircraft. These aircraft may also be permitted to follow tracks which are no longer restricted to airways or set routings ('free-flight'). The multiplicity of digital communication passing from aircraft to aircraft, ground to air and aircraft to ground are expected to achieve increased capacity, reduced delays and ensure that existing safety levels are maintained or improved. These scenarios have significant implications for accident investigation. It is therefore important that these digital messages be properly recorded and that timing correlation with other cockpit and aircraft behaviour be preserved.

While the primary concern of investigators has been the potential loss of information traditionally recorded on board the aircraft on the Cockpit Voice Recorder, a system to ensure that these digital communications are available for investigation purposes consists of both ground and airborne components, with the airborne information continuing to be crash survivable.

1.3 OPERATIONAL APPLICATIONS

The on-board recording requirements shall be applicable to all aircraft (fixed and rotary wing) required to be equipped with a cockpit voice recorder and which operate in a CNS/ATM environment. The ground based recording requirements shall be applicable to ground systems which provide CNS/ATM services.

1.4 OPERATIONAL GOALS

It is important to distinguish between recording information to investigate an occurrence and recording information to troubleshoot or diagnose the health of a system. The reasons for recording are based on investigation needs, not the latter. Therefore, the underlying philosophy for accident investigation is the need to record information at the initiating source and the end receiver of the system, and not necessarily at intermediate points throughout the system. For digital communications, ground based recordings at the originating or final receiving station cover one end of the system, but have no easy means of recording when information was presented to the flight crew in the context of the cockpit environment, which is considered the other originating or final receiving end of the system.

The reasons for requiring digital communications to be recorded both on board the aircraft and on the ground are summarised as follows:

- a. All communications to and from the flight-deck crew must be recorded on the aircraft in order to develop a thorough understanding of the working environment of the flight deck. This is of fundamental importance to accident investigation.
- b. In the same way that traditional audio recording has enabled investigators to determine if radio communications systems were overall functioning as required, the on-board recording of digital communications will help to confirm the end-to-end functioning of the CNS/ATM system.
- c. Ground based recording will involve many stations and locations around the world. An effective means of ensuring that the information is readily available to an accident investigation is to record as much of it as practical on board the aircraft.

- d. Recording on the ground is required in order to correlate the transmitted and received messages and to investigate periods beyond the duration of the on-board recording. Part of this reason is to be able to understand the role of air traffic control in the occurrence, and to be able to understand the interactions between ground stations, other aircraft, and other agencies.
- e. Increased reliance will be placed on digital messaging to ensure safe operation in an environment where separations will be significantly reduced and profiles flown will be assumed to be much more precise. Much of this information may not involve the crew or controller and messages may be addressed directly to and from the aircraft's systems. The recording of such information will prove valuable.

To meet the operational goals, there are two main issues to be considered, namely:

- f. Recording of digital communications to and from the crew. This includes those messages that would have traditionally been passed by voice means.
- g. Other digital communications recording requirements. Digital messages will be passed to and from the aircraft for the purposes of weather information, navigation and surveillance (for example differential GPS will require position correction information to be continually sent to the aircraft), and advanced ACAS may require communication from aircraft to aircraft.

Each of these issues requires consideration in terms of both airborne and ground recording.

The recording of digital communication on board shall cover at least the duration of any Cockpit Voice Recorder required to be fitted.

The recording shall have the same level of crash survivability as the fitted Cockpit Voice Recorder.

Recording on ground shall be made at the originating station, and shall be retained for a minimum of 30 days.

1.5

ASSUMPTIONS

- a. This specification applies to aircraft operating in a CNS/ATM environment, which are data-link equipped.
- b. Recording of data-link messages shall be independent of media transmittal method (either VHF, HF, Satcom or other).
- c. The effect of Intra network and International boundaries shall be transparent to the recording and recovery of the data-link message and data-link service providers shall offer a continuity of service to the aircraft system.
- d. It is not within the scope of this document to specify the class of recorder required to be installed in a particular category of aircraft. Recording of the data-link messages shall be as appropriate for the applicable aircraft operating regulations.
- e. Since the ground records acknowledgements generated by the aircraft, even though each message is not necessarily unique, it can be assumed that the ground and corresponding air messages can be correlated.

- f. The information required to be recorded (as specified herein) is in addition to any existing requirements for mandatory flight recording systems.
- g. The precise content of any digital message need not necessarily be recorded on board the aircraft if sufficient information can be recorded on board such that the message can be reasonably deduced. For example, the precise contents of an CPDLC message up-linked from the ground need not be explicitly recorded on board if the contents can be determined from the ground. In these cases, an appropriate code and timing information may only be required to be recorded on board to meet this MASPS.
- h. The Generic Model addresses the generic recording needs. The Generic Model is independent of system architecture.
- i. Since the priority of the message is automatically assigned, priority can be deduced by virtue of the message contents and the priority need not be explicitly recorded.
- j. Traditional voice communications will continue to be recorded by the current means on the CVR.

1.6

VERIFICATION PROCEDURES

The verification procedures specified in this document are intended to be used as one means of demonstrating compliance with the performance requirements. Although specific test procedures are cited, it is recognised that other methods may be used. Alternate procedures may be used if it can be demonstrated that they provide at least equivalent information. System performance tests as they relate to operational capability are the most important tests. Subsystem tests are useful as subsystems are added during system build up and to ensure continued subsystem performance as it relates to system performance.

Verification of the recording system will include individual procedures for both the airborne and ground components as well as integrated procedures for the overall system.

1.7

DEFINITION OF TERMS

Partitioning	A technique for providing isolation between independent functions to prevent interaction in normal operation and under fault conditions. Partitioning design considers the hardware resources of processors, memory devices, I/O, interrupts and timers, and data coupling.
Segregation	The physical separation of memory devices within a recorder crash protected memory,
Timebase	A signal which provides the reference time for other recorded signals.
Time scale	A defined scale to be used in relation to the time base signal.
Up-link	Transmission from ground to air
Down-link	Transmission from air to ground

1.8

ABBREVIATIONS

AAC	Airline Administrative Communication
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision and Avoidance System
ACMS	Airplane Condition Monitoring System
ADF	Automatic Direction Finding
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance Broadcast
AISC	Aeronautical Services Communication
ANP	Actual Navigation Performance
AOC	Airline Operational Communications / Aeronautical Operational Control
APC	Aeronautical Passenger Correspondence
ARINC	Aeronautical Radio, Incorporated
ASAS	Airborne Separation Assurance System
ATC	Air Traffic Control
ATCS	Air Traffic Control Services
ATIS	Automatic Terminal Information Services
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATNP	ATN Panel
ATS	Air Traffic Services
ATSC	Air Traffic Services Communication
ATSM	Air Traffic Services Message
ATSU	Air Traffic Services Unit
BEA	Bureau Enquêtes Accidents
BDS	Binary Data Store
BEA	Bureau Enquêtes accidents
CAS	Computed Air Speed
CDTI	Cockpit Display of Traffic Information
CMU	Communications Management Unit
CNS	Communications Navigation Surveillance
CNS/ATM	Communications Navigation Surveillance / Air Traffic Management
CPDLC	Controller / Pilot Data Link Communications
CRC	Cyclic Redundancy Check
CVR	Cockpit Voice Recorder
DAP	Down-link of Aircraft Parameters
DCDU	Data link Control and Display Unit
DME	Distance Measuring Equipment

EIS	Electronic Instrument System
EUROCAE	European Organisation for Civil Aviation Equipment
FCU	Flight Control Unit
FDR	Flight Data Recorder
FIS	Flight Information Service
FLIREC	Flight Recorder Panel (of ICAO)
FMS	Flight Management System
FWS	Flight Warning System
GICB	Ground Initiated Comm-B
GNLU	GNSS Navigation and Landing Unit
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HF	High Frequency (3-30MHz)
HFDL	HF Data Link
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
MASPS	Minimum Aviation System Performance Specification
MCDU	Multiple-purpose Control and Display Unit
metar	meteo information for arrival
MLS	Microwave Landing System
MMR	Multi-Mode Receiver
Mode-S	Mode Selective
MOPS	Minimum Operational Performance Specification
MSP	Mode-S Specific Protocol
MU	Management Unit
NDA	Next Data Authority
PC	Personal Computer
PIREP	Pilot Report
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RVR	Runway Visual Range
SARPs	Standard and Recommended Practices
Satcom	Satellite Communication
SID	Standard Instrument Departure
SITA	Societe Internationale des Telecommunications Aeronautique
STDMA	Self-organising Time Division Multiple Access
TAWS	Terrain Awareness and Warning System

TBD	To Be Defined
TCAS	Traffic Alert and Collision Avoidance System
TCP	Trajectory Change Points
TWDL	Two-Way Data Link
UTC	Co-ordinated Universal Time
VDL	VHF Data link
VHF	Very High Frequency (30-300 MHz)
VOR	VHF Omni-directional Radio Range

1.9

REFERENCES

ARINC 660 - "CNS/ATM Avionics, Functional Allocation and Recommended Architectures"

CNS/ATM Package 1

EUROCAE ED-12B / RTCA DO - 178B "Software Considerations in Airborne Systems and Equipment Certification" (Dec 1992).

EUROCAE ED-78 "Guidance Material for the Establishment of Data Link supported ATS Services (June 1997).

RTCA DO - 212 "Minimum Operational Performance Standards for Airborne Automatic Dependent Surveillance"

RTCA DO - 219 "Minimum Operational Performance Standards for ATC Two-Way Data-link Communications"

EUROCAE ED-55 – "MOPS for Flight Data Recorder systems" (May 1990)

EUROCAE ED-56A – "MOPS for Cockpit Voice Recorder system" (December 93)

EUROCAE ED-85 "Data-Link Application System Document (DLASD) for the "Departure Clearance" data-link service" (June 1998)

EUROCAE ED-89 "Data-Link Application System Document for the "ATIS" data-link service" (in preparation)

CHAPTER 2

OVERALL SYSTEM2.1 INTRODUCTION

In this chapter a generic model of the complete CNS/ATM system as it applies to an individual aircraft is presented. Figure 2-1 depicts both the airborne and ground components of the model. The elements of the model are:

- a. the Subject Aircraft with its systems and Flight Deck Crew,
- b. other aircraft which may be in direct communication with the Subject Aircraft,
- c. external data sources which provide data to the Subject Aircraft,
- d. the ATM ground based services and the individual airline operation controllers
- e. the communication system between air and ground.

The structure shown in the model does not imply any particular system architecture employed on board the Subject Aircraft or within either the ground based ATM system or the individual airline operations control centres. It is intended to represent the functions present in each of the elements and the information flow between these functions which are then necessary for the operation of the complete air traffic system.

2.2 MODEL DESCRIPTION

The CNS/ATM system is broken down into individual functions that have unique inputs and outputs, the data paths between the functions and the logical recording points of the system. Each block or function within the generic CNS/ATM System model, as depicted in Figure 2-1 (items 1 to 18) is defined in paragraph 2.2.1, the data path flows are defined in paragraph 2.2.2 and the recording points (A-M) are defined in paragraph 2.3.1.

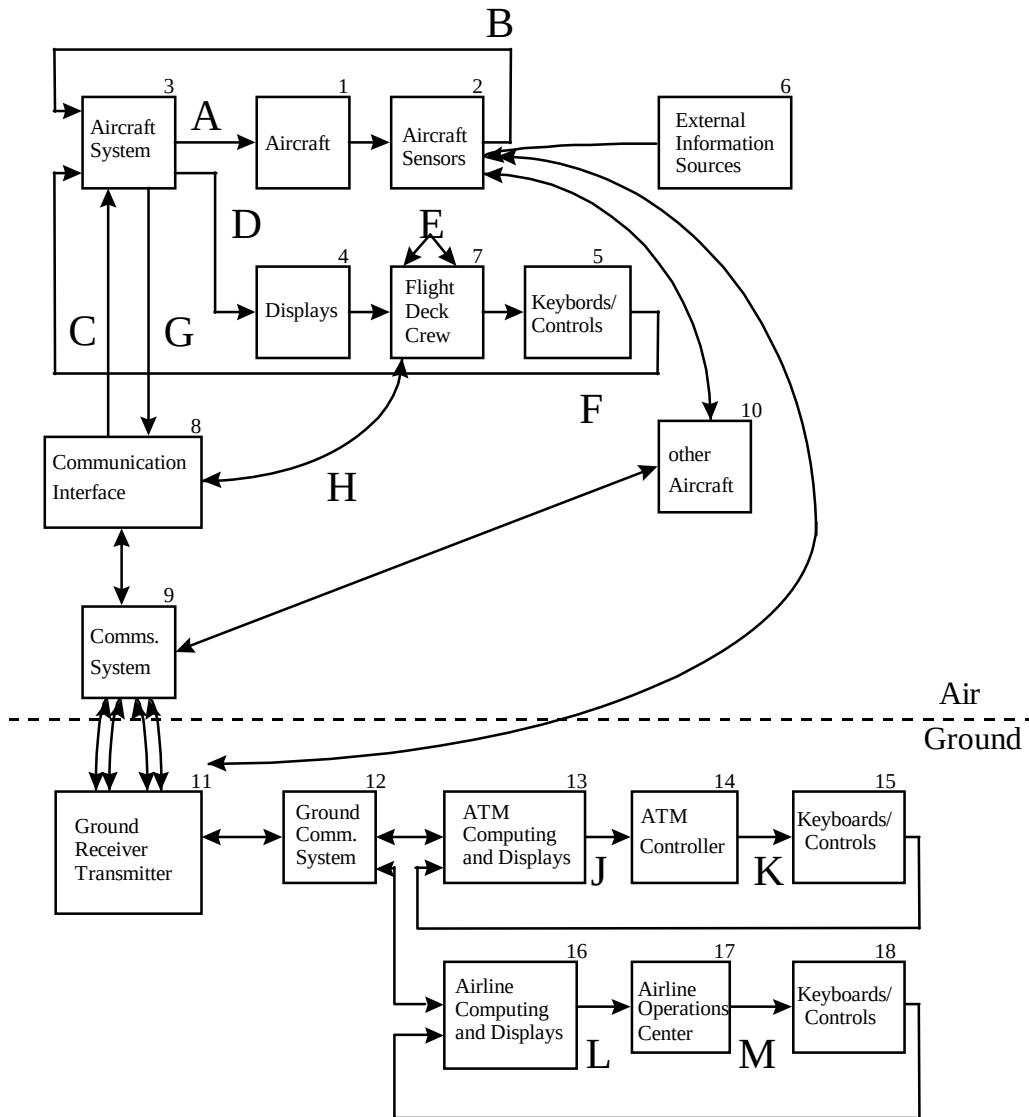


FIGURE 2-1: CNS/ATM SYSTEM MODEL

2.2.1 Description of the Function Blocks

2.2.1.1 Aircraft (1)

This block includes as its inputs all of those actions which lead to a change of state of the aircraft. These include such things as the movement of control surfaces and the external forces of the airstream.

2.2.1.2 Aircraft Sensors (2)

This block encompasses the measurement of:

- a. basic aircraft state parameters, such as acceleration, angle of attack, and roll angle
- b. inputs affecting the aircraft motion and also other parameters, such as velocity, altitude and position which arise from the kinematics of the aircraft motion
- c. aircraft internal state measurements also includes such things as door closure, landing gear position, etc.
- d. outside sources

Additionally the sensors include those which take information from outside sources. For example DME distance, ILS error, GPS position/correction DME, VOR, Air Data, Altitude Heading, ILS, MLS or MMR. It also encompasses automatic broadcast systems such as transponders used by applications like ACAS and ADS-B with protocols such as STDMA etc.

2.2.1.3 Aircraft Systems (3)

This block represents complete avionic /electronic systems. These comprise the totality of the (principally) electronic systems, which provide inputs to the aircraft, generate displays for the flight deck crew, or process all types of messages/transmissions beyond the aircraft, such as FMS, GNLU, EIS, FWS, or ACARS/MU/CMU/ATSU (application part of CPDLC, ADS, ...).

2.2.1.4 Displays (4)

These include all of the visual instruments, panels, screens, printers, visual and aural indications, which inform the flight deck crew of the state of the aircraft and its location in the airspace. For example:

- Flight Instrument Display Units and MCDU, DCDU
- Printers
- Audible alarms / alerts
- Headset, loudspeaker
- Announcer (Audio sounds, ...)

2.2.1.5 Controls and Keyboards (5)

These comprise all cockpit interfaces available to the flight deck crew for communicating with and controlling the aircraft systems. They include keyboard (MCDU, DCDU), local announcer FCU (switches), audio input or flight control (for example flight sticks, control yokes and/or joy-sticks) as well as the controls to select the displays they wish to view.

- 2.2.1.6 External Information Sources (6)
These are sources that provide information to the aircraft either autonomously, automatically or in response to interrogation by the aircraft systems. They include for example DME, ILS, GPS, and GPS local area correction.
- 2.2.1.7 Flight Deck Crew (7)
These are the flight deck personnel responsible for the operation of the aircraft and systems.
- 2.2.1.8 Communication Interface (8)
This includes the elements which route the messages received from the on board communications receivers to the appropriate aircraft system or flight deck crew. Conversely the Communication Interface receives messages from various aircraft systems and forwards them to the appropriate communication down-link router system such as ACARS MU, or CMU (ATSU).
- 2.2.1.9 Communications System (9)
This comprises the various communication modes which exist between the aircraft and the external outside world. It may include HF, VHF, VDL, HFDL, Satcom, Gatelink, and Mode-S.
- 2.2.1.10 Other Aircraft (10)
This includes those aircraft that could be in direct communication with the Subject Aircraft using systems such as ACAS, Mode-S, or VHF Voice etc.
- 2.2.1.11 Ground Receiver/Transmitter (11)
This comprises those ground facilities that receive communications from the aircraft and route them to the Ground Communications System or conversely which receive messages from the Ground Communication System and transmit them to the aircraft.
- 2.2.1.12 Ground Communications System (12)
This includes systems which process messages received from the aircraft and routes them through the appropriate ground network. The description includes those systems which accept messages from the various nodes of the ground network and route them to the aircraft via the appropriate ground transmitter; for example, SITA or ARINC ground networks.
- 2.2.1.13 ATM Computing and Displays (13)
This is the main processing point where information, relating to the airspace and the aircraft operating within it, is co-ordinated, analysed and presented to the ground ATM controller. Additionally it also provides a communication path whereby inputs and instructions from the controller are formatted into messages and addressed to particular aircraft.
- 2.2.1.14 ATM Controller (14)
This includes the ATS personnel responsible for the control and monitoring of the aircraft movements within the CNS/ATM environment.

- 2.2.1.15 Controls / Keyboards / Voice Input (15)
This comprises all interfaces which a controller might use to interrogate the ATS situational data and input instructions to the ATS system and subsequently to the Flight Deck Crew of an individual aircraft.
- 2.2.1.16 Airline Computing and Displays (16)
This is the main processing point where information, relating to an airline's own aircraft, is made available to the airline operations centre.

Additionally, it also provides a communication path whereby inputs and instructions from the operations centre are formatted into messages and addressed to particular aircraft.
- 2.2.1.17 Airline Operations Centre (17)
This is an airline facility which monitors and communicates directly with its aircraft, independent of the ATM facility.
- 2.2.1.18 Controls / Keyboards etc. (18)
This comprises the interfaces available to the airline operation centre to interrogate the state of the company's aircraft, or authorise the sending of data and messages to an individual aircraft.
- 2.2.2 Description of Data Flows
The data or information communicated between the various CNS/ATM generic system blocks listed in paragraph 2.2.1 is defined in the following paragraphs.
- 2.2.2.1 Aircraft to Aircraft Sensor (1-2)
This data-flow represents the various states detected by the aircraft sensors and on which their measurements are based. For example, pitch attitude, cabin pressure, landing gear position, etc.
- 2.2.2.2 Aircraft Sensors to Aircraft Systems (2-3)
This data-flow represents the state information gathered by aircraft sensors, which the aircraft systems use to perform processing operations and/or prepare for display, for example glidepath, CAS signals, etc. The communication means may include individual wires conveying analogue/discrete information, data-buses from individual sensors, and data-buses transferring data from many sensors or subsystems.
- 2.2.2.3 Aircraft Systems to Aircraft (3-1)
This represents the data from aircraft systems that result in changes to the state of the aircraft. For example, a command to lower landing gear, set flaps, set throttle lever to take-off level, increase cabin temperature, set elevator angle, etc. The communication may be by individual wires conveying analogue/discrete information, or by data-bus carrying digital commands addressed to particular actuators or subsystems.

- 2.2.2.4 Aircraft Systems to Displays (3-4)
This represents the data that is presented to the Flight Deck Crew either automatically or as a result of switch selections. Communication is generally by data-bus but may be transmitted in analogue format to particular instruments. The data may include messages received via the communication system and which the aircraft systems may have selected for presentation on the basis of priority.
- 2.2.2.5 Displays to Flight Deck Crew (4-7)
This represents the interpretation of the displayed information by the Flight Deck Crew, and results in the subsequent actions or inputs to subsystems by these personnel.
- 2.2.2.6 Flight deck Crew to Controls / Keyboards etc. (7-5)
This represents the actions taken by the Flight Deck Crew in response to the data which is displayed to them, as well as that which they see out of the window, sense by the motion of their bodies or hear around them. These actions may provide data or result in :
- a. inputs to various aircraft systems
 - b. changes to the aircraft state
 - c. changes to the data subset being displayed
 - d. messages transmitted to either the ATM or the AOC
- The Communication is typically by key strokes, button pushes and knob/switch selections, but could include direct voice input.
- 2.2.2.7 Flight Deck Crew to Communication Interface (7-8)
This is aural communication from the flight deck crew, which is routed by radio frequency selection to either the ATM controller or AOC using traditional voice communication.
- 2.2.2.8 Communication Interface to Flight Deck Crew (8-7)
This is an aural radio communication to the flight deck crew using traditional voice communication from any other station within the aircraft or external to it.
- 2.2.2.9 Flight Deck Crew Co-ordination (7-7)
This is aural or visual communication directly between the flight deck crew members.
- 2.2.2.10 Controls / Keyboards etc. to Aircraft Systems (5-3)
This data-flow reflects the flight deck crew input actions to the aircraft sub-systems by means of aircraft controls, keyboards, knobs, switches etc.

2.2.2.11 External Information Sources to Aircraft Sensors (6-2)

The data-flow from external sources may consist of a continuous information flow such as the transmissions received from the observable set of GPS satellites, ILS signals, or it may be in response to a stimulus transmission sent by the aircraft itself such as DME. It also could be a transmission from a ground station giving a local area GPS correction. The signals may be used within the particular receiving sensor, for example, the GPS receiver, or they may be decoded in a particular receiver and then transmitted on a data-bus to be used by other aircraft systems such as ILS signals.

2.2.2.12 Aircraft Systems to Communication Interface (3-8)

This data-flow represents data transmissions from the aircraft, and will have an embedded destination address. Messages may contain aircraft operation or performance data, and may contain data sent in response to a request from the ground, as a result of a flight deck crew decision/action or simply an acknowledgement to a received message. Several different systems may be responsible for generating such messages although many will arise from the Flight Management System, GNLU, or CMU (ACARS/ATSU). The messages may contain queries either to the airline or to the ATM system. Communication will comprise a subset of messages (as in CNS/ATM Package-1).

2.2.2.13 Communication Interface to Aircraft Systems (8-3)

This represents data which has been received by the aircraft and will have the aircraft destination addresses imbedded in them, for example, FMS, Cockpit printer, etc. Messages may contain operational routing preferences or ATC directives, which if followed could provide more economic operation. They may contain instructions from the air traffic services defining flight path which must be followed, or a constraint which must be obeyed for the safe operation of the airspace. The messages may also be in reply to queries raised by the flight deck crew. The communication will consist of a subset of messages (as in CNS/ATM Package-1) and may be transferred, (by the aircrew) to one or more data-buses.

2.2.2.14 Communication Interface to Communications System (8-9)

This communication will be in the form of messages addressed to particular recipients, for example, VHF, HF, Gatelink, etc. in accordance with ARINC 620. According to the used communication protocol this interface will handle any request from the ground to repeat the transmission if the message was not received in its entirety.

2.2.2.15 Communication System to Communication Interface (9-8)

This communication will be in the form of messages addressed to specific recipients, for example FMS.

2.2.2.16 Communication to and from other aircraft (9-10,10-9)

This communication will be in the form of messages transmitted and received between corresponding aircraft sub-network systems such as Mode-S, VHF, ACAS etc.

2.2.2.17 Communication to and from other aircraft (2-10,10-2)

This communication will be in the form of automatic surveillance messages transmitted and received between corresponding aircraft systems such as ADS-B and ACAS.