COMMUNICATIONS MANAGEMENT UNIT (CMU) MARK 2

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A description of the changes introduced by each supplement is included at the end of this document.

FOREWORD

Aeronautical Radio, Inc., the AEEC, and ARINC Standards

ARINC organizes aviation industry committees and participates in related industry activities that benefit aviation at large by providing technical leadership and guidance. These activities directly support aviation industry goals: promote safety, efficiency, regularity, and cost-effectiveness in aircraft operations.

ARINC Industry Activities organizes and provides the secretariat for international aviation organizations (AEEC, AMC, FSEMC) which coordinate the work of aviation industry technical professionals and lead the development of technical standards for airborne electronic equipment, aircraft maintenance equipment and practices and flight simulator equipment and used in commercial, military, and business aviation. The AEEC, AMC, and FSEMC develop consensus-based, voluntary standards that are published by ARINC and are known as ARINC Standards. The use of ARINC Standards results in substantial benefits to the aviation industry by allowing avionics interchangeability and commonality and reducing avionics cost by promoting competition.

There are three classes of ARINC Standards:

a) ARINC Characteristics – Define the form, fit, function, and interfaces of avionics and other airline electronic equipment. ARINC Characteristics indicate to prospective manufacturers of airline electronic equipment the considered and coordinated opinion of the airline technical community concerning the requisites of new equipment including standardized physical and electrical characteristics to foster interchangeability and competition.

b) ARINC Specifications – Are principally used to define either the physical packaging or mounting of avionics equipment, data communication standards, or a high-level computer language.

c) ARINC Reports – Provide guidelines or general information found by the airlines to be good practices, often related to avionics maintenance and support.

The release of an ARINC Standard does not obligate any organization or ARINC to purchase equipment so described, nor does it establish or indicate recognition or the existence of an operational requirement for such equipment, nor does it constitute endorsement of any manufacturer's product designed or built to meet the ARINC Standard.

In order to facilitate the continuous product improvement of this ARINC Standard, two items are included in the back of this volume:

An Errata Report solicits any corrections to the text or diagrams in this ARINC Standard.

An ARINC IA Project Initiation/Modification (APIM) form solicits any recommendations for addition of substantive material to this volume which would be the subject of a new Supplement.

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ATTACHMENTS

1.0 INTRODUCTION

1.1 Purpose of This Document

This document contains the physical form and fit dimensions, the electrical interface definition, and a description of the functions, operations, and interfaces of the Communications Management Unit (CMU) Mark 2.

The CMU Mark 2 is used to provide management and access to the various datalink networks and services available to the aircraft. The CMU Mark 2 may also host various applications related to datalink, including both Company and Air Traffic Services. A brief white paper on the role of the CMU Mark 2 in Communications, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) is provided in Appendix A.

The CMU Mark 2 is defined in terms of capability levels. There are two classes of capabilities, Levels 0 through 2 define communications service capabilities. Levels A through D defines application capabilities, see Section 4.1. The CNS/ATM definition is still in progress.

The CMU levels 0 and A definition has been completed. Future supplements will complete the definition of the other levels. The text for levels 1 through 2 and levels B through D is preliminary.

This document assumes that the architecture of the airborne CMU Mark 2, is as shown in the system block diagrams included as attachments. These architectures are consistent with guidelines provided by **ARINC Report 660A:** *CNS/ATM Avionics, Functional Allocation and Recommended Architectures.*

COMMENTARY

Equipment manufacturers should note that this document aims to encourage them to produce high Mean Time Between Unscheduled Removal (MTBUR), high performance equipment. They are at liberty to accomplish this by the use of design techniques they consider to be the most appropriate. Their airline customers are more interested in the end result than in the means to achieve it.

1.2 Organization of This Document

The purpose of this document is to provide general and specific guidance for the development and installation of the CMU Mark 2. As such, this guidance covers the standards necessary to achieve interchangeability, including mechanical packaging and connector. See Section 2, Interchangeability Standards.

Section 3 provides System Design information, including architecture and configurations.

Section 4 identifies the Functional Capabilities that may be provided.

Section 5 describes the Interfaces and Protocols necessary to provide the Functions.

Section 6 addresses Provisions for Maintenance and Test capabilities.

The attachments contain the referenced figures and tables.

For the reader's convenience, a historical record, referenced documents, and a list of acronyms used in this Characteristic are provided in the appendices.

1.3 Conventions Used In This Document

The following terminology is used in reference to various functions and interfaces:

CMU Mark 2 Levels - term to categorize functional capabilities and manage configurations. See Section 4.

Optional - this capability may be requested on a customer by customer basis, but may not be available in all designs, such as a design made only for digital aircraft.

Reserved - these capabilities are either to reserve some type of legacy interface for backwards capability, or reserving some type of growth interface for near term capabilities that have been identified, but are not yet available.

User Defined - these capabilities are at the manufacturer’s discretion to define in conjunction with specific customer needs.

End System - an end system is a function that generates or processes datalink messages directly with a specific intermediate system. In the ATN environment, an end system operates at the transport layer and above.

Intermediate System - an intermediate system provides communications services to one or more end systems. Intermediate systems may communicate with other intermediate systems or end systems.

Router - the router permits end systems to connect to other end systems, whether they are local or remote. The router function is an intermediate system.

Bridge - a bridge operates typically at the datalink layer between compatible networks. It typically copies/buffers packets from one Local Area Network (LAN) to another.

Gateway - a gateway is a process that allows incompatible networks or upper layer protocols to communicate. In the Aeronautical Telecommunication Network (ATN) environment a gateway may be provided by an appropriate ATN end system. Gateways typically deal with interoperability issues and can be quite complex.

Flight Management Computer (FMC) - for purposes of this document, Flight Management Computer is used in a generic sense. It could actually be an FMC or GNSS Navigator and Landing Unit (GNLU) or GNSS Navigator Unit (GNU) depending on the aircraft.

1.4 Relationship to Other Documents

This Characteristic introduces functionality, protocols, and interfaces into the CMU Mark 2 often by way of reference. Many of these references are to other documents, including other ARINC Standards. Readers should use the most current version of the referenced document, unless a specific version is given. See Appendix C. This Characteristic replaces **ARINC Characteristic 748:** *Communications Management Unit*, which has been reduced to historical status.

1.5 System Overview

The primary function of the CMU Mark 2 is to provide management and access to the Data Link networks and services available to the aircraft. These may be either Aircraft Communications Addressing and Reporting System (ACARS) and/or Aeronautical Telecommunications Network (ATN) compatible datalink networks, and for the transitional cases, may include both.

COMMENTARY

Airlines and suppliers of airborne subsystems interfacing with the CMU Mark 2 should note that a commitment to the CMU Mark 2 system may have an impact on both airborne and ground-based systems. This Characteristic aims at identifying and minimizing these impacts where necessary.

The CMU Mark 2 may host applications related to datalink, including Airline Operational Communications (AOC), Airline Administrative Communications (AAC), and Air Traffic Services (ATS) communications. Applications related to AOC, AAC, and ATS may also be hosted in other equipment. Aircraft should be configured to prevent possible conflicts in these cases.

The CMU Mark 2 may need to be able to accommodate multiple certification levels. Company communications are typically airline specific and the CMU Mark 2 should have sufficient flexibility to accommodate these needs.

ATS communications consist of Air Traffic Control (ATC) and Flight Information Services (FIS). The ATC communications include:

- Automatic Dependent Surveillance (ADS).
- Controller/Pilot Data Link Communications (CPDLC).
- Context Management (CM).

The CMU Mark 2 should provide interfaces and be integrated with on-board systems (e.g., Multipurpose Control and Display Units (MCDUs), alerting systems, printer, etc.) and flight management computers necessary for safe flight crew operation.

Aircraft intended to be equipped with the CMU Mark 2 are expected to have qualified subnetworks to provide the necessary datalink communications capability.

ATN provides the capability to transfer binary data, as well as information using any code set, among host computers independent of the underlying sub-network technologies or protocols. In this manner, system interconnectivity is achieved, so that all users are provided a common environment.

The CMU Mark 2 router function is connected to various avionics subsystems via the onboard avionics data buses. Access to the ground networks includes the following Data Link subnetworks: VHF, HF, Satellite, and RF Gatelink.

The CMU Mark 2 is primarily intended to be a Line Replacable Unit (LRU) based design for replacement or upgrades to existing ARINC 724 and ARINC 724B Management Units (MUs). The CMU Mark 2 is intended to support all Air Transport Category aircraft utilizing LRUs for these functions and is optimized for digital ARINC 700-series aircraft with electronic displays.

1.6 Interchangeability

System interchangeability, as defined in Section 2 of **ARINC Report 607:** *Design Guidance for Avionic Equipment,* is desired for the CMU Mark 2. The standards necessary to ensure this level of interchangeability are set forth in Section 2, Interchangeability Standards.

COMMENTARY

This document specifies standard interwiring that satisfies users' needs over the long-term. ARINC 758 compliance includes the use of the standard interwiring. ARINC 758 retrofit installation may require changes to aircraft wiring or modification to CMU internal wiring to enable it to be installed in existing aircraft that conform to the ARINC 724B interwiring definition. The user community should be aware of the availability in the market place of CMUs that contain ARINC 758 functionality, but include ARINC 724B interwiring.

1.7 Regulatory Approval

This equipment could form part of an ATC datalink system where the separation standards are reduced and the safe operation in these conditions is predicated on the reliability of the overall system.

The equipment should meet all applicable ICAO, JAA, and FAA regulatory requirements. This document does not and can not set forth the specific requirements that equipment must meet in order to be assured of approval. Such information should be obtained from the regulatory agencies themselves. See Appendix C for a list of reference documents.

1.8 Integrity and Availability

The anticipated operational use of the system demands the utmost attention to the need for reliability in all phases of system design, production, installation, and operation of the CMU Mark 2. It is not the purpose of this Characteristic to define specific Mean Time Between Failure (MTBF) or Mean Time Between Unscheduled Removal (MTBUR) requirements. However, it is of paramount importance to the airlines to operate a trouble free unit with minimum impact on scheduling and maintenance. A special emphasis should be given to total system quality, including built-in testing, ramp testing, and shop testing to increase the MTBUR.

COMMENTARY

MTBUR has a profound affect on airline operations, despite a high MTBF. It is anticipated that specific reliability expectations will be negotiated between individual airlines and equipment manufacturers. A very high MTBF (e.g. greater than 40,000 flight hours) is expected for the CMU Mark 2. Ideally, MTBUR should approach MTBF.

1.9 Testability and Maintainability

The total system quality should include adequate ability for the operator to test and maintain the CMU Mark 2 effectively. The CMU Mark 2 designer should confer with the user to establish goals and guidelines for testability to minimize unnecessary removals. The use of advanced Built-In Test Equipment (BITE), ramp testing equipment, and adequate documentation should help the operators increase MTBUR. For airline operations, MTBUR is at least as important, perhaps more so, than MTBF. Testability should be such to identify the causes of repeat removals and eliminate the cause of unconfirmed faults.

For shop maintainability, the design of physical access and functional partitioning of the CMU Mark 2 should be such to minimize repair time. Where possible, excessive unit disassembly should not be required for internal component replacement. Full and complete documentation included in a Component Maintenance Manual should also facilitate effective maintainability.

1.10 Flight Simulators

Flight simulators are recognized as an important part of the aviation industry. Airlines depend upon simulators for flight crew and maintenance training. The CMU Mark 2 should be designed for use in flight simulators. Airlines typically desire simulators to be available as early as possible to allow for crew training prior to introduction into revenue service. The guidelines of **ARINC Report 610A:** *Guidance for Use of Avionics Equipment and Software in Simulators* apply.

2.0 INTERCHANGEABILITY STANDARDS

2.1 Interchangeability Objectives

This section defines the specific form factor, mounting provisions, interwiring, input and output interfaces, and power supply characteristics desired for a CMU Mark 2. These standards permit the parallel, but independent design of compatible equipment and airframe installations.

2.2 Form Factor, Connector, and Index Pin Coding

The CMU Mark 2 should comply with the dimensional standards in **ARINC Specification 600:** *Air Transport Avionics Equipment Interfaces,* for a 4 MCU form factor. The CMU Mark 2 should also comply with ARINC Specification 600 with respect to weight, racking attachments, front and rear projections and cooling.

The CMU Mark 2 should be provided with a low insertion force, size 2 shell ARINC Specification 600 service connector. This connector, which should accommodate service interconnections in its middle plug (MP) and top plug (TP) inserts respectively and power interconnections in its bottom plug (BP) insert should be located on the center grid of the CMU Mark 2's rear panel. Index pin code 58 should be used. See Attachment 2-1, Rear Connector Insert Diagram.

COMMENTARY

> Due to the significant interconnect and planned functional differences the index pin code is intentionally different than prior generation ACARS MUs.

A front panel accessible connector should be provided on the CMU Mark 2 to support on-aircraft Data Loading, when it is installed on aircraft lacking a centralized Data Loading System or no permanently installed access connector to a portable unit exists. A cover should be provided to protect the connector from damage, contamination, etc., while not in use.

COMMENTARY

> If a Portable Data Loader (PDL) is going to be used for on-board data loading, provisions may be needed to supply power to the PDL, perhaps through the front panel connector. If the CMU Mark 2 provides 115 Vac power through this connector, special provisions should be made for safety and short circuits in the design.

An additional front panel connector may also be provided in consideration of a possible connection to an On-Board Local Area Network (OLAN) that complies with **ARINC Specification 636***,* *Onboard Local Area Network (OLAN).*

If bench testing of the CMU Mark 2 with Automatic Test Equipment (ATE) necessitates interconnect capabilities that are not covered by the pin assignments on the service connector set forth in the Attachments, then an auxiliary connector should be provided whose type and location are selected by the equipment manufacturer. The manufacturer should observe the standards of ARINC Specification 600 when choosing the location for the connector. The manufacturer is free to use the auxiliary connector pins as needed. Since the auxiliary connector is not to be used while the CMU Mark 2 is installed in the aircraft, it should be provided with a cover to protect it from damage, contamination, etc., during that time.

COMMENTARY

The auxiliary connector is specified to permit completion of the interface without recourse to the use of individual test leads from the ATE, each of which has to be clipped, or otherwise secured, to a test point on the equipment.

2.3 Power

The CMU Mark 2 should be designed to accept 115 Vac, 400 Hz, single phase ac power as the source of primary power. The primary power input should be protected by circuit breakers 2.0 Amp 115 Vac.

COMMENTARY

Separate Pins (BP 2 and BP 3) are also provisioned on the service connector for 28 Vdc primary power. Support for 28 Vdc power is a marketplace item.

Provisions are included for a standby 28 Vdc (aircraft battery) source. This may be used for long term data storage and/or internal clock operation. Equipment manufacturers may elect to draw power from the dc source continuously or to restrict its use to those times when the ac source is unavailable. In no case, however should the dc drain exceed 75 mA. Installation designers should note that the dc power should be provided by a non-interruptible source, i.e., not via switching circuits to a battery bus, in emergency conditions. This source is not available on all aircraft.

COMMENTARY

Equipment designers should note that in the practical aircraft environment, the steady state dc voltage may vary between 18.0 Vdc and 36.0 Vdc, to which the ripple and transient limits referenced should be applied.

Aircraft power supply characteristics, utilization, equipment design etc. are set forth in **ARINC Specification 413A:** *Guidance for Aircraft Electrical Power Utilization and Transient Protection* and **ARINC Report 607:** *Design Guidance for Avionic Equipment*.

There should be no master ON/OFF power switching for the CMU Mark 2. Any user desiring ON/OFF control should provide, through the medium of a switching function installed in the airframe, means of interrupting the primary power to the unit. It is probable, however, that ON/OFF switching is not needed in most installations and that power is wired to the unit from the circuit breaker panel.

The CMU Mark 2 should be able to continue operating through any transient under 200 ms.

COMMENTARY

The 200 ms value is derived from RTCA DO-160C and is based upon power switching times on-board the aircraft that can occur any time.

The CMU Mark 2 should be capable of storing limited information for at least 30 minutes without power applied.

COMMENTARY

The 30-minute value is derived largely from operational experience. This includes survival during a Ground Power Unit/Auxiliary Power Unit (GPU/APU) power transfer failure which may occur while at the gate, and it is undesirable to either perform re-initialization of the system or to have a loss of data for the current leg that is nearly completed. This is also consistent with the 30-minute aircraft battery life value.

This information could include, but is not limited to, initialization data, received uplink messages, undelivered downlink messages, statistical and BITE information. Data retention should be available in installations with or without the 28 Vdc battery supply bus.

2.4 Standard Interwiring

The standard Interwiring to be installed for the CMU Mark 2 is set forth in Attachment 2-2. This interwiring is designed to provide the degree of interchangeability specified for the CMU Mark 2. See Section 1.6, Interchangeability.

Manufacturers are cautioned not to rely on special wires, cabling or shielding for use with particular units because they may not exist in a standard installation.

COMMENTARY

Manufacturers are encouraged to utilize only those pins on the service connector designated for ATE purposes, and not make use of pins not currently defined or left for customer definition.

2.5 Environmental Conditions

The CMU Mark 2 should be specified environmentally in terms of the requirements of the latest version of RTCA DO-160. Attachment 9 tabulates the relevant environmental test categories.

2.6 Cooling

The CMU Mark 2 should be designed to accept, and airframe manufacturers should configure the installation to provide forced air cooling as defined in ARINC Specification 600. The standard installation should provide an air flow rate of 22 kg/hr of 40 degrees C (max.) air and the unit should not dissipate more than 100 watts of energy. The coolant air pressure drop through the equipment should be 25 $\pm$2.5 mm of water. The CMU Mark 2 should be designed to expend this pressure drop to maximize the cooling effect. Adherence to the pressure drop standard is needed to allow interchangeability of the equipment.

COMMENTARY

Although the CMU Mark 2 is to be packaged in accordance with ARINC Specification 600, some retrofit installations are expected into aircraft racking designed in accordance with **ARINC Specification 404A:** *Air Transport Equipment Cases and Racking*. The cooling provisions of these two racking standards were intentionally established such that ARINC 600 equipment would be compatible with ARINC 404A racking. Thus, the CMU Mark 2 cooling provisions are compatible with ARINC 404A aircraft racking.

The CMU Mark 2 designer should consider that the CMU Mark 2 is expected to operate without substantially lower reliability in an aircraft installation in which cooling is not available.

2.7 Grounding and Bonding

Equipment and airframe manufacturers should follow the guidance material in ARINC Specification 600 Section 3.2.4 and in ARINC Specification 404A in Section 6 and Appendix 2 on the subject of equipment and radio rack grounding and bonding.

2.8 IMA Packaging Considerations

In some aircraft avionics architectures, the CMU Mark 2 functionality, as described in Section 4, may be implemented in Integrated Modular Avionics (IMA) equipment, and integrated with other avionics functions such as Flight Management, Displays, Central Maintenance, Aircraft Condition Monitoring, etc. Under these circumstances, the form factor, mounting provisions, interwiring, power supply, and physical input and output connector pin assignments may not conform to the characteristics set forth in this section. As these characteristics are generally dependent on the form factor, etc. of the specific IMA implementation and the level of functional integration performed, reference should be made to the specifications for the particular equipment.

2.9 ARINC Standard Interfaces

The standard electrical inputs and outputs from the systems should be in the form of a digital format or switch contact. Standards should be established precisely to assure the desired interchangeability of equipment.

Certain basic standards established herein are applicable to many signals. Signals should conform with the standards in the following sections, unless specified otherwise in Section 5.

2.9.1 ARINC 429 Data Bus

ARINC Specification 429: *Mark 33 Digital Information Transfer System (DITS)* is the controlling document for data word formats, refresh rates, resolutions, etc. Material contained in this document related to these topics is included for reference purposes only. In the event of conflict between this document and ARINC Specification 429, the latter should take precedence.

2.9.2 Standard “Open”

The standard, “open” signal is characterized by a resistance of 100,000 ohms or more with respect to signal common.

COMMENTARY

In many installations, a single switch is used to supply a logic input to several LRUs. One or more of these LRUs may utilize a pull-up resistor in its input circuitry. The result is that an "open" may be accompanied by the presence of +27.5 Vdc nominal. The signal could range from 12 to 36 Vdc.

2.9.3 Standard “Ground”

A standard “ground” signal may be generated by either a solid state or mechanical type switch. For mechanical switch-type circuitry, a resistance of 10 ohms or less to signal common would represent the "ground" condition. Semiconductor circuitry should exhibit a voltage of 3.5 Vdc or less with respect to signal common in the "ground" condition.

2.9.4 Standard "Applied Voltage" Output

The standard "applied voltage" is defined as having a nominal value of + 27.5 Vdc. This voltage should be considered to be "applied" when the actual voltage under the specified load conditions exceeds 18.5 volts (+ 36 Vdc maximum) and should be considered to be not applied when the equivalent impedance to the voltage source exceeds 100,000 ohms.

2.9.5 Standard Discrete Input

A standard Discrete Input should recognize incoming signals having two possible states, "open" and "ground". The characteristics of these two states are defined in Sections 2.9.2 and 2.9.3 of this Characteristic. The maximum current flow in the steady state "ground" state should not exceed 20 mA.

The "true" condition may be represented by either of the two states (ground or open) depending on the aircraft configuration.

The maximum input capacitance to ground should be less than 1 microfarad.

COMMENTARY

In past installations there have been a number of voltage levels and resistances for discrete states. In addition, the assignments of “Valid" and "Invalid" states for the various voltage levels and resistances were sometimes interchanged, which caused additional complications. In this Characteristic a single definition of discrete levels is being used to standardize conditions for discrete signals.

The voltage levels and impedance used are, in general, acceptable to hardware manufacturers and airlines. This definition of discrete is also being used in the other ARINC 700-Series Characteristics; however, there are a few exceptions for special conditions.

The logic sources for the Discrete Inputs to the CMU Mark 2 are expected to take the form of switches mounted on the airframe component (flap, including gear, etc.) from which the input is desired. These switches can either connect the Discrete Input pins on the connector to airframe dc ground or leave them open circuit as necessary to reflect the physical condition of the related components.

The CMU Mark 2 is, in each case, expected to provide the dc signal to be switched. Typically, this is done through a pull-up resistor. The CMU Mark 2 input should sense the voltage on each input to determine the state (open or closed) of each associated switch.

The selection of the values of voltages and resistances, which define the state of an input, is based on the assumption that the Discrete Input utilizes a ground-seeking circuit. When the circuit senses a low resistance or a voltage of less than 3.5 Vdc, the current flow from the input should signify a "ground" state. When a voltage level between 18.5 and 36 Vdc is present or a resistance of 100,000 ohms or greater is presented at the input, little or no current should flow. The input may utilize an internal pull-up to provide for better noise immunity when a true "open" is present at the input. This type of input circuit seems to be favored by both manufacturers and users.

Because the probability is quite high that the sensors (switches) are providing similar information to a number of users, the probability is also high that unwanted signals may be impressed on the inputs to the CMU from other equipment, especially when the switches are in the open condition. For this reason, equipment manufacturers are advised to base their logic sensing on the "ground" state of each input. Also, both equipment and airframe suppliers are cautioned concerning the need for isolation to prevent sneak circuits from contaminating the logic. Typically diode isolation is used in the avionics equipment to prevent this from happening.

The maximum input capacitance requirement was added because some implementations included an excessive amount of capacitance, which caused excessive current spikes.

2.9.6 Standard Discrete Output

A standard Discrete output should exhibit two states, "open" and "ground" as defined in Sections 2.9.2 and 2.9.3. In the "open" state, provision should be made to present an output resistance of at least 100,000 ohms. In the "ground" state provision should be made to sink at least 20 milliamperes of steady state current. Non-standard current sinking capability may be defined.

COMMENTARY

Not all discrete output needs can be met by the standard discrete output defined above. Some discrete outputs may need to sink more current than the standard value specified above and will be defined in the appropriate section of this document.

The designer is cautioned that discrete input capacitance and discrete output slew rates have caused current spikes.

A discrete output may need to source current. Discrete outputs which are to source current should utilize the standard "Applied Voltage" output defined in Section 2.9.4. These special cases are noted in the text describing each applicable discrete output function and in the notes to interwiring.

COMMENTARY

Although defined here, discrete outputs, which provide a current output rather than a current sink, are not "Standard Discrete Outputs".

2.9.7 Standard Program Pin Input

Program pins may be assigned on the CMU Mark 2 service connector for the purpose of identifying a specific aircraft configuration or to select or enable optional performance.

COMMENTARY

Program pins may be used for a variety of purposes. Program pins enable a piece of equipment to be used over a greater number of airframe types. One way this is done is by identifying the unique characteristics of the airframe in which the unit is installed. Another is to identify the location (left, right, center) of the unit. Often program pins are used to enable (turn on) options for alternate or extended performance characteristics.

The encoding logic of the program pin relies upon two possible states of the designated input pin. One state is an "open" as defined in Section 2.9.2 of this Characteristic. The other state is a connection i.e., (short circuit of 10 ohms or less) to the pin designated as the "Program Common" pin.

COMMENTARY

Normally, the primary location or usual, common or standard function is defined by the "open" logic and the optional response is programmed (encoded) by connection to Program Common pin.

3.0 SYSTEM DESIGN

3.1 System Architecture

This Characteristic assumes that the architecture of the airborne CMU Mark 2 is as shown in the system block diagrams included as attachments. These architectures are consistent with guidelines provided in ARINC Report 660.

The CMU Mark 2 communication system architecture consists of a suite of protocols and interfaces selected for the aircraft-ground communications.

The datalink infrastructure provides world wide datalink services over a variety of datalink media and protocols. VHF ACARS is the initial media and protocol, but over time is expected to transition to more advanced protocols, wider coverage areas, and higher speed services. The goal of the CMU Mark 2 is to provide seamless availability for the datalink applications. See Attachment 1-1, Datalink Infrastructure.

3.1.1 CMU As End System Architecture

In the CMU as an end system Architecture, the CMU Mark 2 operates as an ATS airborne end system and router. See Attachment 1-2 for a diagram illustrating the architecture for the CMU as an end system. This diagram illustrates both ACARS and ATN end system functions provided by a CMU.

In an ACARS-only (non-ATN) environment, only the protocols and applications outside the heavy line boxes in Attachment 1-2 are provided by the CMU as an ACARS end system. For the supported datalink applications, this architecture provides CMU AOC applications and may also provide ATS character-oriented ARINC 623 and/or ARINC 622 bit-oriented CPDLC and ADS applications, using the ACARS Convergence Function (ACF).

When a CMU Mark 2 is updated with ATN protocols, then the ATN protocol stack as well as the new ICAO applications and network management may additionally be included in this architecture.

Regardless of whether the CMU Mark 2 operates as an ACARS or ATN end system (or both), if it hosts applications, which use internal Flight Management System (FMS) data, then it should support the ARINC 656 CMU/FMC Information Broker (CFIB) application, which resides over the Simple Network Management Protocol (SNMP), the User Datagram Protocol (UDP), and the Internet Protocol (IP). The CFIB, SNMP, UDP, and IP are described in **ARINC Specification 656:** *Avionics Interface Definition for Flight Management and Communications Management Functions,* and are used to provide the necessary data parameter transfers from an FMS, GNLU, or GNU. These parameters are used to fully support the ATS applications hosted by the CMU for this architecture. For AOC applications hosted in an external LRU (e.g., FMS), the CMU Mark 2 also provides ACARS routing support via **ARINC Specification 619:** *ACARS Protocols for Avionic End Systems.*

3.1.2 MU As Router Architecture

In the CMU as Router Architecture, the CMU Mark 2 operates primarily as an airborne router for other onboard end systems, but also operates as an end system for some internal AOC and ATS applications. See Attachment 1-3 for a diagram illustrating the architecture for the CMU as a Router. Attachment 1-3 depicts examples of both ACARS and ATN end system functions, with an FMS providing the primary end system functions for the FANS environment. In this architecture, the FMS may also host some AOC applications.

For the CMU in an ACARS-only (non-ATN) environment, only the protocols and applications outside the heavy line boxes in Attachment 1-3 are provided. In this architecture, the FANS applications - CPDLC, ADS, and AFN - are hosted by onboard LRUs external to the CMU, but are supported by the CMU through the ACARS routing function. The CMU's AOC and ARINC 623 ATS applications are still provided by the CMU in this architecture.

When this architecture is updated with ATN protocols, the CMU Mark 2 is updated as an ATN router. The CMU Mark 2 may also operate as an ATN end system, hosting the ATN network management application as well as other potential applications such as Flight Information Service (FIS). The ICAO applications and ICAO upper layers supporting those applications are hosted in an external LRU for this architecture, such as the FMS.

Neither the ARINC 656 CFIB or the SNMP, UDP, or IP are necessary for this architecture. However, these additional functions may be optionally implemented across the CMU to FMS interface to provide data parameters needed for other internal CMU Mark 2 applications or for other onboard system support, such as ADS-B.

3.1.3 CMU In Distributed Application Architecture

Text for this section will be supplied in a future supplement.

3.1.4 CMU/FMS As Integrated Architecture

In an integrated architecture, the CMU Mark 2 functions operate in conjunction with FMS functions, to allow both airborne router and end system functions to be provided in a single LRU. This architecture is similar to the CMU as end system architecture, except that it does not require data parameter transfers across an external avionics bus. Attachment 1-5 illustrates the architecture for the CMU/FMS as Integrated Architecture.

In an ACARS-only environment, only the protocols and applications outside the heavy line boxes are provided by the CMU/FMS. For the ATN environment, the ATN protocols, including the ICAO upper layers, the ICAO applications, and the network management application are added to the CMU/FMS.

ARINC 656 CFIB nor the SNMP are required for this architecture since data transfers are accommodated through internal buses.

3.1.5 Data Bus Architecture

Most on-board physical interfaces to the air-to-ground digital communication links are typically ARINC 429, with operation of the Bit-Oriented Protocol (BOP) at the link level. See Section 5.3.5, ARINC 429 BOP Protocol. Reference **ARINC Specification 429:** *Mark 33 Digital Information Transfer (DITS), Part 3, File Data Transfer Techniques*.

There may be some operational requirements, such as a desired system availability, which lead to dual CMU Mark 2 aircraft installations. See Section 4.15, Dual Installation, and Attachment 1-8.

Applications, sensors, and peripheral interfaces are dependent on both the aircraft and where applications are hosted in a specific configuration.

3.2 System Flexibility

The CMU Mark-2 should be flexible in its design to meet the ever-changing datalink environment and to provide a system with beneficial life-cycle costs.

To accommodate this need, the CMU Mark 2 should be designed with sufficient margins of growth in memory and processor capacity to accommodate a long-term life cycle. The CMU Mark 2 should be designed such that only half of the memory and processor capabilities of the system are used, when performing the expected functions of a Level 1C System, as described in Section 4.1. This spare capacity can be achieved by designing the CMU Mark 2 for future upgrades. If upgrades are needed to achieve this capability, it should be performed such that the existing circuit cards do not have to be replaced. One standard technique for achieving this capability is to not populate Integrated Circuits (ICs) until needed, or replace existing ICs with higher density devices.

The CMU Mark 2 should also support the need for additional capabilities not yet defined, and which may require additional hardware circuitry. To accommodate this, the CMU Mark 2 should be designed to accommodate the future addition of at least one additional circuit card assembly. The addition of new circuitry should support interfacing with rear connector pins which are not yet assigned.

The following sections provide guidance on the functions, protocols, and interfaces where additional functionality is anticipated.

3.2.1 Transitional Considerations

The CMU Mark 2 should provide the flexibility to support the CNS/ATM requirements in the transition to digital communication, which is expected to occur in a series of upgrades to the CMU Mark 2.

Transitional considerations have been studied by various industry for a and consist of two primary areas: Operational and Technical. Once the operational considerations are defined, the technical considerations should detail how to satisfy those operational requirements.

3.2.1.1 Operational Transitional Considerations

Operational considerations deal primarily with the impact on airspace management and pilot/controller communications, which are now predominately Analog voice communications. Reference RTCA Task Force 2 Final Report *Transition to Digital Communications*, RTCA/DO 219 *MOPS for ATC Controller/Pilot Data Link Communications (CPDLC),* and Society of Automotive Engineers (SAE) ARP4791 *Human Engineering Recommendations for Data Link Systems*.

New flight-deck procedures and improved human/machine interfaces are needed to support Air Traffic Management utilizing primarily data communications. If the CMU Mark 2 is hosting any of these applications, appropriate flight-deck interfaces should be provided. These transitions are expected to occur in oceanic airspace first, then enroute, and finally in terminal areas. International airspace users may also need to have airborne communications capabilities compatible with differing Civil Aviation Administration (CAA) boundaries and Flight Information Regions (FIRs) on a flight.

3.2.1.2 Technical Transitional Consideration

Much of the datalink communications is used for AOC purposes. The operational portion of this data varies from airline to airline and also changes over time and as new ground-based applications are brought on line.

The interfaces and protocols for air-ground communications, end-to-end system communications and interfaces with other on-board systems are expected to evolve to provide the increased reliability, flexibility and functionality needed for CNS/ATM. The CMU Mark 2 should be designed to support this growth, recognizing that as new interfaces and protocols are defined, the CMU Mark 2 should be capable of supporting the new interfaces and protocols, while maintaining support for the existing interfaces and protocols.

Technical considerations that need to be addressed by both the CMU Mark 2 supplier as well as airlines, OEMs, service providers and others involved in the CMU Mark 2 development and deployment, include:

- The CMU Mark 2 will most likely need to support simultaneous communications with various ground systems, in which different protocols may be necessary. This need is based on the different capabilities which are expected to exist at the various ground systems. As an example, the CMU Mark 2 may be simultaneously communicating with two different ATC centers, one supporting ATN and the other supporting ARINC 622, while at the same time transmitting AOC messages using ARINC 618. Technical consideration needs to be given to the implementation approach to support this capability and the need for system level link management functions within the CMU Mark 2 to manage the multiple protocols.
- The CMU Mark 2 is expected to be interoperable with all ATC centers supporting datalink capabilities. Although all ground systems should be developed in accordance with ICAO standards, differences/anomalies should be assumed as systems start to become operational, and entry into service with each new ground system should be carefully monitored by the Airline, Service Provider and CMU Mark 2 Supplier.
- The advent of the ATN protocol may result in current AOC/AAC messages (either generated by the CMU Mark 2 or other on-board LRUs) to be incompatible with an existing airline's host computer system (due to the encapsulation performed for transmitting over an ATN link). Technical considerations should be taken to ensure the airline and/or service providers have made the necessary changes to reformat such messages or adapt the airline host computer.
- The definition of ATC applications are expected to continually evolve similar to the same type of evolution experienced with AOC applications. Technical considerations need to be given in the ability to support such changes without imposing significant cost and effort.
- Additional interfaces are expected to be added to the CMU Mark 2 in phases, with different airlines integrating in new CNS/ATM equipment at different times, and in different time phases. As an example, new FMCs (or GNLUs/GNUs) may be added before or after the addition of a new display unit; which may be added before or after the installation of Global Positioning System (GPS);

which may be added before or after new datalinks such as VHF Data Radios (VDRs). In addition, LRU interfaces are also expected to evolve. As an example, the CMU Mark 2 may initially be installed on aircraft with an ARINC 702 FMC. The FMC interface may evolve from a standard ARINC 429 interface to an ARINC 702A FMC using the ARINC 656 interface. Technical considerations need to be given during the design to support these inevitable permutations, while attempting to maintain a system that can be common across multiple aircraft configurations. The CMU Mark 2 will need to be able to accommodate the differing CMU architectures, as shown in Attachments 1-2 through 1-5.

- With the advent of CNS/ATM, the number of datalink equipped aircraft and the number of datalink messages are expected to increase significantly during the CNS/ATM transition. Technical considerations need to be given to the optimization and management of the networks to ensure that operational performance for ATS communications is maintained. This includes additional considerations in the prioritization and scheduling of AOC/AAC data communications.

3.2.2 Aircraft Variants

Aircraft variants described in this Characteristic, consist not only of older analog aircraft and digital aircraft, but also incorporates the wide ensemble of aircraft in which different avionics interfaces are installed.

The CMU Mark 2 should be designed to support installation on all such aircraft variants, given a minimal equipment configuration, to include: datalink radios, cockpit display units, and the necessary input buses/discretes to support the intended function of the CMU Mark 2. A single hardware solution should be designed to support all such variants.

The CMU Mark 2 should support the differences which exist between the different aircraft variants through the use of configuration information, which can be easily reconfigured on an aircraft-by-aircraft (or aircraft-type) basis. This reconfigurable data can be resident in reconfigurable (operational) databases. This data should provide the ability to identify which buses and discretes are used on each aircraft, for receiving the needed data for CMU Mark 2 functions. In addition, this configuration information is expected to identify the type and quantity of devices installed on the aircraft (such as GNLUs, GNUs, FMCs, VDRs, SDUs, MCDUs, DMUs, etc.). A routing capability to transfer ACARS messages directly to SDUs is defined as ARINC 619 ACARS peripherals from airline host computers.

In general, the installation of the CMU Mark 2 on today's digital aircraft present few challenges, since these aircraft already support multiple display units, incorporate a data bus architecture, and provide many of the interfaces required for a Level 0A (and higher) CMU Mark 2, see Section 4.1. These aircraft may need to have additional wiring to support some of the interfaces (and the functions these interfaces provide), as identified in Section 5. In contrast, older analog aircraft that are to be upgraded to support CNS/ATM functions may need more significant changes. This may require major changes to both avionics wiring and flight deck alterations. Flight deck alterations could include such changes as the addition of new Radio Management Panel(s), addition of new display units, and other graphical interfaces for improved flight management and navigation functions. Incorporating new radios (VHF, HF, SDU), FMCs, and other equipment may result in significant changes to the aircraft avionics bay.

The CMU Mark 2 may not be capable of interfacing with all legacy equipment, which may be installed on older aircraft. This legacy equipment (such as ARINC 500-series radios), are not considered to provide the needed capability to support CNS/ATM. Such equipment is expected to be replaced with new avionics, at the same time or before, installation of the CMU Mark 2.

3.3 Certification and Partitioning Considerations

The CMU Mark 2 contains evolving functionality. Some of the functions may also have differing levels of certification. Because of this, a partitioned design is expected to provide cost-effective mechanisms to support the changes and provide isolation between major functions to assist in certification.

Each software component, which is software loaded into a CMU Mark 2, should include a pattern recognition (Checksum, CRC, or other similar error detection), which should be validated by the CMU Mark 2 to verify that the software or database elements are correctly loaded. The specific means by which validation is performed should be compatible with the criticality level of the specific software component. The CMU Mark 2 should also verify that all other previously loaded software components are not affected following the load of a specific software component.

The equipment manufacturer should refer to **ARINC Report 652:** *Guidance for Avionics Software Management* to obtain guidance concerning partitioning software and software configurations.

To support certification of the CMU Mark 2, qualification tests should be performed to validate the operational characteristics of its intended functions. In addition to supplier testing as described in DO-160C and DO-178B, the avionics supplier should conduct various qualification tests developed by OEMs and service providers as part of the activities to obtain certification. Qualification testing is also expected to be necessary for verification of ATS applications and correct operation of ATN software. The following sections identify specific design guidance for the CMU Mark 2 functional partitioning.

3.3.1 AOC Applications

The CMU Mark 2 should provide the capability to support airline-specific functions, which vary from airline to airline. AOC functions include Out-Off-On-In (OOOI) message processing, connecting gate information, flight statistic generation, free text messages, the corresponding AOC cockpit display menu's and downlink messages. The CMU Mark 2 should accommodate the updating of these software functions without impacting ATS and other functions that would be contained in a different software segment. The avionics designer should recognize the need to develop AOC functions such that they can be easily reconfigured by the airlines. Reconfiguration capabilities should include the ability to modify display formats, printer formats and downlink message formats at a minimum.

3.3.2 ATS Applications

The CMU Mark 2 should provide the capability to update and/or add ATS applications (such as CPDLC, ADS, etc.) via electronic software downloading, such as from a data loader. The ATS applications should be partitioned such that changes to the ATS applications do not impact the other partitions and changes to other partitions do not impact the ATS applications.

COMMENTARY

In the future, functions, processing, and interfaces associated with Air Traffic Services are expected to carry an essential-level certification level.

The CMU Mark 2 should be designed such that it can support both ATS applications contained internally within the CMU Mark 2 as well as ATS applications which are hosted by other on-board systems, such as FMCs, GNUs or GNLUs.

The avionics manufacturer should design the ATS applications such that message formats and display formats can be quickly and easily modified, allowing manufacturers to respond quickly to the changing CNS/ATM environment.

3.3.3 Routing Policy Database

The CMU Mark 2 should accommodate the establishment of a Routing Policy Database. Routing policy information should entail both airline preferences for message routing (such as preferred datalinks to use over specific geographical regions) as well as network management parameters. The routing policy information should be designed such that it can be added and/or updated via electronic software downloading, such as from a data loader. It should be possible to update the CMU Mark 2 Routing Policy Database without affecting the router software. The Routing Policy Database should support both ACARS and ATN-based routing.

The CMU Mark 2 may in the future receive network management parameters dynamically from service providers, and should be considered by the avionics developer during the design.

3.3.4 Configuration Parameters

The CMU Mark 2 should be designed for easy modification or reconfiguration, such that the CMU Mark 2 can be used on multiple aircraft types, with only software loading changes. To accommodate this capability, the CMU Mark 2 should be able to reconfigure various I/O ports to support the differing aircraft interfaces.

The CMU Mark 2 should be capable of updating various tuning parameters (primarily timer values) used within the various protocols, to facilitate future modifications. The avionics designer should recognize the need to perform such updates without impacting the actual protocol software.

Aircraft level configuration and identity may be loaded from the Aircraft Personality Module (APM) or other on-board digital source. See Section 4.12, Configuration Database.

3.4 Software Data Loading

The CMU Mark 2 should accommodate the ability to update its operational software programs and databases electronically. The objectives of data loading is to facilitate modifications to various software components within the CMU Mark 2 without the need to remove the unit from the aircraft, and to accomplish updates rapidly to avoid disrupting normal aircraft operations. These updates should be accommodated through the use of an ARINC Specification 615 Data Loader. Reference Section 6.3, Dataloading. In addition, the CMU Mark 2 should be capable of supporting the loading of software via an Ethernet interface, according to **ARINC Report 615A:** *Software Data Loader with Ethernet Interface and High Density Storage Medium* if an Ethernet data-loader interface is available.

3.5 Support Tools

The term support tools refers to ground-based equipment (software or software and hardware), which is used for the purpose of modifying (reconfiguring) the functionality/configuration of the CMU Mark 2.

To accommodate the updating of software and databases within the CMU Mark 2 (and APM), ground-based tools should be developed that allow for the generation of the electronic media, which is subsequently used to load the CMU Mark 2 system. For CMU Mark 2 functions, such as AOC and AAC, in which certification levels of the software allow user (airline) modification, the corresponding AOC/AAC support tools should be developed for the intended use by airline personnel. The avionics manufacturer should recognize that such ground-based support tools should be developed in a manner which minimizes training of airline personnel and which can be provided at a reasonable cost. The need for airline personnel to understand a programming language to use these tools should be avoided. The recommendation is that the avionics manufacturer develops airline reconfiguration tools such that they can be operated on computer hardware platforms that are commonly used within the industry.

Support tools that are used to create or change those databases, which affect certification of the CMU Mark 2, such as an ATS database, should be used by the avionics supplier.

The datalink service providers may require that ground-based tools, which are used to generate databases for the CMU Mark 2, be provided to them for the purpose of qualification testing and approval of the tool. This may be required if the modifications can result in changes that have a detrimental impact on air-ground link performance or the processing performed by service providers.

Airlines that perform reconfiguration of the CMU Mark 2 using ground-based tools may be required to submit such changes to service providers for qualification testing or review, especially if such changes result in the addition or modification of downlink messages which may impact service provider functions or can adversely affect the performance of the air-ground link.

4.0 FUNCTIONAL CAPABILITY

4.1 Functional Description

This section describes the functional aspects of CMU Mark 2 airborne equipment. The protocols and interfaces used to support these functions are defined in Section 5, Interfaces and Protocols. Functions related to maintenance and support are defined in Section 6, Maintenance and Test.

The CMU Mark 2 major functions are specified in terms of capability levels organized in two groups to manage the large number of potential equipment options. The first group of levels consists of CMU Mark 2 functions providing data link services. The second group of levels consists of applications. The first group is numeric (0-2) and the second group is alphabetic (A-D). Together they provide a high-level capability definition, such as a “Level 2A CMU Mark 2”. Each level is incremental, unless otherwise stated.

Tables 4.1-1 and 4.1-2 provide a quick reference to CMU Mark 2 levels and associated functional capabilities:

Table 4.1-1 – Service Functional Capabilities

Level	Service Functional Capabilities
0	A CMU Mark 2 that is functionally equivalent to an ARINC 724B ACARS CMU, but upgradeable to other levels.
0.1	Level 0 plus the ability to use *a* VDR configured to operate in Mode A, ARINC 618 protocol and modulation, with ARINC 429 interface between CMU and VDR.
0.2	Level 0.1 plus the ability to use a VDR configured to operate in Mode 2, ACARS Over AVLC (AOA) per ARINC Specification 618.
0.3	Level 0.2 plus the ability to use multi-bearer SATCOM support.
1.0	ATN Services using VDL Mode 2, SATCOM (Data 3) and HF DL (RLS) subnetworks.
1.1	Level 0.1 plus Level 1.0
1.2	Level 0.2 plus Level 1.0
2.0	Level 1.0 plus high speed services, such as VDL (Mode 3 and up), Ethernet LAN, and Gatelink.

Table 4.1-2 – Application Functional Capabilities

Level	Application Functional Capabilities
A	A CMU Mark 2 that provides Airline/AOC applications and ARINC 623 ATS messages.
B	Level A plus ATS applications support and flight deck interfaces compatible with non-radar controlled airspace operations.
C	Level B plus applications support for ATN Operations, including Context Management. In addition, applications and flight deck interfaces compatible with radar/enroute operations.
D	Level C plus ATS applications and flight deck interfaces compatible with terminal and surface operations (tactical).

4.2 Level 0, 0.1, 0.2, and 0.3 Service Functional Capabilities

A Level 0 CMU Mark 2 provides ACARS only data link services as defined in ARINC Specification 618. The VHF modulation is MSK as defined in ARINC Specification 618. The CMU includes an MSK compatible modem for ARINC 716 VHF radio interfacing.

A Level 0.1 CMU Mark *2* includes the option to use a VDR configured to operate in Mode A and use the ARINC 429 interface between the CMU and VDR instead of the ARINC 716 analog interface.

COMMENTARY

Using the VDR in Mode A provides the same level of performance as an ARINC 716 transceiver.

The advantages of using the VDR in Mode A are:

- Less wiring.
- Dual installations are less complex.
- VDR/CMU wiring is ready to evolve to higher levels.
- Removes the restriction on use of transceiver.

A Level 0.2 CMU Mark 2 includes the option to use a VDR configured to operate in Mode 2 and use the ARINC 429 interface between the CMU and VDR instead of the ARINC 716 analog interface. Routing and data formats are ACARS character based, see ARINC Specification 620.

A Level 0.3 CMU Mark 2 includes functionality that adds the capability to distinguish between SATCOM multi-bearer systems and treat them as separate, independent air-ground subnetworks.

COMMENTARY

Using the VDR in Mode 2, even in the AOA configuration, is expected to provide a significant increase in performance compared to Plain Old ACARS (POA) (Mode 0 and Mode A). AOA does not take full advantage of the VDL Mode 2 capabilities such as bit-oriented messages and larger messages.

4.2.1 ACARS "Network" Function

The ACARS Network function provides a character-oriented air-ground data link service.

The CMU Mark 2 should be capable of:

- Interoperability with all available commercial aviation ACARS compatible air-ground networks.
- Providing uplink/downlink queues for each supported media.
- Automatic link establishment, maintenance, and disconnect in the mobile environment of the aircraft.

- Concurrent ACARS services over the different media: VHF, SATCOM, and HF. ACARS VHF services and AOA VHF services will typically be mutually exclusive because the CMU may only have access to one VHF radio.
- Routing AOC messages to the appropriate media and queue management in a manner that meets specific airline's needs.
- Routing data link messages to and from the ACARS end systems, including other external on-board systems.
- Buffering capability for at least one complete uplink ACARS message (all blocks) and at least one complete downlink ACARS message (all blocks) for each ACARS end system.
- Providing data link status (link available and join/leave) information to each ACARS end system for message management and crew alerting.
- Providing the necessary interfaces to the on-board radios:
    - Level 0: SATCOM, VHF, HF.
    - Level 0.1: SATCOM, VHF (including ARINC 429 interface and VDL Mode A), and HF.
    - Level 0.2: ARINC 741 SATCOM, ARINC 761 SATCOM, VHF (including ARINC 429 interface, VDL Mode A, VDL Mode A and Mode 2) and HF.

The ACARS Subnetwork Air-Ground Protocol and Interfaces should be according to Section 5.1.1, ACARS Air-Ground Protocols.

4.2.2 ACARS VHF Subnetwork Function

VHF ACARS operation is supported with a VHF radio (ARINC 716 or ARINC 750) that provides an ARINC 716 interface. This includes an ARINC 750 radio operating in ARINC 716 mode. VHF ACARS operation is also supported by a VDR that supports Mode A. ACARS messaging can also occur via VDL Mode 2 by using the ACARS over AVLC configuration defined in ARINC 618. VHF ACARS operation can be implemented with any of the following configurations:

- ARINC 716 radio
- ARINC 750 radio operating in Mode 0 (ARINC 716 emulation)
- ARINC 750 radio operating in Mode A where the VDR hosts the modem (CMU Level 0.1)
- ARINC 750 radio operating in VDL Mode 2 AOA where the VDR hosts the modem (CMU Level 0.2)

4.2.2.1 ARINC 716 Support (Level 0)

To support the use of VHF ACARS operation, the CMU Mark 2 should include an MSK capable modem, discrete outputs and digital tuning bus output. This includes an ARINC 750 radio emulating an ARINC 716 (VDR Mode 0).

The CMU Mark 2 should provide a digital (ARINC 429 based) frequency output. This output is used to automatically set the VHF frequency while the radio is being used for data communications.

COMMENTARY

Should the VHF transceiver that is available for data link need 2x5 frequency tuning, some form of adapter unit may be used, such as a

VHF control panel with a digital input from the CMU Mark 2, and 2x5 output (to the ARINC 566/546 transceiver). However, utilization of these radios for data link is highly discouraged.

The ACARS VHF interface should be according to Section 5.2.1.1, VHF Radio Interface. Also, see **ARINC Specification 618:** *Air-Ground Character-Oriented Protocol Specification.*

4.2.2.2 ARINC 618 Mode A Functions (Level 0.1)

To support the use of VHF ACARS operation using an ARINC 750 radio operating in Mode A, the CMU Mark 2 should include ARINC 429 inputs and outputs as defined in Sections 5.3.2.6 and 5.3.2.7.

The ACARS VHF interface should be according to Section 5.2.1.2, VHF Radio Interface. Also, see ARINC Specification 618 and ARINC Characteristic 750.

Mode A utilizes an ARINC 429 physical layer between the CMU and VDR. The MAC layer is implemented in the VDR according to ARINC Specification 618. The Logical Link Control (LLC) is implemented in the CMU according to ARINC Specification 618.

4.2.2.3 ARINC 618 in an AOA Configuration (Level 0.2)

To support the use of VHF ACARS operation using an ARINC 750 radio operating in Mode 2, the CMU Mark 2 should include ARINC 429 inputs and outputs as defined in Sections 5.3.2.6 and 5.3.2.7.

The ACARS VHF interface should be according to Section 5.2.1.2, VHF Radio Interface. Also, see ARINC Specification 618 and ARINC Characteristic 750.

VDL Mode 2 utilizes an ARINC 429 Physical layer between the CMU and VDR. The MAC layer is implemented in the VDR according to ARINC Specification 631 and the LLC is implemented in the CMU according to ARINC Specification 631.

4.2.3 ACARS SATCOM Subnetwork Function

To support the use of SATCOM ACARS operation, the CMU Mark 2 should provide ARINC 429 interfaces as defined in Sections 5.3.2.4, 5.3.2.6, and 5.3.2.7. The CMU should interface with up to two Satellite Data Units (SDUs) as defined in ARINC Specification 618 and ARINC Characteristics 741 and 761.

COMMENTARY

The satellite air-ground protocol is implemented within the SDU, which provides this service to the CMU. It is specified for the Inmarsat-type and other similar systems in ARINC Characteristic 741. There are two CMU/SDU protocols defined, which are called Data-2 and Data-3. These correspond to the similarly named satellite air-ground protocols. Data-2 provides the means to establish a connection between onboard avionics units and a ground service provider for the transparent transfer of arbitrary binary data at a fixed priority/precedence level at the OSI physical and data link layers. Data-3 adds a network layer (ISO 8202 on the CMU/SDU interface) to support a Switched Virtual Circuit (SVC) subnetwork layer service to provide virtual calls at selectable priority/precedence levels.

4.2.4 ACARS HF Subnetwork Function

To support the use of HF ACARS operation, the CMU Mark 2 should provide ARINC 429 Interfaces with dual ARINC 753 HFDL Systems. See Section 5.2.3. The ACARS HF Interface should be according to **ARINC Characteristic 753:** *HF Data Link System*.

COMMENTARY

The HF air-ground protocol is specified in **ARINC Specification 635:** *HF Data Link Protocols*, and is implemented within the HFDR. The HFDR provides this service to the CMU Mark 2. An interim implementation supports operation similar to SATCOM Data 2 which utilizes ACARS character-oriented messages over the HF bit oriented protocol.

4.3 Level 1.0 Service Functional Capabilities

A Level 1 CMU Mark 2 provides ATN capabilities. This should include VDL Mode *2* AVLC, HF, and SATCOM Data-3 support.

4.3.1 ATN Network Function

The CMU Mark 2 should be capable of interoperability with available commercial aviation air-ground subnetworks compatible with the ATN. Management and control information is exchanged between the CMU Mark 2 and each subnetwork.

The CMU Mark 2 should be capable of:

- Interoperability with all available commercial aviation ATN compatible air-ground networks.
- Providing uplink/downlink queues for each supported media.
- Automatic link establishment, maintenance, and disconnect in the mobile environment of the aircraft.
- Concurrent ATN services over the different media (VHF, HF, SATCOM).
- Routing AOC messages to the appropriate media and queue management in a manner to meet specific airline’s needs.
- Routing data link messages to and from the ATN end systems, including other external on-board systems.
- Providing data link status (link available) information to each ATN end system for message management and crew alerting
- Providing the necessary interfaces to the on-board radios (VHF, HF, SATCOM).
- Meeting the Required Communications Performance (RCP) to support Air Traffic Services Communications and CNS/ATM.

4.3.2 Air-Ground Subnetworks

To be supplied in a future supplement.

4.3.2.1 SATCOM Data Subnetwork Function

To be supplied in a future supplement.

4.3.2.2 VDL Mode 2 Subnetwork Function

To support the use of an ARINC 750 radio operating in VDL Mode 2, the CMU Mark 2 should include ARINC 429 inputs and outputs as defined in Sections 5.3.2.6 and 5.3.2.7.

The VDR Interface should be according to the portions of Section 5.2.1.2 that pertain to VDL Mode 2. Also, see ARINC Specification 631 and ARINC Characteristic 750.

VDL Mode 2 utilizes an ARINC 429 physical layer between the CMU and VDR. The MAC layer is implemented in the VDR according to ARINC Specification 631 and the LLC is implemented in the CMU according to ARINC Specification 631.

COMMENTARY

VDL Mode 0 and VDL Mode A are unsuitable subnetworks for ATN.

4.3.2.3 HFDL RLS Subnetwork Function

To be supplied in a future supplement.

4.3.3 ATN Join/Leave Events

The subnetworks defined in this document are either air-initiated, such as VDL Mode 2, SATCOM, and HFDL or ground-initiated such as Mode S. Air-initiated means the aircraft needs to detect subnetwork connectivity via a logon status for SATCOM and HFDL, or link establishment for VDL Mode 2. Ground-initiated means the ground subnetwork equipment (e.g., Mode S Transponder) needs to detect a response from the aircraft and starts a connection sequence.

For air-initiated subnetworks, upon detecting subnetwork connectivity, each of the airborne ATN subnetwork functions is responsible for generating join events and sending them to the IS-SME function in the CMU Mark 2. While the VDL Mode 2 join event contains the DTE address of the air-ground router, the SATCOM and HFDL join events do not.

For air-initiated subnetworks, the join event is used to notify the IS-SME function in the CMU Mark 2 that connectivity on the subnetwork specified in the join event is possible. For SATCOM and HFDL, the join event is sent by the SDU or HFDR in the form of ARINC 429 labels 270 and 271. The subnetwork management function in the CMU (e.g., SN-SME) needs to forward these join events to the IS-SME. For VDL Mode 2, the join event is generated by the LME when a link is established. The mechanism used to send the VDL Mode 2 Join event to the IS-SME is implementation dependent since it is local to the CMU Mark 2.

For air-initiated subnetworks, the join event is used to trigger the start of ATN air-ground communications using ISO 8208, ISO 9542 and ISO 10747 and the CMU Mark 2 is in the initiator role with the air-ground router being in the responder role. See ICAO Doc 9705 for the requirements of the CMU Mark 2 in the initiating role as expected by these protocols.

For ground-initiated subnetworks, join events are generated within the ground equipment and the air-ground router needs to start the ATN air-ground communications using ISO 8208, ISO 9542 and ISO 10747. The CMU Mark 2 is in the responder role, with the air-ground router being in the initiator role. See ICAO Doc 9705 for the requirements of the CMU Mark 2 in the responder role as expected by these protocols.

The leave event is the indication that the connectivity on the specified air-ground subnetwork has ceased to exist. For SATCOM and HFDL, the leave event is sent by the SDU or HFDR in the form of ARINC 429 labels 270 and 271. For VDL Mode 2, the leave event is detected when the VHF link with the current service provider cannot be maintained, i.e., the link with the current ground station is no longer viable and attempts to hand-off to other ground stations in the same ground system are unsuccessful. For Mode S, the CMU Mark 2 can detect the leave event by the expiration of an SNDCF watchdog timer or an ISO 8208 Clear Indication packet as defined in ICAO Doc 9705. For all subnetworks, a leave event can be intentionally triggered by local policy even if the subnetwork connectivity is good; for example, a subnetwork management function (e.g., SN-SME) can determine that a more preferred subnetwork/service provider has become available and should replace the existing subnetwork/service provider.

Upon receiving the leave event, the IS-SME will initiate a clean-up of routing tables and associated resources allocated to the connectivity that was lost as indicated by the leave event.

Besides the join and leave events, implementations may implement the handoff event which can be used to signal a VDL Mode 2 handoff from a ground station to the next. See ARINC Specification 631 for the details of the VDL Mode 2 hand-off event.

4.3.4 ATN Internetworking Function

When performing the function of an ATN Router, the CMU Mark 2 should operate as an Intermediate System (IS). The ATN Router performs connection-less relaying and routing of data packets according to the ICAO ATN SARPs.

Interconnecting subnetworking is based on source and destination network layer addresses and the user’s routing policy. The functional Internetworking capabilities are described in the ICAO ATN SARPs.

4.3.5 Multiple Network Function (ATN/ACARS)

The communication elements of the CNS/ATM architecture should be able to smoothly transition from character-oriented protocols (ACARS) to bit-oriented protocols (ATN) with minimal software modification. This recognizes ARINC Specifications 622 and 623, and the transition to the Aeronautical Telecommunications Network (ATN).

COMMENTARY

In some scenarios, overlap of two or more of the protocols may be used.

This transition produces the need for a CMU Mark 2 that can perform both ATN and ACARS services as needed.

The CMU Mark 2 should be capable of supporting a Multiple Network Function. This allows the CMU Mark 2 to provide independent and concurrent access to the ACARS and ATN data link services.

The CMU Mark 2 should use its routing policy database to perform downlink message routing using the airline preferred service. The CMU Mark 2 should determine when an ATN service should be used instead of ACARS for particular traffic, when both are available.

If the CMU Mark 2 is connected to two independent VHF/VDR radios, it should be capable of supporting independent and concurrent VHF data links as well. The CMU Mark 2 can support only one ACARS VHF connection due to a single internal modem.

The CMU Mark 2 should be capable of data communications (ACARS and/or AVLC) with more than one VHF/VDR radio simultaneously, provided at least one of the radios is an ARINC 750 VDR utilizing the ARINC 429 interface.

The CMU Mark 2 should send and receive ATN and ACARS packets with the SDU and HFDL Systems as needed.

4.4 Level 2.0 Service Functional Capabilities

COMMENTARY

CMU Level 2.0 Services are not specified at the time of this writing due to immaturity in their definitions and lack of availability. However, these capabilities are expected to include additional subnetworks and provide higher speed services. These subnetworks are also expected to be ATN compatible. Some of these services may need additional I/O capabilities, such as LAN interface adapters. Air-ground radio equipment interface (other than broadband, e.g., Gatelink) is likely to be ARINC 429 for the foreseeable future.

4.5 Level A Application Functional Capabilities

4.5.1 ACARS End System Function

The ACARS end system function is needed in the CMU Mark 2 if it hosts the applications that receive and send ACARS messages via the ACARS “Network” Function Services.

An ACARS end system is any system that is consistent with **ARINC Specification 620:** *Data Link Ground System Standard and Interface Specification*, and **ARINC Specification 619:** *ACARS Protocols for Avionic End Systems*. The message character set is limited and there are specific message size and buffering limitations.

The CMU Mark 2 should support multiple external ACARS end systems, including two FMCs, two SDUs, ACMS, CMC, and Cabin Systems. ARINC 741 and ARINC 761 SDUs may use two types of protocol interfaces over the same physical bus connection to the CMU Mark 2. One interface supports the air-ground subnetwork as defined in Section 4.2.3 and the other supports the SDU as an ACARS end system.

COMMENTARY

Some SDUs do not interface with the CMU Mark 2 as an end system.

4.5.2 Non ATS Communications (Character Based)

The CMU Mark 2 provides character based data link messages using an ACARS End System Function. In this role, the CMU Mark 2 originates the formats of the messages and is responsible for processing of received messages.

These data link messages are used to support various operations, including Aeronautical Operational Communications (AOC), and Aeronautical Administrative Communications (AAC).

AOC data link messages include crew initiated and automatic communication with dispatch, maintenance, and other departments of the airline related to operations of the flight.

AAC data link messages include crew and cabin personnel communications related to administrative matters, such as crew scheduling and cabin services.

In the ACARS environment, Company Communications are primarily limited to character based messages. See ARINC Specification 620. The message formats are generally unique to a specific airline based on their operational needs. These types of messages include:

- OOOI reports.
- Weather requests/display/print.
- Maintenance reports.
- Flight plan messages.

The CMU Mark 2 should be able, on an airline/aircraft basis, to:

- Customize the pilot interface display, printouts, and alerting mechanisms.
- Generate customized messages based on customizable triggers.
- Decode and generate data link messages as an end system.

Some company communications data is passed through to other on-board systems. In this role the CMU Mark 2 is serving as a router/bridge.

4.5.3 ATS Communications

Character based ATS messages can be provided by the CMU Mark 2 according to **ARINC Specification 622:** *ATS Data Link Applications Over ACARS Ground Network*, and **ARINC Specification 623:** *Character-Oriented Air Traffic Service (ATS) Applications*.

ARINC Specification 623 includes ATS applications such as ATIS, PDC, and Oceanic Clearances using character based messages. ARINC Specification 622 contains sections which provide support for ARINC 623 messages. These messages may be relayed and formatted by the airline host or may consist of direct ATS communications.

4.6 Level B Application Functional Capabilities

A Level B CMU Mark 2 provides extended application support. These extended applications are bit oriented and can include ATS Applications.

Some of these applications are dependent upon the availability of the ARINC 656 Flight Management Interface. See ARINC Specification 656. The Level B CMU Mark 2 provides current Level A ACARS application support.

COMMENTARY

Development of CMU functions is market driven. Therefore, the development of the CMU Level B applications is likely to be delayed until there is a market for these applications.

4.6.1 ACARS Convergence Function (ARINC 622)

The ACARS Convergence Function (ACF) capabilities should be provided by the CMU Mark 2 when it is hosting Bit-Oriented Applications, such as CPDLC, but using the ACARS data link service. The ACF is fully described in ARINC Specification 622.

The ACF encapsulates and provides an end-to-end integrity CRC of binary oriented data link messages making it compatible with the ACARS character-oriented network.

The ACF was developed to allow Bit-Oriented ATS applications to be used with the ACARS data link service. However, it may also be used to permit binary data to be exchanged directly with the airline hosts.

4.6.2 Non ATS Communications

The CMU Mark 2 should support both character and bit-oriented, non-ATS applications.

Binary data formats offer more efficient packaging (smaller messages) for many data link applications. Binary data is also easier to process by computers and simplifies software designs.

Candidate AOC applications for binary data include encryption, compression, graphics, position data, maintenance data, and exchanging loadable table values.

4.6.3 ATS Communications

The CMU Mark 2 may support a variety of ATS Communications. These include Automatic Dependent Surveillance (ADS), Controller/Pilot Data Link Communications (CPDLC), and Flight Information Services (FIS).

COMMENTARY

Equipment manufacturers should note that this document does not detail the operation of the ADS, CM, and CPDLC functions.

Conversely, their system functions, so far as they affect the CMU Mark 2 architecture and electrical interfaces, are addressed in Sections 3, 4 and 5.

4.6.3.1 Air Traffic Facilities Notification (ARINC 622)

Air Traffic Services Facilities Notification (AFN) function should be provided by the CMU Mark 2 when it is hosting ATS communications other than ARINC 623 in an ACARS Network Environment. AFN provides a character based application to provide a log-in and hand-off facility for communications with ATS ground based systems. It also provides aircraft ATS data link capabilities status information.

The CMU Mark 2 should be able to determine or access information necessary for ATS data link capabilities status reporting of the ATS applications hosted within the CMU.

COMMENTARY

At this time there is no mechanism defined for centralized reporting of the ATS data link capabilities status of the avionics suite. Each LRU (CMU, FMC, etc) is responsible for reporting its own ATS data link capabilities status. It is possible that more than one LRU will provide ATS data link capabilities status reporting on the same aircraft due to either poor configuration of the aircraft avionics or distribution of the ATS applications between the CMU and FMC.

The CMU must complete the AFN procedures before it can support the other ATS data link applications. AFN message formats and protocol are specified in ARINC Specification 622.

4.6.3.2 CPDLC Function

Controller/Pilot Data Link Communications (CPDLC) functions provide the means for controllers/ATC systems and pilots/aircraft systems to communicate using data link. It is expected that voice communications will continue to be used for emergency and non-routine ATM operations and serve as a back-up (or secondary) mode to data link. The message sets for CPDLC are specified in accordance with RTCA DO-219, the ICAO ATN SARPs, and optionally RTCA DO-280/EUROCAE ED-110.

Interaction with the crew is needed for CPDLC, including alerting mechanisms, priority management, message display and activation of uplink clearances, and crew initiated responses and requests for clearances.

When the CMU interfaces with a compatible Flight Management Computer and an ARINC 656 interface is provided, then the avionics may be able to:

- Preview, load, and extract routes.
- Request, receive and process on-board sensor/status information (primarily from the FMC) to pre-fill messages (and display to the crew for verification) to be sent to ATC. This could also be achieved, to a certain extent, using traditional ARINC 429 broadcast data.

4.6.3.3 ADS-A Function

The Automatic Dependent Surveillance Addressable (ADS-A) Function automatically provides flight position and other optional information data in the form of ADS reports upon request from ground-based end system applications.

The ADS-A function should be implemented in accordance with RTCA DO-212 Automatic Dependent Surveillance, **ARINC Characteristic 745:** *Automatic Dependent Surveillance,* the ICAO ATN SARPs, and optionally RTCA DO-280/EUROCAE ED-110.

The CMU Mark 2 will need to acquire necessary information to use in the ADS-A reports. Most of this information is expected to be acquired via the ARINC 656 interface with the FMC, but other implementations are possible.

4.7 Level C Application Functional Capabilities

The CMU Mark 2 Level C applications function provides compatibility for applications in an ATN environment. In addition, more advanced applications can be added.

4.7.1 ACARS/ATN Gateway Function

The ACARS Gateway function provides a translation facility that can enable existing ACARS end system equipment and applications to continue to function without replacement or modification for company communications when data linked via ATN services.

ACARS end systems were designed to send and receive messages across the ACARS air-ground network as defined in ARINC Specifications 618, 619 and 620. If these systems need to operate over the ATN without an update, then the CMU Mark 2 should provide the relevant ACARS/ATN Gateway.

For external ACARS End Systems, such as the Airplane Condition Monitoring System (ACMS) or Flight Management Computers (FMCs), ARINC Specification 619 describes the on-board interface between the CMU Mark 2 and the external ACARS End Systems. The gateway function should be compatible with the ARINC 619 interface.

COMMENTARY

If the avionics end system requires an ACARS/ATN gateway in the CMU, then a corresponding ATN/ACARS Gateway is needed in the ground based system.

The airborne Gateway assumes two possible scenarios for the ground version to minimize the complexity of the airborne gateway.

- ATN packets containing ARINC 618-like files are delivered direct to an ATN End System Gateway in the airline host. In this case, any conversion from an ARINC 618 air-ground format to a TYPE B ground/ground format or equivalent, should be provided by the airline host.
- The ATN packets containing ARINC 618 like files are all routed to an ATN End System Gateway in the Data Link Service Provider’s network. This gateway extracts normal front end processing as if it was received via the

ACARS air-ground subnetwork. It is then converted to a TYPE B format and delivered to the airline.

4.7.2 ATN Upper Layers Function

To be supplied by a future supplement.

4.7.3 ATN End System Function

To be supplied by a future supplement.

4.7.4 CM Application

The Context Management (CM) application is used in the ATN environment. It provides for the exchange of relevant address information between an aircraft CM Communications system and a ground CM system peer. Basically, the CM process includes three functions: Log-On, Update, and Contact. The disciplines for Context Management (CM) operation are in accordance with **RTCA DO-233**: *MOPS for Aircraft Management (CM) Equipment* CM utilizes a crew interface using ICAO names for airport facilities and the flight number designated by the airline.

4.7.5 FIS Application

Flight Information Services (FIS) are part of Air Traffic Services (ATS) communications. The CMU Mark 2 should accommodate the ability to request and display FIS information to the flight crew, such as NOTAMS, ATIS and weather information.

4.7.6 ATS Event Recording

The CMU Mark 2 should be capable of sending ATS/ATN information to an onboard recorder. Event recording is not a router function, but rather it is part of the ATS applications. Provisions for this application have been incorporated in newer Voice Recorders for data link input via an ARINC 429 interface. Refer to **ARINC Characteristic 757:** *Cockpit Voice Recorder (CVR).*

4.8 Level D Application Functional Capabilities

A Level D CMU should provide network management and managed object facilities to support ATS data link communications as defined in ICAO Manual of Technical Provisions for the ATN, Third Edition (Sub-Volumes VI-IX).

4.8.1 ATN Systems Management

Systems Management for ATN systems provides the mechanisms for monitoring, controlling and coordinating system and network resources through the use of OSI protocols. These resources are described as Managed Objects (MOs) with well defined properties and functions. These MOs are organized into Management Information Bases (MIBs) for each subsystem. The functions include: fault, accounting, configuration, performance, and security management. Systems Management may be distributed, centralized, or local to a specified environment and this distribution depends on the chosen architecture for the ATN subsystem.

Since there are no specific ISO standards regarding the distribution of management agents, suppliers are free to develop either n-layer agents or system-level agents for equipment.

4.8.1.1 Management Functions

The specific CMU Mark 2 management functions include:

- Fault management.
- Accounting management.
- Configuration and name management.
- Performance management.
- Security management.

4.8.1.1.1 Fault Management

Fault management facilities allow the network manager to detect problems in the ATN environment. These facilities include mechanisms for the detection, isolation, and correction of abnormal operation in any network component or in any of the OSI layers. Fault management provides procedures to:

- Detect and report the occurrence of faults. These procedures allow a managed system to notify its manager of the detection of a fault, using a standardized event-reporting protocol.
- Log the received event report. This log can then be examined and processed.
- Schedule and execute diagnostic tests, trace faults, and initiate correction of faults. These procedures may be invoked as a result of analysis of event logs.

4.8.1.1.2 Accounting Management

Accounting management facilities allow a network manager to determine and allocate costs and charges for the use of ATN resources. Accounting management provides procedures to:

- Inform users of costs incurred, using event-reporting, and data-manipulation software.
- Enable accounting limits to be set for the use of managed resources.
- Enable costs to be combined where multiple resources are used to achieve needed communication.

COMMENTARY

Describe CMU accounting management functions which may concentrate on QOS for various router/communications paths which have varying charges (e.g., VHF versus HF versus SATCOM).

4.8.1.1.3 Configuration and Name Management

Configuration and name management facilities allow network managers to exercise control over the configuration of the network components and ATN layer entities. Configuration may be changed to alleviate congestion, isolate faults, or meet changing user needs. Configuration management provides procedures to:

- Collect and disseminate data concerning the current state of resources. Locally initiated changes or changes occurring due to unpredictable events are communicated to management facilities by means of standardized protocols.
- Set and modify parameters related to network components and ATN layer software.
- Initialize and close down managed objects.
- Change the configuration.
- Associate names with objects and sets of objects

COMMENTARY

Describe CMU configuration management entities for CMU resources including hardware/software modules, network connections, physical configurations, virtual configurations, etc.

4.8.1.1.4 Performance Management

Performance management facilities provide the network manager with the ability to monitor and evaluate the performance of system and layer entities. Performance management provides procedures to:

- Collect and disseminate data concerning the current level of performance of resources.
- Maintain and examine performance logs for such purposes as planning and analysis.

COMMENTARY

Describe CMU performance management entities for CMU resources including communications thresholds which influence performance. Timing and delay parameters, as well as communications QOS parameters are candidates (i.e. loss of signal, framing error, local/remote transmitter/receiver error, call establishment, degraded signal, queue size, bandwidth, storage capacity levels, data corruption, etc.).

4.8.1.1.5 Security Management

Security management facilities allow a network manager to manage access and protection of communications resources. Security management provides support for the management of:

- Authorization facilities.
- Access control.
- Encryption and key management.
- Authentication.
- Security logs.

COMMENTARY

Describe CMU security management entities for resource access, router/communications channel access, resource reconfiguration and authentication, log history access, physical violation, etc.

4.8.1.2 Managed Objects/MIB Structure

COMMENTARY

Describe the general classes of managed objects and CMU specific philosophy for organization of MOs/MIBs.

ATN systems management relies heavily on the concepts of object-oriented design. Each resource that is monitored and controlled by ATN systems management is represented by a managed object. A managed object can be defined for any resource that an organization wishes to monitor and/or control. Examples of hardware resources are switches, work stations, PBXs, LAN port cards, and multiplexers. Examples of software resources are queuing programs, routing algorithms, and buffer-management routines. Managed objects that refer to resources specific to an individual layer are called (N)-layer managed objects. Managed objects that refer to resources that encompass more than one layer are called system managed objects. A managed object is defined in terms of attributes it possesses, operations that may be performed upon it, notifications that it may issue, and its relationships with other managed objects. To structure the definition of a MIB, each managed object is an instance of a managed-object class. A managed-object class is a model or template for managed-object instances that share the same attributes, notifications, and management operations. The definition of a managed-object class, as specified by the template, consists of:

- Attributes visible at the managed-object boundary.
- System-management operations that can be applied to the managed object.
- Behavior exhibited by the managed object in response to management operations.
- Notifications that can be emitted by the managed object.
- Conditional packages that can be encapsulated in the managed object.
- Position of the managed object in the inheritance hierarchy.

4.8.1.3 Common Management Information Service Interface

COMMENTARY

Describe the specific CMU network management service facilities which are invoked with the host manager. This service provides the protocol link to the manager for manipulating MOs.

The Common Management Information Service (CMIS) defines the services provided for ATN systems management (ref. ISO 9595). These services are invoked by management processes in order to communicate remotely. The table in Attachment 3 lists the CMIS services in terms of service primitives. CMIS services are of two types: confirmed services need a remote management process to send a response to indicate receipt and success or failure of the operation requested; non-confirmed services do not use responses.

Three categories of service are relevant to CMIS:

- **Association services**: the Common Management Information Service Element (CMISE) user needs to establish an application association to communicate. The CMISE user relies on the Association-Control-Service Element (ACSE) for the control of application associations.
- **Management-notification service**: this service is used to convey management information applicable to a notification. The definition of the notification and the consequent behavior of the communicating entities is dependent on the specification of the managed object that generated the notification.
- **Management-operation services**: these six services are used to convey management information applicable to systems-management operations. The definition of the operation and the consequent behavior of the communication entities is dependent on the specification of the managed object at which the operation is directed.

The CMIS provides several structuring facilities:

- Multiple responses to a confirmed operation can be linked to the operation by the use of a linked-identification parameter
- Operations can be performed on multiple managed objects, selected to satisfy some criteria and subject to a synchronizing condition.

4.8.1.4 Common Management Information Protocol (CMIP)

The Common Management Information Protocol (CMIP) supports the services provided for ATN systems management by means of a set of protocol data units that implement the CMISE (ref. ISO 9596). These PDUs are transmitted in response to CMISE-service primitives issued by CMISE-service users.

4.9 Military Configuration Functions

The CMU Mark 2 may be used in military aircraft as an aid for efficient operation in civilian airspace.

COMMENTARY

This configuration of a commercial CMU Mark 2 is expected to be functionally equivalent to a Level 2B unit, except that the on-board interfaces may include MIL-STD-1553B. The requirements of these interfaces are beyond the scope of this document.

The data link radio interfaces are expected to be as identified in this document. An ARINC 750 VDR (not ARINC 716) is the assumed baseline.

Special security (Identification) procedures and encryption techniques may be necessary for handling of ATS data link messages with these aircraft.

4.10 Data Management Function

4.10.1 Simple Network Management Protocol (SNMP) and CMU/FMC Information Broker (CFIB)

To host ATS (and some AOC) data link applications, the CMU Mark 2 should have access to data from a wide variety of aircraft systems and sensors. In some cases data may also need to be transferred to another on-board system, such as the Flight Management Computer.

The SNMP and CFIB serve together as an internal Data Concentrator to the CMU Mark 2 of airplane related information used by other functions within the CMU Mark 2.

The SNMP and CFIB application provide an internal database of information relevant to operation of the CMU Mark 2. This data can be static, determined at power up or initialization (such as the aircraft address) or dynamic data that represents the current state of the airplane (position, fuel, etc.).

To provide the necessary flexibility to implement changes and adapt to different aircraft configurations, internal, loadable tables, should be used to describe the database.

The CMU Mark 2 should be capable of storing and retaining specified operational data and data link messages. The CMU Mark 2 should be capable of automatically clearing certain data at the end of flight.

Dynamic data, used within the CMU Mark 2, such as altitude, needs to be refreshed as it may be used in internal algorithms that generate trigger events, such as sending an automatic downlink to dispatch when descending through 10,000 feet.

The CFIB application gathers information from many various sources and interfaces dependent on airplane model, configuration, and equipage.

Static data is any data that does not typically change from flight to flight on a given aircraft. Static data is typically stored in the Aircraft Personality Module (APM).

If a peer CFIB application exists in an external LRU, such as an FMC, then the two CFIB applications may request and transmit data between each other. This capability is described in **ARINC Specification 656:** *Avionics Interface for Flight Management and Communications Functions Specification.*

COMMENTARY

In this case, when a peer CFIB application exists, the CMU Mark 2 CFIB application provides an agent-manager relationship as described in ARINC Specification 656. The ARINC 656 CFIB is a peer-to-peer application and the SNMP is a peer-to-peer protocol. The CFIB and SNMP may or may not exist in the CMU Mark 2 depending on the avionics architecture.

4.10.2 Static Data

Static Data is information and parameters that do not change during flight. This includes Identification Data (i.e., ICAO registration, etc.) and Aircraft Configuration Data (aircraft type, installation configuration). Static Data is stored in the CMU Configuration Database (See Section 4.12).

4.10.2.1 Identification Data

Identification information is necessary to perform any data link communications. This information is unique to each aircraft and should not change, once loaded.

For ACARS operation, the CMU Mark 2 should have access to the seven character (56 bits) Aircraft Registration Mark and ARINC Specification 618 flight identifier. The ARINC Specification 618 flight identifier is composed of a 2 character airline identifier and a flight number. The CMU Mark 2 should be capable of allowing the airline to quickly modify the airline ID, to support those airlines which share aircraft on a frequent basis.

Some airlines also use a fleet ID number scheme independent of tail number. Provisions for a user defined name should be provided. This would only be used for airline communications.

For ATN and ATS Applications, the CMU Mark 2 should have access to the ICAO 24-bit aircraft address as well as the full ICAO flight identifier. The ICAO flight identifier is composed of a 3 character airline identifier and a flight number as defined in ICAO 4444. The ICAO Flight Identifier and Flight Number are not static data and are not a candidate for storage in an external APM. The three character ICAO airline identifier could be stored in the APM provided that a suitable mechanism is provided for aircraft leasing, code sharing, etc.

For on-board LAN communications, the CMU Mark 2 should have access to the appropriate MAC address for its terminal(s).

The CMU Mark 2 should load the addresses upon power-up. Once the CMU Mark 2 has determined the address, this address should be maintained until the CMU Mark 2 detects installation on a different aircraft.

4.10.2.2 Aircraft Configuration Data

Aircraft configuration data is necessary because the CMU Mark 2 is planned to operate in many different fleet types, with many different configurations. Some examples of configuration data include, but are not limited to: aircraft model, data link radio configuration, printer/CDU configuration, cabin system configuration, and applications installed, such as enabling functions for over water operations.

This information may also be used by internal BITE processing to ensure that external systems that are not installed or operative on the aircraft do not illicit a fault from the CMU Mark 2.

4.10.3 Dynamic Data

Dynamic data is used primarily to drive the data link applications. The data elements may need to be reformatted, truncated, etc., to be used by the applications. Dynamic data may include, but is not limited to:

- Flight number.
- Scheduled date.
- Departure station.
- Destination station.
- Air-ground status.
- Doors and brakes status.
- Beacon, landing lights status.
- Engine data/status.
- Fuel data/status.
- Meteorological (wind, temperature, turbulence, humidity).
- Figure of merit, RNP, ANP.
- Position (4-D), velocity, track.
- Intent, trajectory, trend.
- Selected heading, speed, altitude.
- Connecting LRU status/health.

The source of the dynamic data may vary significantly from aircraft to aircraft. The on-board Flight Management System is the best source for the majority of the data. The CMU Mark 2 should be capable of accessing this information from:

- A peer CFIB application and SNMP, such as in a Flight Management Computer.
- ARINC 429 data buses (broadcast words from other systems).
- Discrete Inputs (such as OOOI sensors).

Reference **ARINC Specification 656:** *Avionics Interface Definition for Flight Management and Communications Functions*.

The CMU Mark 2 should be capable of clearing as well as preserving dynamic data at the end of a flight. It should provide sufficient sophistication to automatically update data, such as destination, to the new departure station after arrival.

The designer should take into consideration that valid dynamic data is not always available and create a design which can tolerate this condition gracefully.

Propagation and use of out of date data should be avoided when possible.

The CMU Mark 2 should be flexible enough to support the various data needs of the different Airline's AOC functions. This may require the ability to store dynamic data at various events during a flight, such as fuel and engine data at various flight phases, possibly over several flight legs.

4.11 Internal Clock

The CMU Mark 2 should provide a real time clock capability synchronized with UTC. It can be set manually, via uplink, or from an on-board LRU such as GNSS. The CMU Mark 2 should provide the flexibility to the airline to reconfigure the source of the time.

A GNSS Time base should be used as the source of the UTC when available.

The internal clock drift should be less than $\pm$ 1 second over a 24-hour period (without updates) while power is applied. The CMU should detect that its internal clock may not be accurate due to primary power interruptions or elapsed time since an update.

COMMENTARY

If the CMU Mark 2 receives GNSS time indirectly through other systems, considerations to transport delay should be made. The GNSS time that is received should be adjusted to represent true UTC time.

4.12 Configuration Database

The CMU Mark 2 should include a separate database for Configuration Data, which is used for static data instead of program pins (see Section 4.10). This database should be stored in the CMU Mark 2 Non-Volatile Memory (NVM).

The CMU Mark 2 Configuration Database may be updated via a number of methods of handling static data as identified in Section 4.12.2.

COMMENTARY

Alternative memory devices as listed in Section 4.12.2 may be used to store a back up copy of the Configuration Database. In the following sections, use of the term APM refers to any type of alternative memory device that is used.

The CMU Mark 2 should provide a CMU Configuration Database status display page, which displays a Part Number for CMU Mark 2 Configuration Data entered by software load from a diskette, and displays individual data elements entered manually (such as ICAO 24-bit aircraft address). It is recommended that this display be kept to a single page.

4.12.1 Minimum Data Contents

The Configuration Database should include formatting and Header information as specified in **ARINC Report 607:** *Design Guidance for Avionic Equip*ment, for an APM. The database should include as a minimum the data elements shown in Attachment 5, Table 5-1. Other data may be included as specified by the supplier, see Attachment 5, Table 5-2 for an example.

4.12.2 Loading/Updating of Configuration Database

Configuration Data may be updated by a combination of software load and manual entries on interactive displays. An update of the Configuration Database should not require reload of other CMU Mark 2 software. To maintain configuration control, update by manual entry should be restricted access and limited to aircraft on ground conditions.

New Configuration Data is first loaded into CMU NVM. Upon update completion, the CMU Mark 2 copies the data to the APM, then proceeds with Database validation, as described in Section 4.12.3.

Different methods may be used to input Configuration Data to the CMU Mark 2. These methods include:

- Loading the data via an interface to a centralized on-board source directly into non-volatile memory. The port used for this method is aircraft specific.
- Loading the data via an interface to an external APM (See Section 5.3.14 APM Interface).
- Loading the data as part of the Data Load process from either an external data loader or internal removable mass media directly into NVM memory.
- Inputting the data via a control panel device directly into NVM.

However, since the static data includes the address that is used for Air Traffic Services, and this is unique to each and every aircraft, careful consideration should be given to ensure the CMU Mark 2 has a source of the data with sound configuration management procedures and high data integrity such as using CRCs.

4.12.3 Validation and Automated Correction

At power up or at the end of a configuration database update, the CMU Mark 2 should perform a validation of the databases stored in NVM and in the APM. During this validation routine, the databases are to be assigned a status of Failed, Invalid, or Valid. Non-valid databases should be automatically updated with validated databases, if available, as described below. The CMU Mark 2 initially performs a CRC check of both the NVM database and the APM database. Any CRC verification failure should be logged and the corresponding database declared Failed.

If the CRC verification passes, the CMU Mark 2 compares the ICAO 24-bit aircraft address stored in NVM and the APM with the ICAO 24-bit aircraft address broadcast from an external source (such as the Mode S Transponder). A database containing an ICAO 24-bit aircraft address different from the broadcast ICAO 24-bit aircraft address is declared Invalid. A database with a matching ICAO 24-bit aircraft address is declared Valid.

If an external source for the ICAO 24-bit aircraft address is not available, the following logic is used to determine validity. If the APM database is not Failed, the APM database is assumed to be Valid. The CMU Mark 2 declares the NVM database as Valid if the APM's database is Valid and ICAO 24-bit aircraft address contained in the APM database and NVM database match. Else, the CMU Mark 2 declares the NVM database as Invalid.

If the NVM database is Valid and the APM database is Invalid or Failed, the CMU Mark 2 attempts to copy the NVM database into the APM. If successful, the APM provides normal operation. If unsuccessful, the CMU Mark 2 indicates an APM is failed, but otherwise provides normal operation.

COMMENTARY

> The use of both CRCs and comparison of embedded ICAO 24-bit aircraft address with an independent ICAO 24-bit aircraft address source allows the CMU Mark 2 operation to continue while an APM is failed.

If the NVM database is Invalid or Failed and the APM database is Valid, the CMU Mark 2 attempts to copy the APM data into NVM. If successful, the CMU Mark 2 provides normal operation. If unsuccessful, the CMU Mark 2 generates a CMU Failed Status on Label 270, suppresses data link transmissions, and displays a status message that requests the CMU configuration data be reloaded.

If both the NVM database and the APM database are Invalid or Failed, the CMU Mark 2 should generate a CMU Failed Status on Label 270, suppress data link transmissions, and display a status message that requests the CMU Mark 2 Configuration Data be reloaded.

If both the NVM and APM databases are Valid, the CMU Mark 2 compares corresponding CRCs. If the CRCs match, the CMU Mark 2 provides normal operation. If the CRCs differ, the CMU Mark 2 copies the APM database into the CMU Mark 2 and, if successful, provides normal operation.

4.13 Flight Deck Functions

The CMU Mark 2 should provide the capabilities for control, display, and alerting (visual and aural) as well as support to a cockpit printer.

These functions should be designed consistent with operational use, such as by flight phase and integrated with other systems which may be sharing the displays.

The CMU Mark 2 should provide the facility to internally inhibit inappropriate CMU driven alerting (visual and aural) during designated phases of flight, such as takeoff and landing.

COMMENTARY

> For data link applications support, the goal of the CMU Mark 2 Flight Deck Function should be to provide as consistent an interface with the crew for all data link communications (airline and ATS) as possible, regardless of the type of airplane model.

However, since the CMU Mark 2 is intended to be installed in a variety of existing flight deck configurations, considerations to support specific characteristics (including MCDU variations, alternate CDUs, and primary field of view displays) should be given.

4.13.1 Data link Services Flight Deck Support

The CMU Mark 2 should be able to provide basic data link status to the crews at all times. Primary Field of View annunciation should be used for system failure or loss of data communications.

The Flight Crew should be able to view individual link status and frequencies, where applicable.

The Flight Crew should be able to alter on demand or select new data link services or frequencies where applicable. Data link availability requirements of some applications, such as ATS, may restrict the selections available to the crew.

If providing analog VHF voice control, the CMU Mark 2 should allow the crew to manage the VHF in a similar manner to a VHF control panel and provide active status of the analog voice frequency in use.

4.13.2 ATS Flight Deck Support

For ATS end system functions, the CMU Mark 2 should support a crew interface that enhances crew efficiency and minimize heads down time. Additional general guidance for ATS applications and crew interface is available in FAA Notice 8110.50, “Guidelines for Airworthiness Approval of Airborne Data Link Systems and Applications” or successor Advisory Circular.

For non-tactical ATS messages or in remote operations, the CMU Mark 2 should provide an interface with an alerting system in the Primary Field of View for crew notification as well as aural alerting.

The alerting should support multiple priority levels. Aural alerting should be available on a message by message basis, but care should be taken to avoid excessive aural alerting.

For time-sensitive “tactical” ATS end system functions, the ATS end system should provide an interface for both message display and response in the primary field of view.

The CMU Mark 2 should be capable of operation of multiple displays concurrently if used to host ATS applications.

The CMU Mark 2 should provide access to message logs of both queued ATS messages and received ATS messages.

COMMENTARY

It is expected that future ATS applications such as terminal area ATS messages, will require primary field of view display and response.

4.13.3 AOC Flight Deck Support

AOC Flight Deck Support typically utilizes the same resources (CDU, printer, etc.) as the ATS applications. However, the AOC applications can operate with reduced primary field of view functions, thus a single CDU is adequate.

COMMENTARY

In three person crew aircraft retrofits of the CMU Mark 2, airline communications and ATC communications may be handled by different crew members on different display controllers. So the CMU Mark 2 should be able to provide these services independently to crew members.

4.13.4 VHF Analog Voice Flight Deck Support

When the CMU Mark 2 is installed in an aircraft which may call for the VHF data radio to serve in an analog voice capacity, the CMU Mark 2 should provide for an orderly release of and subsequent re-establishment of data connectivity. CMU Mark 2 VHF data communications are interrupted for the duration of the analog VHF voice conversation see ARINC Specification 618.

If the CMU Mark 2 provides analog VHF voice tuning capabilities, in addition to data frequencies, it also should support the extended VHF range and 8.33 kHz channel spacing tuning.

In addition, the CMU Mark 2 should be capable of providing isolation of the signals controlling the analog voice/data modes to the associated VHF transceiver. This should be done in a manner that preserves the VHF/control panel approvals for ATC analog voice operations. These signals include:

- Voice/data mode output discrete.
- MSK audio inputs and outputs.
- DFS port select output discrete.
- Data key line output.

See Section 5.2.1.1.9, Voice Mode Isolation Program Pin, and Appendix B, ARINC 716 VHF Voice Configuration.

4.14 Operation/Initialization

The CMU Mark 2 should conduct a comprehensive built in test whenever Power-up or Reset occurs to determine the health of the CMU Mark 2. See Section 6.1.2.

The CMU Mark 2 should initiate actions (ACARS and/or ATN protocols) to determine system connectivity.

The CMU Mark 2 should perform initialization on the subnetworks in order for the subnetworks to obtain addressing information and begin communication.

4.15 Dual Installation

A dual CMU Mark 2 installation should be supported.

COMMENTARY

The following information is preliminary and does not fully define the dual CMU Mark 2 architecture.

Two levels of dual functionality may be provided. If the CMU Mark 2 is operating at or below Level B, then only limited information needs to be exchanged between the dual units.

If the CMU Mark 2 is operating above Level B, then a more robust exchange should be provided consistent with flight management systems.

In a dual CMU Mark 2 configuration, the left CMU Mark 2 is considered the normal primary unit. One CMU Mark 2 should be ACTIVE and the other in STANDBY. Only the active CMU Mark 2 should transmit Link and Network Layer data, and be a protocol-active participant with the interfaced air-ground subnetwork(s).

Two mechanisms have been provided to control which CMU Mark 2 is active and which is standby:

- Discrete I/O pins Dual Active/Standby Discrete Out (TP-2J) and Dual Inhibit Discrete In (TP-6D), see Sections 5.3.16.2 and 5.3.16.3
- Crosstalk bus, see Section 5.3.16.1

COMMENTARY

Transfer of active status from one to the other deserves some forethought. Designers should take care to preclude both units from being commanded to be active or standby simultaneously. Timing of the command, turn-on time and turn-off time of the units should be considered.

Pilot control of which CMU Mark 2 is active can be performed on a MCDU screen or optional panel.

Systems interfacing with the CMU Mark 2 which do not support dual CMU Mark 2 inputs, such as the ARINC 716 VHF Communications Transceiver, should interface only with the left CMU Mark 2 as shown in Attachment 1-8. Dual CMU Mark 2 operation over VHF can be achieved with digital interfaces (ARINC 429) with an ARINC 750 VHF Data Radio.

COMMENTARY

Relays and switching devices can be used to provide dual CMU Mark 2 interfaces with systems containing only one input. The relays and switching devices may significantly increase the cost of the installation and adversely affect the system reliability. Such installations are not recommended or defined herein.

4.16 Options and Growth

The CMU Mark 2 is defined to support a variety of aircraft architectures, as well as allowing for the system to be configured in a way that meets the individual needs of each airline. Within some aircraft architectures, the CMU Mark 2 is expected to perform all of the applications identified in Section 4. In other aircraft configurations, a subset of the applications may reside within the CMU Mark 2, such as the basic message routing, while other avionics perform other functions.

COMMENTARY

Some functions are based on technology that is in the definition stage. These functions are expected to be offered as upgrades by avionics suppliers when such technology is defined. Aspects of the system design, identified in Section 3, should be considered by the avionics supplier as being part of the basic CMU Mark 2.

4.17 CMU Simulator Functions

The CMU should support all of the simulator functions listed in ARINC Report 610A, Appendix I. The simulator functions are controlled by ARINC 429 broadcast words defined in ARINC Report 610A The CMU receives the simulator broadcast words via the interface defined in Section 5.5.2 of this document.

Section 5.5 of this document defines the CMU-simulator interfaces.

The CMU detects that it is installed in a simulator when the Installed in Simulator program pin is grounded (see Section 5.5.1) and the simulator ARINC 429 broadcast words are present (see Section 5.5.2). An Ethernet interface is provided (see Section 5.5.3) for the transfer of air-ground messages.

COMMENTARY

Protocols and message formats are expected to be defined so that the Ethernet link can be used instead of simulating the VHF, satellite, and HF air-ground data links.

4.18 Data Link Recording

This section specifies the parameters selected for data link recording. Such messages are used in incident/accident investigations. Events that trigger recording are used by the CMU to format messages that are sent to the data recorder using ARINC 429. Section IV-2 1.6 of EUROCAE ED-112 was analyzed for recording triggers as well as the data to be recorded. The sections that follow are in compliance with ED-112.

4.18.1 Data To Be Recorded

The CMU should forward copies of all messages of the following types to the recorder:

- Uplinks that are destined to be displayed by the CMU
- Uplinks that are destined to be printed by the CMU
- All Uplinks to FMC

- Downlinks created by the crew from the CMU display unit menu
- All downlinks from the FMC including ADS
- CMU clock updates
- Messages received from other LRUs containing the recorder's Destination Code
- Label HX downlinks (Undelivered Uplink Report)

4.18.2 Events That Trigger Recording

When the following events occur, the CMU should first format a copy of the message according to ARINC 619, and then send it to the recorder using ARINC 429 Williamsburg Version 3. See ARINC Specification 429 Part 3.

- When the CMU receives a complete uplink message from any of the air-ground subnetworks it will determine whether that uplink should be recorded. If the uplink will be displayed, printed or sent to the FMC, then it should be recorded. The ARINC 429 transmission to the recorder should begin within 1 second of receiving the end of the uplink message when at least 1 second has elapsed since the previous data link recording event.
- When the CMU forwards an uplink from any of the air-ground subnetworks to the FMC then it should be recorded. The ARINC 429 transmission to the recorder should begin within 1 second of receiving the ARINC 429 ACK word from the FMC when at least 1 second has elapsed since the previous data link recording event.
- When the CMU displays an uplink message then it should record a copy of the message. The ARINC 429 transmission to the recorder should begin within 1 second of finishing the transmission (receive ARINC 429 ACK word) to the display unit when at least 1 second have elapsed since the previous data link recording event.
- When the CMU prints an uplink then it should record a copy of the message. The ARINC 429 transmission to the recorder should begin within 1 second of the ARINC 429 ACK when at least 1 second has elapsed since the previous data link recording event.
- When the CMU sends a downlink (including HX downlinks, Undelivered Uplink Report) on any of the air-ground subnetworks it will determine whether that downlink should be recorded. If the CMU determines that the downlink should be recorded then it will format a copy of the message according to ARINC 619 and send it the recorder. The ARINC 429 transmission to the recorder should begin within 1 second of receiving an ARINC 429 ACK word from the transmitter (VHF, HF, SATCOM) or transmit indication (VDLM2, VDLM0) and at least 1 second has elapsed since the previous data link recording event.

  If the message is retransmitted on the same air-ground subnetwork, then it is NOT recorded again.
- When the CMU receives a downlink from the FMC it will format a copy of the message according to ARINC 619 and send it the recorder. The ARINC 429 transmission to the recorder should begin within 1 second of the ARINC 429 ACK word transmission to the FMC for the last LDU/block of the file and at least 1 second has elapsed since the previous data link recording event.
- When the crew presses the SEND prompt on the ACARS menu display unit then the CMU formats a copy of the message according to ARINC 619 and

sends it to the recorder. The ARINC 429 transmission to the recorder should begin within 1 second of receiving the SEND command prompt but be no sooner than 1 second since the previous data link recording event.

4.18.3 Multiple Recording Events

When the CMU is in the process of recording a data link recording event and another data link recording event occurs then the data for the second event should appear on the ARINC 429 bus to the recorder within 1 second of the completion of the previous file transmission to the recorder.

5.1 Air-Ground Communications - Protocol

The CMU Mark 2 is expected to implement a wide variety of protocols related to aeronautical mobile communications. Most notably, they consist of the ACARS and ATN related protocols.

5.1.1 ACARS Air-Ground Protocols

The ACARS Air-Ground protocols may be used to provide a character-oriented datalink service utilizing various air-ground media including VHF, SATCOM, and HF. The air-ground protocol used in sending and receiving ACARS messages is defined in ARINC Specification 618. The CMU should operate in the store and forward mode defined in ARINC Specification 618.

For VHF ACARS mode of operations, the CMU Mark 2 provides an internal MSK modem. The CMU performs all ACARS link layer and MAC protocols.

For VDL Mode A operation, the VDR provides the MSK modem. As such, an internal MSK modem in the CMU Mark 2 is not needed. In this configuration, the CMU hosts the ACARS Link Layer sub-layer and the VDR hosts the MAC sub-layer.

For VDL Mode 2 operation, the VDR provides the AVLC D8PSK modem. In this configuration, the CMU hosts the ACARS and VDL Mode 2 Link Layer sub-layer and the VDR hosts the MAC sub-layer. The ACARS Over AVLC (AOA) configuration uses the VDL Mode 2 services in a manner similar to satellite and HF datalink as described in ARINC Specification 618. An ATN configuration uses the VDL Mode 2 Services.

Satellite and HF datalink provide their own reliable air-ground protocols. The CMU should exercise the ACARS air-ground protocols defined in ARINC Specification 618 above the Air-Ground Link Layer protocols.

5.1.2 ACARS Ground-Ground Communications

ARINC Specification 620 describes the conversion to/from the ACARS Air-Ground format and the ACARS Ground/Ground format. The Ground/Ground message format is called Type B.

COMMENTARY

Type B ground/ground messages do not use the air-ground multi-block format. The service provider performs the conversion between the Type B ground/ground message and the air-ground messages. See ARINC Specification 620.

5.1.3 ACARS 622 ACF (ATN Bit to ACARS Char)

The ARINC 622 ACARS Convergence Function (ACF) provides a protocol that permits binary data to be transmitted using ACARS and provides additional integrity to the message.

COMMENTARY

This function is quite similar to other commercial communication protocols providing binary services using character protocols such as KERMIT and UUENCODE.

The CMU Mark 2 could utilize the ACF to send company communications, but the ACF was developed to support the ATS applications.

Since the ACF provides additional integrity to permit the ACARS network to handle ATS messages, it should be performed by the same host that is generating or decoding the ATS messages.

5.1.4 ATN Air-Ground Protocols

The ATN architecture consists of a suite of protocols selected for the air-ground and ground-ground communications as derived from the OSI protocols, based on the OSI Reference Model (specified in ISO/IEC 7498.) This layered architectural model is specially designed to permit greater interconnectability of systems.

The OSI model represents a layered system in which the communications functions are partitioned into a vertical set of layers, where the complete stack consists of seven layers. Each layer performs a related sub-set of the functions necessary to communicate with another peer system. The OSI model provides the basis for connecting Open systems for distributed applications processing.

5.1.4.1 ATN/ACARS Gateway/Envelope

Current avionics end-systems were designed to send and receive messages across the ACARS air-ground network. If these End Systems are not updated to operate within the ATN, the CMU Mark 2 is expected to provide a translation facility, called a Gateway that can enable the existing equipment to continue to function without replacement.

COMMENTARY

However, in the case where a CMU Mark 2 is sending ACARS data over the ATN, this envelope conversion should be considered and could become a CMU Mark 2 function.

ARINC Specification 619 describes the existing interface between the ACARS management unit and its interface avionics. The gateway function is expected to support this interface.

The CMU Mark 2 should determine the appropriate Link Layer protocol to interface to each end system as specified in ARINC Specification 429.

5.1.4.2 ATN Protocol Stack

The ATN SARPs (ICAO Doc 9705) defines two levels of communications service offered by the ATN stack: the Internet Communications Service and the Upper Layer Communications Service.

5.1.4.2.1 Internet Communications Service

The Internet Communications Service is provided with the Transport protocols (connection-oriented class 4 – based on ISO/IEC 8073 or connectionless – based on ISO/IEC 8602), the Inter-networking protocol (based on ISO/IEC 8473), the End System to Intermediate System (ES-IS) protocol (based on ISO/IEC 9542), the Inter-domain Routing Protocol (IDRP - based on ISO/IEC 10747), and the Sub-network Dependent Conversion Protocol (SNDCP).

The SNDCP provides access to all air-ground Sub-Networks such as SATCOM Data-3, VDL Mode 2, HFDL, etc. It also compresses the NSAP addresses and the octet strings from layer 3 and above, including application data, for transmission over all air-ground Sub-Networks.

IDRP makes it possible to connect all ATN island networks to form a global interconnected network. ATN Security (router authentication) is provided with IDRP to ensure that routing information is not compromised by masquerade, replay, or integrity attacks.

The CMU Mark 2 is expected to be an ATN airborne router which has IDRP and SNDCP protocols. Other avionics that are not routers do not have these two protocols.

5.1.4.2.2 Upper Layer Communications Service

The connection-oriented Upper Layer Communications Service is provided by the OSI Session protocol - efficiency enhancements (specified in ISO/IEC 8327-1:1996/Amd. 1:1997), the OSI Presentation protocol – efficiency enhancements (specified in ISO/IEC 8823-1:1994 /Amd. 1:1997), and one or more OSI-based Application Service Elements. The efficiency enhancements to the Session and Presentation protocols make it possible to reduce the headers of these layer 5 and layer 6 protocols to 2 octets during connection establishment and zero octets at all other times. A connectionless Upper Layer Communications Service is also provided in the ICAO Doc 9705, Edition 3.

Application security (authentication) is provided by the Application Service Elements to protect application data from masquerade, replay, and integrity attacks.

Network management (based on OSI Common Management Information Protocol – CMIP, specified in ISO/IEC 9596) is a function within the Upper Layer Communications Service.

COMMENTARY

The CMU Mark 2 will need to provide a mapping mechanism to support the co-existence of the ATN network management (CMIP) on the air-ground side and the TCP/IP-based network management (SNMP) on the onboard side if installed.

5.2 Subnetwork Interfaces

5.2.1 VHF Radio Interface

The specific VHF interface varies from airline to airline and airplane to airplane. In some cases, portions of the defined interfaces may not be needed. However, the CMU Mark 2 is expected to be capable of supporting the various options. The interfaces (and associated interwiring) used on a given aircraft depend largely upon:

- Type of radio (ARINC Characteristic 716/750).
- Radio configuration (750 Mode 0/Mode A/Mode 2).
- Voice mode and radio management system issues.
- Air-Ground protocols and speeds, including MSK ACARS, AVLC Mode 2, and Mode 3.

The ARINC Characteristic 750 VDR has the capability of providing several modes of operation. The various modes which have been defined are documented in **ARINC Characteristic 750**: *VHF Data Radio*. The CMU controls which mode is to be used and mode switching may be dynamic depending on the services provided along the route.

When the CMU is connected to an ARINC Characteristic 750 VDR, then the CMU can control whether the VDR responds to the analog interface (Mode 0) or the ARINC 429 interface (all other modes at this time) with bit 15 in the CMU Label 270 status word. By providing explicit direction to the VDR regarding which interface (ARINC 429 or analog) is to be used, it is possible to install the CMU/VDR ARINC 429 bus wiring (see Sections 5.3.2.4, 5.3.2.6, and 5.3.2.7) in anticipation of future use, yet still use the analog interface. The VDR defaults to ARINC 716 analog interface (Mode 0). The CMU sends a message to the VDR to cause the VDR to switch to ARINC 750 mode and then the CMU can send other messages to select the desired air-ground protocol (Mode A, Mode 2, etc.).

5.2.1.1 ARINC 716 VHF Transceiver Interface

5.2.1.1.1 ARINC 716 Modem Interface

If the aircraft is configured to communicate using radios designed to ARINC Characteristic 716 functionality, the CMU Mark 2 should include an MSK (minimum shift keying) modem (modulator/demodulator).

COMMENTARY

ARINC 750 VHF Data Radios are highly desired for all installations in the CNS/ATM environment. However, provisions are permitted to allow other radios to be used.

The CMU Mark 2 does not support VHF radios designed to **ARINC Characteristic 546:** *Airborne VHF Communications Transceiver System,* or **ARINC Characteristic 566A:** *Mark 3 VHF Communications Transceiver* due to inadequate radio performance for datalink communications.

The CMU Mark 2 MSK modem interfaces with the VHF transceivers via a twisted shielded pair over which 1200 and 2400 Hz MSK audio tones are exchanged.

The characteristics of the audio signals, the MAC sub-layer, and the ACARS frame layer are described in ARINC Specification 618.

5.2.1.1.2 Voice/Data Mode Monitor Input Discrete

The CMU Mark 2 should provide a discrete input (TP-7E) to monitor whether the VHF air-ground link is in Data Mode or Analog Voice Mode. A “Standard Ground” indicates the CMU Mark 2 should operate in Data mode, and a “Standard Open” indicates the CMU

Mark 2 should operate in Voice Mode. Standard Ground and Standard Open signals are defined in Section 2.9, ARINC Standard Interfaces.

In installations in which the CMU Mark 2 controls the VHF transceiver, TP-7E is typically strapped to connector pin TP-7F on the aircraft side of the connector.

5.2.1.1.3 Remote Voice/Data Select Input Discrete

The CMU Mark 2 should change from VHF Data mode to VHF Analog Voice Mode and vice versa whenever a momentary airframe dc ground is applied to the Remote Voice/Data Mode Select Discrete Input located on service connector pin TP-5J.

Momentary is defined as application of a “Standard Ground” for 50 milliseconds or more. At all other times, this pin should see a “Standard Open” circuit. Standard Ground and Standard Open signals are defined in Section 2.9, ARINC Standard Interfaces. One source of this input could be a push-button switch on the VHF COMM transceiver control panel.

5.2.1.1.4 Voice/Data Mode Annunciation Output Discrete

The Voice/Data Mode Annunciation Output Discrete (TP-7F) is used to indicate whether the VHF transceiver associated with the CMU Mark 2 is to operate in Analog Voice or Data Mode. This discrete may also be used to control the keying mode of the ARINC 716 VHF transceiver. Its operation is defined in ARINC Specification 618.

This Discrete should consist of a “Standard Ground” when the VHF transceiver is to operate in the Data Mode or “Standard Open” when the VHF transceiver is to operate in the Analog Voice mode. Standard Ground and Standard Open signals are defined in Section 2.9, ARINC Standard Interfaces.

5.2.1.1.5 Remote Voice/Data Mode Annunciation Output Discrete

A Remote Voice/Data Status Annunciator Output Discrete having identical logic to pin TP-7F should appear at CMU Mark 2 connector pin TP-5K for the purpose of operating a status annunciator. The switching component in the CMU Mark 2 should be capable of handling 250 milliamperes of current in the ground state and holding off 36 Vdc in the open state.

COMMENTARY

The current handling capabilities of this discrete output are an exception to the Standard Ground and Standard Open outputs defined in Sections 2.9.2 and 2.9.3. The more stringent criteria are due to the potential for the CMU Mark 2 to be installed on aircraft in which the output is used to sink lamp current directly, rather than control a lamp driver.

5.2.1.1.6 DFS Port Selection Output Discrete

A DFS Port Select Output Discrete (TP-7C) provides tuning source selection to the VHF transceiver. The DFS Port Selection Output discrete should be a "Standard Ground" whenever the CMU Mark 2 expects to be the source of the ARINC 716 VHF frequency to that transceiver. It should be a "Standard Open" whenever control is relinquished to an external tuning system or dedicated control head. Standard Ground and Standard Open signals are defined in Section 2.9, ARINC Standard Interfaces.

5.2.1.1.7 DFS ARINC 429 Tuning Interface

ARINC 429 tuning information should be passed from the CMU Mark 2 to the VHF transceiver via a twisted shielded pair using the broadcast protocol of ARINC Specification 429 when providing ARINC 716 tuning data to the VHF transceiver. This output is primarily used to supply data frequencies, but may also be used to provide voice frequencies. See Section 5.3.3.2.

COMMENTARY

ARINC 716 and ARINC 750 transceivers with 25 kHz channels only respond to Label 030 for frequency tuning.

ARINC 716 and ARINC 750 transceivers which have been modified to support 8.33 kHz channels respond to Label 047 and Label 030. Label 030 is used to supply data frequencies to the VHF transceivers and 25 kHz Analog voice frequencies.

For CMUs supporting both 8.33 kHz and 25 kHz Analog voice frequency channels, it is recommended that only one Label (030 or 047) be sent to the VHF transceiver at a time. This allows VHF transceivers to non-ambiguously determine which type of channel is to be used. Another possibility is to use the ARINC Specification 429 SSM to specify which label is to be used, but some VHF transceivers may not process this field.

5.2.1.1.8 VHF Data Key Output Discrete

A VHF Data Key Line Output Discrete (TP-5H) and Return (TP-7K) provide radio keying. Operation of the VHF Data Key Line Discrete Output is defined in ARINC Specification 618.

The VHF Data Key Line Output Discrete should be a "Standard Ground" whenever the CMU Mark 2 is providing MSK signals to the VHF transceiver. It should be a "Standard Open" to end data transmission. Standard Ground and Standard Open signals are defined in Section 2.9, ARINC Standard Interfaces.

5.2.1.1.9 Voice Mode Isolation Program Pin

The Voice Mode Isolation Program Pin is assigned to pin MP-9D. Its operation is defined in **ARINC Characteristic 724B:** *Aircraft Communications Addressing and Reporting System (ACARS).* A Standard Program Pin Ground is used to indicate that the VHF Isolation function is active as defined in ARINC Characteristic 724B. Standard Program Pin Ground and Open signals are defined in Section 2.9, ARINC Standard Interfaces.

5.2.1.1.10 Voice Channel Frequency Control Program Pin

The Voice Channel Frequency Control Program Pin is assigned to pin TP-11C. Its operation is defined in ARINC Specification 618. A Standard Program Pin Ground is used to indicate that the CMU Mark 2 is used to provide Analog Voice frequencies to the transceiver. A Standard Program Pin Open indicates an external control source is available for VHF Analog-Voice tuning. Standard Program Pin Ground and Open signals are defined in Section 2.9, ARINC Standard Interfaces.

5.2.1.1.11 8.33 kHz Tuning Discrete Input Pin

The 8.33 kHz Tuning Discrete Input Pin is assigned to CMU pin MP-2B. A “Standard Ground” is used to indicate that the VHF transceiver supports 8.33 kHz analog voice channels when ARINC 429 Label 047 is used (see ARINC Characteristic 716.) A “Standard Open” indicates that the transceiver only supports 25 kHz channels.

Standard Ground and Open signals are defined in Section 2.9, ARINC Standard Interfaces.

5.2.1.2 ARINC 750 VHF Transceiver

The ARINC 750 VHF Transceiver supports several modes of operation as defined in ARINC Characteristic 750. All modes, except Mode 0 (ARINC 716 emulation), are expected to use the ARINC 429 CMU-VDR Physical and Link layer interface as defined in ARINC Characteristic 750 and Sections 5.2.1.2.1 and 5.2.1.2.2 of this document. When the CMU interface uses the ARINC 429 interface instead of the analog interface, then the CMU should send the PR_SET command as defined in ARINC 750 and ignore the analog interface.

A CMU Mark 2 designed to level 0.1 or higher should support the ARINC 618 protocols over the air-ground link via an ARINC 429 CMU-VDR interface. A CMU Mark 2 designed to level 0.2 or higher should also support AVLC protocols over the air-ground link via an ARINC 429 CMU-VDR interface. A CMU Mark 2 designed to level 1 or higher should also support high speed AVLC protocols over the air-ground link via an ARINC 429 CMU-VDR interface.

The CMU-VDR digital interface is described in **ARINC Characteristic 750:** *VHF Data Radio*.

5.2.1.2.1 Physical Interface

The CMU-VDR physical layer interface is an ARINC 429 data bus operating at high speed. Word size, voltage thresholds, and electrical interface specifications are per ARINC Specification 429. The minimum word gap between two words should be as defined in ARINC Characteristic 750.

5.2.1.2.2 Link Layer Interface

The CMU should use the high speed version 1 or version 3 ARINC 429 BOP to exchange command, control, and data packets as described in ARINC Characteristic 750. In addition to sending and receiving ACARS blocks ARINC 429 BOP, additional support for this interface is provided by ARINC 429 discrete data words sent between the CMU and VDR as specified in ARINC Characteristic 750, Section 5.5.

When a CMU is configured to use Mode A and it is interfaced to a VDR that only supports Mode A with Version 1, then the CMU will need to support high speed ARINC 429 BOP Version 1 also.

For BOP transmissions from the CMU to VDR, the CMU should use the System Address Label (SAL) reported by the VDR in its Label 172 data word output to the CMU, as shown in Table 5.2.1.2.2-1.

Table 5.2.1.2.2-1 – SAL Definition for Various VDR

VDR	SAL
1	251 octal
2	252 octal
3	253 octal

All BOP transmissions from a VDR to a CMU should use SAL 304 octal. The master CMU should accept a received SAL of 304 octal regardless of installed position, 1 or 2.

5.2.1.2.2.1 BOP Version 1

The CMU and VDR use a tailored set of timer values and protocol events in order to provide the performance (primarily minimum propagation delay) to support the air-ground link with a modified version 1 of ARINC 429 BOP. All protocol events for the CMU/VDR ARINC 429 version 1 interface should be according to the definitions in ARINC Characteristic 750. All timer values for the CMU/VDR interface should be the modified definitions in ARINC Characteristic 750.

In addition, Table 5.2.1.2.2.1-1 shows BOP Protocol Options should be used by the CMU for the VDR interface (*see* reference ARINC Characteristic 750):

Table 5.2.1.2.2.1-1 BOP – Protocol Options for VDR Interface Version 1

Option	Description	Default
O1	Half or Full Duplex	Half
O2	High or Low Speed Bus	High
O3	Automatic CTS When Ready	Yes
O4	Accept Automatic CTS	Yes
O5	SYS Priority to Resolve Conflict	CMU
O6	Reserved	
O7	Reserved	
O8	Use of SOLO Word	Yes
O9	Reserved	
O10	Destination Code Required	Yes
O11	Bit-Protocol Verification (ALO/ALR Protocol Determination)	Yes
O12	Use Subsystem SAL from ALO word	No

Reception of a SYN word should cause the receiving system to abort any reception or terminate any transmission in progress. In addition, if the system was transmitting, it should re-initiate transmission of the file that was aborted.

On power-up, systems should transmit ALO words as opposed to sending NAK or SYN. All systems are to respond with an ALR if an ALO is received, as defined in O11.

5.2.1.2.2.2 BOP Version 3

The CMU and VDR use the standard set of timer values and protocol events for Version 3 of ARINC 429 BOP.

In addition, the following BOP Protocol Options should be used by the CMU for the VDR interface (see ARINC Characteristic 750).

Table 5.2.1.2.2.2-1 – BOP Protocol Options for VDR Interface Version 3

Option	Description	Default
O1	Half or Full Duplex	Full
O2	High or Low Speed Bus	High
O3	Automatic CTS When Ready	N/A
O4	Accept Automatic CTS	N/A
O5	SYS Priority to Resolve Conflict	N/A
O6	Reserved	
O7	Reserved	
O8	Use of SOLO Word	Yes
O9	Reserved	
O10	Destination Code Required	N/A
O11	Bit-Protocol Verification (ALO/ALR Protocol Determination)	Yes
O12	Use Subsystem SAL from ALO word	No
O13	Use of info or command frames	Command frames only
O14	Use of pause function	No (Note 1)
O15	32 bit CRC	No

Note :

1. The VDR may send a pause command which the CMU is required to process correctly. The CMU should not send a pause command to the VDR.

On power-up, systems should transmit ALO words. A system should respond with an ALR if an ALO is received, as defined in BOP Protocol Option O11.

5.2.1.2.3 ARINC 750 Status Exchange

The CMU Mark 2 should receive broadcast ARINC 429 data words (Label 270) containing the Analog Voice/Data Mode status from each interfacing VDR. Labels 172 (VDR System Address Label) and 377 (VDR Equipment Identifier) are also available. See ARINC Characteristic 750 for the definition of these ARINC 429 word formats.

The CMU Mark 2 should transmit broadcast ARINC 429 data words (Label 270 and 172), containing the CMU Mark 2 status information and CMU System Address Label, respectively, to the VDRs on the COMM output buses.

5.2.1.2.4 ARINC 750 Control and Configuration

The CMU and VDR exchange the messages defined in ARINC Characteristic 750. The messages defined in Sections 3 and 5 of ARINC Characteristic 750 are used to control and configure the VDR. ARINC Characteristic 750 contains an attachment for each air-ground protocol and the corresponding attachment defines the messages for that protocol. Each message transmitted by the CMU triggers a response message from the VDR. The CMU should wait for the response message before sending the next message. The VDR should transmit the response message within the time indicated in ARINC Characteristic 750.

5.2.1.2.4.1 VDR Configuration

The VDR supports several modes of operation. Therefore, the initial step in CMU-VDR communication is to establish the desired mode of operation, which is referred to as air-ground protocol *selection* or VDR configuration. VDR configuration is performed every time the VDR transitions to Data Mode, either from power up or from Analog Voice mode.

ARINC Characteristic 750, Sections 3 and 5, define the primitives used to perform VDR configuration. Air-ground protocol selection is defined in ARINC Characteristic 750, Sections 3 and 5. The next step after air-ground protocol selection is initialization of the air-ground protocol with the data required for operation by the selected protocol.

VDR configuration is performed using general data format GFI 2, and file type of Command when ARINC 429 Version 3 is used, and destination code 00_h when ARINC 429 Version 1 is used. Solo words and file transfer are used as indicated in ARINC Characteristic 750, Section 5, to perform the VDR configuration. At this time messages with GFI values other than 2 are considered errors and are ignored, other than error processing.

COMMENTARY

Sometimes changing the VDR configuration will require changing which version of BOP is used to communicate with the VDR. The BOP switch should be performed prior to the configuration switch per ARINC 750.

COMMENTARY

When the CMU resets and the VDR does not, then it is possible for the CMU to receive protocol messages even though the CMUs state indicates that a protocol has not been selected yet. Likewise, if the VDR resets and the CMU does not, then it is possible for the CMU to transmit protocol messages before it detects the change in VDR state because there can be up to a 1 second delay in the annunciation of the change in VDR status. The CMU and VDR designers should consider this.

5.2.1.2.4.2 VDR Protocol Initialization

After the VDR configuration has been determined then the initialization data used by the selected protocol is transferred to the VDR.

5.2.1.2.4.2.1 VDL Mode A (ACARS Protocol)

When Mode A (ACARS protocol) is selected then the initialization is performed as defined in ARINC Specification 618, Section 11. ARINC Characteristic 750, Attachment 11, lists the various message formats that have been defined for CMU-VDR communication when the ACARS protocol is used. VDR initialization is performed using general data format GFI F_h, extended GFI $F2_h$. CMU-VDR communications based on ARINC 429 Version 3 uses file types command and data.

CMU-VDR communications based on ARINC 429 Version 1 uses destination codes 00_h and 01_h. VDR initialization is performed every time the VDR transitions to Data mode, either from power up or from Analog Voice mode, or after a loss of VDR bus activity or from other data modes.

The extended GFI code $F2_h$ indicates that the ACARS protocol message set, as defined in ARINC Characteristic 750, Attachment 11, is being used. In the ACARS protocol message set when ARINC 429 Version 3 is used then file type Command is used to identify control messages and file type Data is used to identify data (uplink/downlink) messages. In the ACARS protocol message set when ARINC 429 Version 1 is used then, destination code 00_h is used to identify control messages and destination code 01_h is used to identify data (uplink/downlink) messages.

Messages with GFI values other than 2_h or F_h are considered errors and are ignored, other than error processing. Messages with GFI value F_h and extended GFI values other than $F2_h$ are considered errors when the ACARS protocol has been selected and are ignored, other than error processing. When ARINC 429 Version 1 is used then destination codes other than 00_h and 01_h are considered errors when the ACARS protocol has been selected and are ignored, other than error processing.

COMMENTARY

> The CMU designer may choose to respond to invalid extended GFI codes by resetting the VDR, or re-configuring the VDR, or ignoring this unlikely event. Other protocols, such as AVLC use a different extended GFI value.

The CMU initializes the VDR with the operational parameters (frequency, prekey, modulation) and addresses (aircraft registration, flight identifier and broadcast address). At a minimum, the CMU uses the PARAM_REQ message and the ADDR_REQ message to initialize the ACARS protocol. See ARINC Specification 618, Attachment 13, Figures 13-3 and 13-4.

5.2.1.2.4.2.2 VDL Mode 2 (AVLC Protocol)

When the AVLC protocol is selected by the CMU then the initialization is performed as defined in ARINC Characteristic 750, Attachment 10. VDR initialization is performed using general data format GFI F_h and extended GFI $F1_h$. VDR initialization is performed every time the VDR transitions to Data Mode, either from power up or from Voice mode or after a loss of VDR bus activity or from other data modes.

The extended GFI code $F1_h$ indicates that the ASIP protocol message set, as defined in ARINC Characteristic 750, Attachment 10, is being used. Messages with GFI values other than 2 or F_h are considered errors and are ignored, other than error processing. Messages with GFI value F_h and extended GFI values other than $F1_h$ are considered errors when the AVLC protocol has been selected and are ignored, other than error processing.

5.2.1.3 VHF Loadable Options

Due to the broad nature of VHF related options, the CMU Mark 2 should be able to support additional configuration functions through loadable options. Most of the functions are assumed to be stored in the APM. However, other methods could also be used such as MCDU data entry or stored internal to the CMU Mark 2. ARINC Specification 618, Section 6, outlines some of these VHF Configuration options, as well as the following information:

- The CMU Mark 2 may need to know whether the ARINC 716 VHF transceiver supports 8.33 kHz channels or only 25 kHz channels. See Section 5.2.1.1.11.
- The CMU Mark 2 may need to know whether Analog Voice tuning capabilities should be provided and any associated timers.

COMMENTARY

Typical aircraft wiring does not allow the CMU to provide the voice tuning for the ARINC 750 VHF transceiver.

When the CMU Mark 2 is installed with multiple VDRs, it should be able to determine which one should be primarily used for data communications.

5.2.2 SDU ARINC 741 Interface

Satellite data communications are conducted via an interface with a Satellite Data Unit (SDU). The CMU Mark 2 should be capable of interfacing with two SDUs as defined in ARINC Characteristic 741. Dual SDUs operate in a Master/Slave mode, where only the master SDU exchanges air-ground packets with the CMU Mark 2. The SDUs determine which unit is master and which unit is slave and conveys this information to the CMU Mark 2 in the SDU status word. The CMU Mark 2 recognizes which SDU is master and utilizes its services to communicate with the ground.

The connections defined in Section 5.3.2.4 are used when the CMU Mark 2 interfaces with SDUs via a low speed ARINC 429 bus.

The connections defined in Sections 5.3.2.6 and 5.3.2.7 are used to interface with SDUs via a high speed ARINC 429 bus. On any one aircraft, when two SDUs are connected to the CMU Mark 2, both SDUs use similar ARINC 429 interfaces, i.e., both low-speed or both high-speed.

SDUs output Label 271 Join/Leave messages to indicate their current air-ground connectivity status – reference ARINC Characteristic 741, Part 2, Section 4.7.3.3. SDUs which indicate no specific satellite system type in their Label 172 equipment type words include different data in their Join/Leave messages in place of the Aero service type (H, H+, I or L) currently being provided; for such SDUs the CMU cannot determine the specific type of Aero service currently being provided.

Data 2 and Data 3 modes of operation have been defined. Both modes can operate simultaneously.

5.2.2.1 SATCOM Data 2

The Data-2 CMU-SDU protocol is defined in ARINC Specification 618. Data 2 is an ACARS packet based Sub-Network developed to facilitate integration into the existing ACARS VHF network. The complete CMU-SDU interface for Data 2 is defined in ARINC Characteristic 741 or ARINC Specification 618 either explicitly or by reference. ARINC Specification 618 also contains the packet formats exchanged between the CMU Mark 2 and its peer on the ground.

5.2.2.2 SATCOM Data 3

The Data 3 CMU-SDU protocol is defined in ARINC Characteristic 741. Data 3 is a bit-oriented, ATN compatible sub-network. The complete CMU-SDU Data 3 interface is defined in ARINC Characteristic 741 either explicitly or by reference.

5.2.2.3 SDU as an End System

The CMU Mark 2 also supports the SDUs as an End System. The CMU Mark 2 can route uplinks to each SDU and the CMU Mark 2 can route downlinks from both SDUs. ARINC Characteristic 741 and ARINC Specification 619 define the SDUs as an End System with the CMU Mark 2.

Dual SDUs are considered separate end systems and can generate and receive messages as an end system regardless of Master/Slave status.

5.2.3 HF Datalink ARINC 753 Interface

HF Datalink (HFDL) is conducted via an interface with an HF Data Radio (HFDR) or HF Data Unit (HFDU). The HF Data Radio and HF Data Unit are described in ARINC Characteristic 753. The HF datalink air-ground protocols are defined in ARINC Specification 635.

HF datalink supports the transmission of both enveloped ACARS messages and ATN sub-network access according to ISO 8208. The HFDL asserts its protocol support in its Label 270 word to the CMU Mark 2. Some HFDLs may only have enveloped ACARS message capabilities. In addition to ACARS messages and ATN packets, status, and command and control messages may also be sent between the CMU Mark 2 and HFDLs.

The CMU-HFDL Link layer interface uses the ARINC 429 Bit-Oriented Protocol (BOP*)* to exchange information and packets with the HFDL. Link Layer options are specified in ARINC Characteristic 753. The CMU Mark 2 should use the HFDL transmitted Label 172 to acquire the SAL of the HFDL attached to a specific I/O port. The HFDL equipment should normally be connected to the COMM Link General Bus #4 ports. The HFDL SALs are 340 for HFDL #1 and 344 for HFDL #2. An ARINC 429 BOP GFI of "1110_b" is used for Enveloped ACARS, "0100_b" for 8208, and "0010_b" for command and control with the CMU Mark 2.

The CMU-HFDL Physical layer interface is an ARINC 429 data bus operating at low speed. The CMU Mark 2 is capable of interfacing with two HFDLs on its COMM Link Bus #4 as defined in Section 5.3.2.4. Dual HFDLs both operating in Data Mode should operate in a master/slave mode, where only the master HFDL exchanges air-ground packets with the CMU Mark 2. The CMU Mark 2 contains logic to determine which HFDL is master and which HFDL is slave. The master/slave control information is conveyed to the HFDLs via the Label 276 word transmitted by the CMU Mark 2. See Section 5.2.3.7.

5.2.3.1 HFDL Air-Ground Messages

The CMU-HFDL ACARS interface is described in ARINC Specification 618.

The CMU-HFDL ATN ISO 8208 interface is described in ARINC Characteristic 753.

5.2.3.2 HFDL Configuration Management

The CMU Mark 2 should utilize its Configuration Management Data Base to determine:

- The number of HFDLs installed in the aircraft.
- The CMU Mark 2 data bus (port) being used.

The CMU Mark 2 determines whether datalink capable HF radios are installed based on information stored in the Configuration Management Data Base and reports status on its Label 276 output word. Bit 22 indicates the installation status of HFDL 1 and Bit 23 indicates the installation status of HFDL 2. A bit value of 1 indicates that a datalink capable HF radio is installed in that position. A bit value of 0 indicates either no HFDL is installed in that position or the HFDL installed in that position does not support datalink operation.

Installation status of the HFDL is determined solely from the configuration data base. ARINC 429 activity is not used in calculating HFDL installation status. ARINC 429 information (bus activity and Label 172) may be used by the CMU Mark 2 to determine which port the HFDL's are attached to in a particular installation.

5.2.3.3 Reserved

This section is retained as a placeholder.

5.2.3.4 HF Datalink Fault Status Determination

Each CMU Mark 2 determines fault status for HF datalink by looking for failures reported from each installed HFDR, or by absence of activity on the HFDR ARINC 429 interface. The CMU Mark 2 reports the status on Label 276, Bits 24 (HFDR 1) and 25 (HFDR 2).

See Attachment 4, Tables 4-1 through 4-4 for the HF Datalink Fault Status Determination logic to be implemented in the CMU Mark 2.

CMU #1 uses Bits 12 and 16 from each HFDR and ARINC 429 activity from each HFDR to determine the Fault status for each HFDR that is installed.

CMU #2 uses Bits 16 and 19 from each HFDR and ARINC 429 activity from each HFDR to determine the Fault status for each HFDR that is installed.

Faults are only reported for HFDRs which are considered installed according to the definition in Section 5.2.3.2.

5.2.3.5 HF Link Status Determination

The CMU Mark 2 is responsible for monitoring and annunciation of the HFDL link status. Air/ground message traffic is only routed to the HFDL when an active HF datalink is indicated as available.

The CMU Mark 2 annunciates HFDL Link status on both its MCDU and through digital annunciations (Label 270). See Attachment 6.

For ATN communications, the CMU Mark 2 processes HF Join/Leave events broadcast by the HFDL in order to update the CMU Router tables.

5.2.3.6 HF in Voice Reporting

The CMU Mark 2 reports the Voice/Data Mode of each HFDR 1 and HFDR 2 on Label 276, Bits 20 and 21, respectively. HF data communication may not be possible during HF Voice operations.

COMMENTARY

> It should be noted that HF radios utilize a single antenna and only one HF radio can transmit at a time. Long voice transmissions from the aircraft will suspend all HF data communications. Bits 13 and 14 in the Label 270 word from each HFDR may be utilized to monitor this type of event, which reports the HF transmission status to the CMU Mark 2.

See Attachment 4, Tables 4-5 and 4-6 for the HFDR Voice/Data Mode Determination logic to be implemented in the CMU Mark 2. Note that HF Voice/Data Mode determination is performed by the CMU Mark 2 regardless of whether the HFDR is installed.

5.2.3.7 HFDR Master/Slave Determination Logic

In dual HF Data Radio installations, the CMU Mark 2 is responsible for determining the Master/Slave status of each HFDR.

The CMU Mark 2 conveys the Master/Slave status to each installed HF Data Radio on Label 276, Bits 26 (HFDR 1) and 27 (HFDR 2).

If only one HFDR is Installed, that HFDR is designated Master and the other is designated Slave.

If no HFDRs are Installed, both HFDRs are designated Slave.

If both HFDRs are Installed, then HFDR 2 should be designated as the opposite Master/Slave state of HFDR 1. See Attachment 4, Table 4-7 for the HFDR Master/Slave Determination logic to be implemented in the CMU Mark 2.

COMMENTARY

The Master/Slave logic is used by some Warning Alert systems to determine when to annunciate HF Datalink Failures, for airplane configurations that alert failure of only the Master HFDR. To enable the appropriate Alerting, the CMU Mark 2 consequently declares a failed HFDR in Data Mode as Master if the other HFDR is in Voice Mode, and declares it as Slave if the other HFDR is in Data Mode.

5.2.3.8 HFDR/HFDU BITE Support

The CMU Mark 2 may be used in some installations to provide maintenance support as the HFDR/HFDU has no significant display capability. At a minimum the CMU Mark 2 should be able to display this information in a maintenance friendly format, and may optionally be able to print or downlink the data. In order to do this, the CMU Mark 2 should:

- Process the Bit Oriented BITE fault codes (Label 350) information received from the HFDR/HFDU for equipment status information. This information includes basic equipment health (HW).
- Process information in the Label 270 word from the HFDL that may be useful for maintenance and troubleshooting purposes.
- Be able to request and process pages of data as defined in ARINC Characteristic 753, Section 10.5.2.2, using command/control response messages.

COMMENTARY

ARINC Characteristic 753 has also made provisions to use Command/Control messages to exchange Owner's Requirements tables. However, at present there are no Owner's Preference elements defined for HF datalink.

5.2.4 Gatelink Interface

COMMENTARY

The operation of the Gatelink has yet to be defined although the increasing need for such a link to accommodate the extremely high volume of digital data to and from the aircraft is recognized.

Gatelink data communications should be conducted via an interface with a Gatelink Unit.

The Link layer interface should be an ARINC 429 data bus operating at high speed.

5.2.5 Transponder

There is currently no subnetwork defined over Mode S. Until such a subnetwork is defined, the Mode S bus to TCAS may be connected to the CMU input port reserved for a Mode S transponder, in order to provide a source for ICAO 24-bit aircraft address. The Mode S outputs ICAO 24-bit aircraft address on Labels 275 and 276, per ARINC Specification 429, Part 2. If the separate Transponder datalink is later connected to these CMU input ports to support a new subnetwork, the datalink bus may also be a source for ICAO 24-bit aircraft address. If so, the transponder is expected to output ICAO 24-bit aircraft address on Labels 214 and 216 as per Attachment 6 Tables 6-10 and 6-11 and ARINC Specification 429, Part 1.

The CMU Mark 2 should, therefore, recognize ICAO 24-bit aircraft address from the transponder on either Labels 275, 276 or Labels 214, 216. Note that similar formats are used for the two label pairs.

5.2.6 ARINC 761 SDU Interface

Satellite data communications can be conducted via interfaces with ARINC 761 SDUs. The CMU Mark 2 should be capable of interfacing with up to two ARINC 761 SDUs. The CMU should consider each ARINC 761 SDU as providing a separate and independent air-ground sub network, except for the case of dual ARINC 761 Inmarsat Aero-I SDUs (which operate in a master/slave mode, as described for dual ARINC 741 SDUs in Section 5.2.2). The CMU should be able to transmit and receive simultaneously via each independent ARINC 761 SDU installed.

COMMENTARY

> The CMU Mark 2 has a potential capability to connect with up to a total of two (ARINC 741 or ARINC 761) SDUs.

The ARINC 761 SDU Label 172 word (defined in ARINC Characteristic 761, Attachment 2, Item 2) includes an equipment type field which identifies the type of air-ground links provided by that SDU. The CMU uses the equipment type field to identify which physical CMU ARINC 429 ports lead to which air-ground links (i.e. aircraft wiring and SDU capabilities can vary). The CMU detects which equipment is installed on the aircraft and configures itself accordingly.

For the case of SDUs which support more than one type of air-ground bearer system, the CMU and SDU use the Williamsburg protocol Destination Code to select the bearer system to be used for each downlink, and to identify the bearer system which was used for each uplink, as defined in ARINC Characteristic 761, Attachment 2, Item 3. Reference Section 5.3.3.3 and Attachment 6, Table 6-15 of this document.

The ARINC 761 SDU Labels 27X Join/Leave messages indicate the current air-ground connectivity status for each bearer system for which support is indicated n the SDUs Label 172 word. For the case of the Inmarsat system, the Join/Leave message also includes the type of Aero service (H, H+, I or L) currently being provided. Reference ARINC Characteristic 761, Attachment 2 and (for the Inmarsat system's Label 271) ARINC Characteristic 741, Part 2, Section 4.7.3.3.

Inmarsat SDUs, which indicate no specific satellite system type in their Label 172 words, include different data in their label 271 Join/Leave messages in place of the Aero service type currently being provided. For such SDUs, the CMU cannot determine the specific type of Aero service currently being provided.

The connections defined in Section 5.3.2.4 are used when the CMU interfaces with SDUs via a low-speed ARINC 429 bus. The connections defined in Sections 5.3.2.6 and 5.3.2.7 are used to interface with SDUs via a high-speed ARINC 429 bus. On any one aircraft, when two SDUs are connected to the CMU Mark 2 both SDUs use similar ARINC 429 interfaces, i.e., both low-speed or both high-speed.

5.2.6.1 SATCOM Data 2

The Data 2 CMU-SDU protocol is defined in ARINC Specification 618. Data 2 is an ACARS packet based Sub-Network developed to facilitate integration into the existing ACARS VHF network. The complete CMU-SDU interface for Data 2 is defined in ARINC Specification 618 (and for the case of Inmarsat Aero-I in ARINC Characteristic 741) either explicitly or by reference.

ARINC Specification 618 also contains the packet formats exchanged between the CMU Mark 2 and its peer on the ground.

5.2.6.2 SATCOM Data 3

Reference Section 5.2.2.2.

5.2.6.3 SDU as an End System

Reference Section 5.2.2.3.

5.3 Onboard System - Interface and Protocols

5.3.1 Digital ARINC 429 Physical Interface

COMMENTARY

> The physical layer provides the functions necessary to activate, maintain, and release the physical link, which carries the bit stream of the communication.

The electrical interface, voltage, timing, output impedance, etc., is described in ARINC Specification 429 Part 1.

Both high-speed and low-speed buses should be supported on specified ports.

5.3.2 Digital ARINC 429 Device Interface

The CMU Mark 2 should be capable of providing at least 12 ARINC 429 outputs. Five of the outputs should be low-speed. Four of the outputs should be capable of high-speed.

5.3.2.1 General Data Bus #1

General Data Bus Group #1 provides one low-speed output and four low-speed inputs. These data bus interfaces are intended for general onboard avionics subsystems. Table 5.3.2.1-1 lists the pins assigned in Group #1. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.1-1 – Pins Assigned in Group #1

Bus	Source	Spec	Pins
Output #1	CMU Mark 2	758	MP-15E,F
Input #1A	MCDU #1	739	MP-14A,B
Input #1B	Printer	740/744	MP-12J,K
Input #1C	CFDIU/OMS	604/624	MP-13G,H
Input #1D	FMC #1	702/A	MP-15J,K

5.3.2.2 General Data Bus #2

General Data Bus Group #2 provides one low speed output and four low speed inputs. These data bus interfaces are intended for general onboard avionics subsystems. Table 5.3.2.2-1 lists the pins assigned in Group #2. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.2-1 – Pins Assigned in Group #2

Bus	Source	Spec	Pins
Output #2	CMU Mark 2	758	MP-12E,F
Input #2A	MCDU #2	739	MP-12C,D
Input #2B	MCDU #3	739	MP-12G,H
Input #2C	FMC #2	702/A	MP-11C,D
Input #2D	ACMS	717	MP-11E,F

5.3.2.3 Comm Data Bus #3

General Data Bus Group #3 provides one low speed output and four low speed inputs. These data bus interfaces are intended for connection to two cabin terminals. Two of the inputs are provided for expansion. These inputs are not limited to cabin terminals. Table 5.3.2.3-1 lists the pins assigned in Group #3. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.3-1 – Pins Assigned in Group #3

Bus	Source	Spec	Pins
Output #3	CMU Mark 2	758	MP-15G,H
Input #3A	Cabin Term #1	N/A	MP-14C,D
Input #3B	Cabin Term #2	N/A	MP-14J,K
Input #3C	Spare	--	MP-13J,K
Input #3D	Spare	--	MP-07J,K

5.3.2.4 Comm Data Bus #4

Comm Data Bus Group #4 provides one low-speed output and four low-speed inputs. These data bus interfaces are intended for connection to air-ground datalink subsystems. Table 5.3.2.4-1 lists the pins assigned in Group #4. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.4-1 – Pins Assigned in Group #4

Bus	Source	Spec	Pins
Output #4	CMU Mark 2	758	TP-07G,H

Input #4A	SDU # 1	741/761	TP-02C,D
Input #4B	HFDR#2/SDU # 2	753/741/761	TP-02E,F
Input #4C	HFDR #1	753	TP-10C,D
Input #4D	**Spare**	**--**	MP-10G,H

5.3.2.5 General Data Bus #5

General Data Bus Group #5 provides one programmable low/high speed output, one high-speed input (5A) and three programmable low/high-speed inputs. These data bus interfaces are intended for connection to air-ground datalink subsystems. Table 5.3.2.5-1 lists the pins assigned in Group #5. The preferred installation configuration is shown in the SOURCE column. Two spare inputs are provided.

COMMENTARY

Check with TAWS supplier to determine whether low-speed or high-speed should be used.

Table 5.3.2.5-1 – Pins Assigned in Group #5

Bus	Source	Spec	Pins
Output #5	CMU Mark 2	758	TP-06F,G
Input #5A	SDL	615	TP-05D,E
Input #5B	TAWS	--	TP-14H,J
Input #5C	Spare	--	MP-05E,F
Input #5D	Spare	--	MP-06A,B

5.3.2.6 Comm Data Bus #6

Comm Data Bus Group #6 provides one high-speed output and four high-speed inputs. These data bus interfaces are intended for connection to air-ground datalink subsystems. Table 5.3.2.6-1 lists the pins assigned in Group #6. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.6-1 – Pins Assigned in Group #6

Bus	Source	Spec	Pins
Output #6	CMU Mark 2	758	MP-12A,B
Input #6A	XPDR #1**/TCAS #1**	718	MP-08C,D
Input #6B	VDR #1	750	TP-05A,B
Input #6C	VDR #2	750	TP-10A,B
Input #6D	SDU #1	741/761	TP-06H,J

5.3.2.7 Comm Data Bus #7

Comm Data Bus Group #7 provides one high-speed output and four high-speed inputs. These data bus interfaces are intended for connection to air-ground datalink subsystems. Table 5.3.2.7-1 lists the pins assigned in Group #7. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.7-1 – Pins Assigned in Group #7

Bus	Source	Spec	Pins
Output #7	CMU Mark 2	758	TP-13H,J
Input #7A	VDR #3	750	MP-07C,D
Input #7B	XPDR #2/**TCAS #2**	718	MP-10A,B
Input #7C	SDU #2	741/761	TP-12D,E
Input #7D	Gatelink	--	MP-08J,K

5.3.2.8 General Data Bus #8

General Data Bus Group #8 provides one high speed output and four high speed inputs. These data buses are intended for connection to end systems such as ELS. Table 5.3.2.8-1 lists the pins assigned in Group #8. The preferred installation configuration is shown in the SOURCE column. One input is provided as a spare.

Table 5.3.2.8-1 – Pins Assigned in Group #8

Bus	Source	Spec	Pins
Output #8	CMU Mark 2	758	MP-10J,K
Input #8A	EFB-1	--	MP-10C,D
Input #8B	Cabin	746	MP-08G,H
Input #8C	EFB-2	--	TP-14A,B
Input #8D	Spare	--	TP-14C,D

COMMENTARY

ARINC 429 interfaces for two Electronic flight bags have been defined herein. However, this does not preclude the use of an Ethernet interface with an EFB. The Ethernet interface has not been defined yet in ARINC 758 and anyone interested in using it is encouraged to work with the ARINC Datalink Subcommittee in order to avoid conflicts future enhancements to ARINC 758.

5.3.2.9 Flight System Data Bus #9

Flight System Data Bus Group #9 provides one high speed output and three high speed inputs. These data buses are intended for connection to advanced flight management systems. Table 5.3.2.9-1 lists the pins assigned in Group #9. The preferred installation configuration is shown in the SOURCE column. One input is provided as a spare.

Table 5.3.2.9-1 – Pins Assigned in Group #9

Bus	Source	Spec	Pins
Output #9	CMU Mark 2	758	TP-10G,H
Input #9A	DCDU #1	--	MP-08A,B
Input #9B	FMC #1	702A	TP-10E,F
Input #9C	Spare	--	MP-05A,B

5.3.2.10 Flight System Data Bus #10

Flight System Data Bus Group #10 provides one high-speed output and three high-speed inputs. These data buses are intended for connection to advanced flight management systems. Table 5.3.2.10-1 lists the pins assigned in Group #10. The preferred installation configuration is shown in the SOURCE column. One input is provided as a spare.

Table 5.3.2.10-1 – Pins Assigned in Group #10

Bus	Source	Spec	Pins
Output #10	CMU Mark 2	758	MP-11A,B
Input #10A	DCDU #2	--	TP-06B,C
Input #10B	FMC #2	702A	MP-04C,D
Input #10C	Spare	--	MP-08E,F

5.3.2.11 Simulator Interface and CVR Data Bus

The Simulator Interface and CVR Data Bus Group provides one high-speed output and one high-speed input. These data buses are intended for connection to a simulator while not installed on an aircraft, or a cockpit voice recorder (output only) while installed on an aircraft. Table 5.3.2.11-1 lists the pins assigned to this group. The preferred installation configuration is shown in the SOURCE column.

Table 5.3.2.11-1 – Pins Assigned in the Simulator/CVR Group

Bus	Source	Spec	Pins
Simulator/CVR	**CMU Mark 2**	**758**	**MP-15C,D**
Simulator Bus In	**Simulator**	**610A**	**MP-10E,F**

5.3.3 Broadcast ARINC 429 Interface

ARINC Specification 429: *Mark 33 Digital Information Transfer System (DITS)*, is the controlling document for many data word formats, refresh rates, resolutions, etc. Material contained in this document related to these topics is included for reference purposes only. In the event of conflict between this document and ARINC Specification 429, the latter should be assumed to be correct.

The CMU Mark 2 should accept incoming ARINC 429 content (broadcast) data words as described in applicable related ARINC Standards.

ARINC Specification 429 provides for certain data words which are used for bus maintenance and to maintain the integrity of the avionics systems. These data words are exchanged using the content-specific labels listed in ARINC Specification 429. The CMU Mark 2 should support transmission of necessary housekeeping data and be capable of accepting requests for content data words. Content data words are transmitted periodically and usually referred to as broadcast words.

The CMU Mark 2 should broadcast ARINC 429 content data words at the rates (high/low speed) specified on general purpose output buses as needed. The contents of these data words are described in the following subsections. The content data words identified in the following subsections should be sent at the one Hz minimum rate specified in ARINC Specification 429.

COMMENTARY

> ARINC Specification 429 calls for a repetition interval between 0.5 and 1.0 seconds for the broadcast of data content words. The nominal is set to the upper bound of this range.

5.3.3.1 Digital Data Bus Inputs

The Digital Data Bus Inputs #1 through #6 are assigned to pins (MP-14E,F), (MP-14G,H), (TP-1F,G), (TP-4J,K), (TP-4E,F), and (TP-4G,H), respectively. These are general purpose ARINC 429 inputs that may be used by the CMU Mark 2 to acquire aircraft related parameters transmitted in a periodic (broadcast) format from various sources.

Typically, these may be used to input sensors for OOOI events. The data sources and formats may be different in various installations. These labels and formats are generally derived from specific aircraft Interface Control Drawings (ICDs).

Sources peculiar to Boeing aircraft include the EFIS/EICAS Interface Unit (EIU) and the Engine Indication Crew Alert System (EICAS). Sources peculiar to Airbus Industries include the System Data Acquisition Concentrator (SDAC) and the Flight Warning Computer (FWC).

The Digital Data Buses may run high-speed or low-speed depending upon aircraft installation.

Digital Data Bus Input #7 is assigned to pins (MP-6E,F) and is expected to be connected to a source of GPS data.

Digital Data Bus Input #8 is assigned to pins (TP-8G,H) and is expected to be connected to ARINC 702A FMC #1 broadcast data output.

Digital Data Bus Input #9 is assigned to pins (MP-6J,K) and is expected to be connected to ARINC 702A FMC #2 broadcast data output.

5.3.3.2 DFS/UTC Output Data Bus

Assignments have been made for a DFS/UTC Data Bus Output on TP-07A and TP-07B as a low speed output. This combined output can provide both VHF tuning frequency data and a real time clock output source. The UTC Clock data words include Labels 125, 150, and 260. The DFS data word Labels are 030 and 047. See Attachment 6, Broadcast Word Definitions.

When the installation includes an ARINC 716 VHF transceiver, the CMU Mark 2 outputs the operational channels for the VHF transceiver to use on this bus. See Section 5.2.1.1.7, DFS ARINC 429 Tuning Interface.

Only the active CMU transmits UTC and DFS data words. The standby CMU does not transmit UTC and DFS data words.

5.3.3.3 Subsystem Identifier Word Definition (172)

The CMU Mark 2 should report its system identification using data words having the Label 172. The format and content of data word Label 172 is defined in Attachment 6, Broadcast Word Definitions. The active CMU and standby CMU both transmit Label 172 data words.

On all outputs, the CMU should use bit 17 to indicate its support of the satellite Multi-Bearer System (MBS) protocol specified in ARINC Characteristic 761, Attachment 2, Item 3. Reference Section 5.2.6 and Attachment 6, Table 6-15 in this document.

COMMENTARY

Support of the MBS protocol involves the ability to use the Williamsburg protocol "Destination Code" to allow the CMU to select which SATCOM bearer system is to be used for each downlink message, and to allow the SDU to indicate which bearer system was used for each uplink message.

On all outputs, setting bit 18 to the 1 state indicates that the CMU supports the new Signal Quality Parameter scale, as defined in ARINC Characteristic 750-4 Attachment 10, Sections A10.4.7 and A10.5.10.

5.3.3.4 LRU Identification Word Definition (377)

The CMU Mark 2 should report unit identification using data words having the Label 377. The format and content of the data word is defined in Attachment 6, Broadcast Word Definitions. The active CMU and standby CMU both transmit Label 377 data words.

5.3.3.5 ICAO 24-bit Aircraft Address Word Definition

The Active and Standby CMU Mark 2 should transmit the ICAO 24-bit aircraft address of the aircraft in which it is installed using ARINC 429 Label 214 and 216 data words on all general output buses. The ICAO 24-bit aircraft address is as stored in the CMU Configuration Database. The format and content of Label 214 and 216 data words are defined in Attachment 6, Tables 6-10 and 6-11, and ARINC Specification 429. All PAD bits are set to zero. The ICAO 24-bit aircraft address may be utilized by various connected LRUs, including SDUs, HFDL, VDR, and FMCs for addressing purposes. It is very important that all aircraft systems have access to a valid ICAO 24-bit aircraft address for correct operation.

The CMU Mark 2 may receive the ICAO 24-bit aircraft address via an APM. The CMU Mark 2 may receive the ICAO 24-bit aircraft address via the Mode-S transponder's Traffic Alert and Collision Avoidance System (TCAS) output bus using ARINC 429 words containing Labels 275 and 276 on the high speed ARINC 429 port assigned as the Mode-S Input. The non-address bits are utilized to report status (bits 9-13 of Label 275 and bits 9-12 and 21-29 of Label 276) and are ignored by the CMU. If the CMU is connected to a datalink capable Mode-S, then it should receive the ICAO 24-bit aircraft address using Labels 214 and 216. This externally sourced ICAO data may be utilized to validate the CMU Configuration Database.

For a Mode-S-acquired ICAO 24-bit aircraft address to be declared valid for use by the CMU, the following applies:

- The bus on which the ICAO 24-bit aircraft address is transmitted is active (as defined in Attachment 6).
- The data can not be zero (note it may be set to zero during power up with NCD SSM), nor can it have all bits set (i.e., octal 7777 7777).
- SSM can not be Functional Test (note that Mode-S sets Labels 275 and 276 to NCD while in standby mode, typically while on ground, so SSM is typically NCD when the CMU acquires the data).
- Both labels are present.

5.3.3.6 Status Output Word #1 (270)

The CMU Mark 2 should report status on two separate ARINC 429 words, identified by Labels 270 and 276. These words convey air-ground datalink status, maintenance related information, and also provide crew alerts for use on external display systems.

The Label 270/276 words should be output on all CMU General Output Buses once per second at all times during normal operation. In dual CMU Mark 2 installations, the active CMU and standby CMU both transmit the Label 270 and 276 words. The standby unit should set all of the bits consistent with the active CMU Mark 2 data (as monitored via the Cross Talk Bus), except those in Table 5.3.3.6-1, which are internally generated by each respective CMU.

Table 5.3.3.6-1 – Internally Generated Bits

Bits	Label	Meaning
9-10	270/276	SDI
16	270	CMU Fail
20	270	Active/Standby
22-25	276	HF Status (HFDL Installed and HFDL Fail)
30-31		SSM

The general format of CMU Status Word #1 (Label 270) and CMU Status Word #2 (Label 276) are defined in Attachment 6, Tables 6-8 and 6-9. The CMU Mark 2 should determine and report Datalink Media Status on the subnetworks. The CMU Mark 2 should set the bits in its Label 270/276 words at all times during normal operation for each individual media that is defined, whether it is actually installed or not on the aircraft.

This information is then provided in bits 17-19, and 24 of Label 270 and bit 19 of Label 276 by the CMU Mark 2. This information is needed by the End Systems, such as FMC's, as not all datalink services are available at times (such as VHF datalink). The Datalink Media Status is also necessary for the internal router to make routing decisions based on the user policy table. That is, the router should not attempt transmissions on links that do not exist. This information may also be needed by any Datalink Applications End System hosted by the CMU Mark 2.

COMMENTARY

> The messages, as defined, provide media availability information, not the type of service, such as ACARS or ATN. The ATN is expected to utilize Join/Leave Messages for each subnetwork. The definitions and protocols of the Join/Leave messages are not yet all mature. See ARINC Characteristic 741, Part 2, Section 4.7.3.3 for the specification of the Join/Leave message for the ARINC 741 SDU, and for the ARINC 761 Inmarsat Aero-I SDU. Additional Status output words may be added in future Supplements to address this as needed.

Bits 11-16, 21-23 of Label 270 and bits 11-18 of Label 276 are intended for the generation of aural/visual alerts to the flight crew on events related to datalink. These bits provide general link availability status and are for general alerting, such as after receipt of an uplink message to the crew. The actual message text displayed, the existence of a message, and priorities (when multiple messages are set) are dependent on the aircraft model and configuration of the external display system.

COMMENTARY

> It may be more desirable to have the actual message text supplied by the CMU Mark 2 to the external display system, as the message contents could be derived from the uplink. An example could be annunciation of receipt of "ATIS BRAVO" as opposed to just annunciating the text "MESSAGE." This capability may be considered in future Supplements to ARINC Characteristic 758.

Bit 12 (Link Availability) of Label 270, is the logical OR of all the links. It is intended for crew annunciation and applications should instead monitor the individual link status bits. The CMU Mark 2 NO COMM discrete output (see Section 5.4.6.2) also provides this information and should always represent the logical OR of the links.

COMMENTARY

> Some aircraft restrict the setting of the bits in Label 270 because of the design of the display device. In this case, other bits in the Label 270 word may sometimes inhibit the setting of the Link Availability bit. As such, Link Availability may not represent the true datalink status.

Other Label 270/276 crew alert discretes are set by the CMU Mark 2 when the event occurs, such as by receipt of an uplink message or a change in the printer status. The CMU Mark 2 should not annunciate inappropriate alerts during certain phases of flight, such as during takeoff and landings.

Bit 16 (CMU Fail), bit 20 (Active/Standby), and bits 30-31 (SSM) of Label 270 provide external systems with the overall health and state of the CMU Mark 2. External subsystems should use bit 20 in dual CMU installations to determine with which CMU Mark 2 to exchange information.

5.3.3.7 Status Output Word #2 (276)

The CMU Mark 2 transmits an ARINC 429 word with Label 276 which contains bits that indicate message status data and bits that indicate the status of the HF datalink system. The logic for bits 20 through 27 is defined in Section 5.2.3 and its subsections.

The active CMU and standby CMU both transmit Label 276 data words. The standby unit should set all of the bits according to the active CMU data, except bits 22-25 (HFDR #1 installed, HFDR #2 installed, HFDR #1 fail, and HFDR #2 fail) which are independently calculated by the standby CMU.

5.3.3.8 Status Output Word #3 (271)

COMMENTARY

This section is reserved for an additional Datalink Status word which is expected to be added by a future supplement to allow reporting of both ACARS and ATN subnetwork status.

5.3.3.9 Maintenance Words (350, 351, 352)

The CMU Mark 2 transmits ARINC 429 words with Labels 350, 351, **and 352** which contain bits that indicate LRU status data based on the activity of the ARINC 429 receiver for each LRU. Reference Attachment 6, Broadcast Word Definitions. The active CMU and standby CMU both transmit Label 350, 351**, and 352** data words. Each CMU independently determines the values of the LRU status bits.

5.3.4 ARINC 429 System Address Label (SAL)

For all "dialog" based ARINC 429 protocols, such as ARINC 739, ARINC 740, and ARINC 429 File Transfer, the CMU Mark 2 should recognize a System Address Label (SAL) value of 304.

5.3.5 ARINC 429 BOP Protocol

The ARINC 429 Bit Oriented Protocol (BOP) Link layer is used for transferring information from one LRU to another. ARINC Specification 429 defines several versions of the BOP.

The CMU Mark 2 supports BOP Version 1 and optionally supports Version 3 (connectionless) depending on the CMU Mark 2 architecture.

Version 1 provides flow control, error detection, and error recovery. Version 1 provides a highly reliable Link layer.

Version 3 is streamlined for higher throughput and lower propagation delays. Version 3 assumes that error detection, error recovery, and flow control occur at a higher level, when needed.

COMMENTARY

Bit-oriented protocol was first introduced into ARINC Specification 429 by Supplement 12 and has been expanded to include newer versions and clarified in subsequent supplements.

5.3.6 ARINC 646 ELAN Interfaces

The CMU Mark 2 should provide ports compatible with **ARINC Specification 646**, *Ethernet Local Area Network* (ELAN) for high-speed LAN transfers based on Ethernet protocols.

COMMENTARY

ARINC Specification 646 is not needed for a Level 0 or Level 1 CMU Mark 2 except for simulator and 615A Data Loader support. Future supplements are expected to define the ARINC Specification 646 interfaces which are part of the Level 2 aircraft interface definition.

5.3.7 ARINC 619 ACARS Interfaces

ARINC Specification 619 is used to access external ACARS End Systems (Message source/sinks). ARINC Specification 619 provides interfaces to ACMS, CMC, FMCs, and Cabin Systems that are directly compatible with the ACARS Air/Ground Sub-network. SDUs may also be ACARS End Systems for purposes of maintenance data and owner table exchange.

The CMU Mark 2 should use ACARS Label/Sublabel combinations to route messages to and from these LRUs. ARINC Specification 619 uses ARINC 429 as a physical interface and a variety of ARINC 429 link layer protocols depending upon aircraft configuration and the LRU.

The CMU Mark 2 should support BOP and character ARINC 429 protocols with the ACARS End Systems as needed.

The CMU Mark 2 should be capable of DUAL FMC master/slave determination as specified in ARINC Specification 619.

5.3.8 ARINC 656 Flight Management Interface

For a Level B CMU as end system architecture, (see Attachment 1-2), the ARINC Specification 656 Interface is used to send and receive data between the Data Management application in the CMU Mark 2 and the Flight Management System. See ARINC Specification 656 and **ARINC Characteristic 702A**, *Advanced Flight Management Computer System.* This interface should be provided by high-speed ARINC 429 using the BOP Link layer Services.

5.3.9 Optional MIL-STD-1553B Interface

The CMU Mark 2 may be installed in a military configuration that could require support for MIL-STD-1553B Buses. In this configuration six pins on the rear connector can be used to provide dual standby redundant MIL-STD-1553B Buses. The MIL-STD-1553B terminal is anticipated to be installed in a military only configuration of the CMU Mark 2.

The MIL-STD-1553B Data Bus is expected to be used to pass information with the onboard Flight Management Computer. It may also be used to provide access to remote annunciators and CDUs. ARINC Characteristic 739 MCDUs are not anticipated in this configuration. ARINC Specification 656 could potentially be used, but the MIL-STD-1553B implementation is beyond the scope of this document.

In terms of MIL-STD-1553B, the CMU Mark 2 acts as a Remote Terminal (RT) on the bus. It is assumed that a Configuration Data Base and APM is also needed with this configuration. The APM should include MIL-STD-1553B configuration information such as MIL-STD-1553B remote terminal address.

The third pin for each 1553 data bus is the cable shield, not DC Common. See Pin definitions in Attachment 2-2.

The primary datalink applications to be supported are related to ATS, but limited “AOC” like applications may be desired as well, such as OOOI, maintenance information, and weather.

Interfaces to the sub-networks (VHF, SATCOM, etc.) are expected to be as defined elsewhere in this Characteristic, including the ARINC 429 data buses.

5.3.10 CMU/Recorder Interface

The CMU to recorder interface is used to stream data to the recorder for recording as described in Section 4.18. The CMU physical interface with the recorder uses pins **MP15C,D**. The CMU to recorder Physical layer is **high**-speed ARINC 429. The datalink layer is **high**-speed Williamsburg Version 3, see ARINC Specification 429 Part 3, and only uses Command frames (Info frames are not used for this interface.) The message format is defined in ARINC Specification 619 Section 6.

The CMU should **not** expect **any** ARINC 429 data from the recorder. The Williamsburg ALO/ALR handshake is not performed with the recorder. The CMU should assume that the recorder supports Williamsburg Version 3.

5.3.11 User Defined Interfaces

Blocks of pins are reserved for additional interfaces that may be provided by the CMU Mark 2. These pins could be used to support other interfaces (older printers, OAT, etc.) that may be desired by some users. These pins could also be used for additional ARINC 429 ports or other data buses. Where electrical definitions can be standardized, the user defined pins have been identified with their electrical characteristics. Inclusion of any of these capabilities is at the manufacturer's option.

5.3.12 Spare Interface

Blocks of pins are reserved for spare interfaces that may be provided by the CMU Mark 2. All spare inputs and outputs are for future ARINC Characteristic 758 assignment activities and are not intended for user defined signaling. Where electrical definitions can be standardized, the spare pins have been identified with their electrical characteristics. Inclusion of any of these capabilities is at the manufacturer's option.

5.3.13 OOOI Discretes

Nine standard ARINC discrete inputs have been reserved by the CMU Mark 2 for input of Out-Off-On-In (OOOI) airplane status. One discrete is reserved for Air-Ground status (TP-15J) and the remainder (TP-15A through TP-15H) are for connection to other sensors, such as doors and parking brakes. A Return Signal is also provided at TP-15K.

The Configuration Data Base is used to define the signal polarity for each discrete in a given installation. On newer aircraft these discretes are transmitted on a digital bus. The CMU Mark 2 is responsible for any filtering or debounce of the discretes as needed. Inclusion of any of these capabilities is at the manufacturer's option.

5.3.14 APM Interface

The Airplane Personality Module (APM) interface is defined in ARINC Report 607.

The APM interface allows the CMU Mark 2 to read and write data to an APM if installed. The APM consists of an externally mounted serial Electrically Erasable Programmable Read Only Memory (EEPROM) device. The APM may be used to store the information for the CMU Mark 2 Configuration Database. The CMU Mark 2 should read the APM data on a regular basis, such as once per flight or upon power up. The CMU Mark 2 should validate the data as described in Section 4.12.3. See Section 4.12, Configuration Database.

APM data is updated (written) by first loading the data into CMU NVM. Upon update completion, the CMU Mark 2 copies the data to the APM, then proceeds with database validation.

The CMU Mark 2 provides the interfaces and header format as needed for the APM as specified in ARINC Report 607. Each APM contains a standard header file used for basic identification. An example memory map for the CMU Mark 2 APM definition is provided in Attachment 5.

The CMU Rear connector pins are assigned (TP-1A, TP-1B, TP-1C, TP-1D, TP-1E, TP-1H, TP-1J, TP-1K, TP-2A and TP-2B) for the APM interface.

The integrity of the APM data should be protected by a CRC.

COMMENTARY

Consideration should be given to mirroring the data in the APM (two copies) for improved integrity and transient protection.

The APM may be powered only when reading/writing to increase APM reliability. When no valid APM data is received from the APM, the CMU Mark 2 should indicate an inoperative APM state.

5.3.15 ATN End Systems Interfaces

The CMU Mark 2 should be capable of interface to onboard ATN end systems which host ATN applications.

The CMU Mark 2 may also be an ATN end system. See Section 3.1.1.

5.3.15.1 ATN - ES/IS Protocol

When interfacing to external onboard ATN end systems, the CMU Mark 2 provides the role of an ATN router. The CMU Mark 2 routes standard Network layer packets via Network level addressing to those End Systems over the ATN-compatible Physical, Link and Network layers. All upper layer (including Transport) protocols which support the ATN application hosted in an external onboard ATN end system, are also resident in that End System, since these protocols operate as the end-to-end peer of the ground-based ATN end system. The ICAO ATN SARPs defines the Internetworking requirements.

5.3.15.2 CMU as ATN End System

The CMU Mark 2 may be an ATN-compatible End System and interface with other ATN-compatible End Systems (ES). The upper layer (including Transport) protocols which support the CMU-hosted ATN application are also hosted in the CMU Mark 2, since these protocols operate as the end-to-end peer of the ground-based ATN end system.

5.3.16 Dual System Interface

The CMU Mark 2 dual interface consists of two serial buses, discrete I/O, and two program pin selects. The active/standby condition of the CMU can be controlled from a CMU MCDU screen and transferred over the cross talk bus or an optional switch connected to the discrete I/O. See Section 4.15 and Attachment 1-8.

5.3.16.1 Cross Talk Bus

Pin assignments have been made for the CMU Mark 2 Cross Talk Input (TP-2G,H) and Output (TP-12B,C) Data Buses.

The CMU Mark 2 cross talk bus should provide information necessary to maintain a robust dual CMU Mark 2 installation. The information exchanged and the medium used are determined by each equipment manufacturer.

The CMUs exchange status, data, and control information over the cross talk bus. The active CMU indicates its active status to the standby CMU over the cross talk bus, and the standby CMU likewise indicates its status. When the active CMU changes its status to standby, then the other CMU detects this change in status (as indicated by data on the cross talk bus) and becomes active.

COMMENTARY

No provision is made for interchangeability of supplier units with regard to dual interfaces and their design.

5.3.16.2 Active/Standby Discrete Input

A discrete input (TP-6D) should be provided to place the CMU Mark 2 in the standby mode. This discrete input is used to command the CMU Mark 2 to assume the standby mode. A "Standard Open" indicates that the CMU Mark 2 is permitted to assume the active state. Some installations may use other means to control the active/standby state and not switch this input. In this case the "Standard Open" indicates that the CMU Mark 2 determines its active/standby state from other inputs (cross talk bus, MCDU screen, etc.). In all cases a "Standard Ground" causes the CMU to switch to the standby mode of operation. "Standard Open" and "Standard Ground" are defined in Section 2.9, ARINC Standard Interface.

5.3.16.3 Active/Standby Discrete Output

The CMU Mark 2 Active/STANDBY Discrete output (TP-2J) is provided to report the status of CMU Mark 2 operation (Active/STANDBY). A "Standard Ground" indicates that the CMU Mark 2 is active and operating normally. In the event of a failure or if the CMU Mark 2 is commanded to the standby mode, the output should be a "Standard Open." The CMU hardware should be designed to ensure that the Active/STANDBY Discrete output is open when the primary power is removed. "Standard Open" and "Standard Ground" are defined in Section 2.9, ARINC Standard Interfaces.

5.3.16.4 Dual SDI Program Pins

Two Source/Destination Identifier (SDI) Program pins (TP-14E,F) are provided to identify the physical location (left, right) of the CMU Mark 2. "Standard Program Pin Ground" and "Standard Program Pin Open" are used for these two inputs. See Section 2.9, ARINC Standard Interfaces. The SDI Program Pins are used to designate the CMU Mark 2 location per Table 5.3.16.4-1.

Table 5.3.16.4-1A – SDI Program Pin Definition

Pin Number	Identifier Program Pin	ARINC 429 Reference
TP-14E	SDI 1	SDI Bit 9
TP-14F	SDI 2	SDI Bit 10

Table 5.3.16.4-1B – SDI Program Pin Definition

SDI 2	SDI 1	Description
0	0	Single
0	1	Left
1	0	Right
1	1	Not used

5.3.16.5 Program Pin Common

Wiring between the SDI program pins and Program Pin Common (TP-11D) is used to determine the "1" state shown in the table above. An open state indicates the "0" state.

5.3.17 ARINC 615 Data Loader Interface

The CMU Mark 2 interfaces with an ARINC 615 data loader via the ARINC 429 connections defined in Section 5.3.2.5 and a discrete input, Pin TP-6E. ARINC **Report 615:** *Airborne Computer High Speed Data Loader*, defines the ARINC 429 protocol used to interface with a software data loader.

The CMU Mark 2 should provide a discrete input (TP-6E) to monitor the status of a selector switch, located in aircraft wiring, which indicates that the ARINC 429 input and output data buses are connected to the data loader. The ground state indicates that the data buses are connected and the data loading function is enabled. An open state indicates no connection. Reference ARINC Reports 615 and 615A.

5.4 Flight Deck Systems - Interfaces and Protocols

The CMU Mark 2 should be able to adapt to a wide variety of flight deck systems. These systems include MCDUs, printers, aural alerting, and visual alerting devices.

5.4.1 ARINC 739 MCDU Interfaces

The Multipurpose Control and Display Unit (MCDU) described in ARINC Characteristic 739 is the primary flight crew interface for CMU Level A-B, and perhaps C Applications.

ARINC 429 ports are assigned to send and receive information to and from at least three independent MCDUs utilizing the ARINC Characteristic 739 protocol.

If the CMU Mark 2 provides crew interfacing for ATS applications, then the CMU Mark 2 is expected to provide concurrent MCDU operations and the capability for access to the ATS messages with a minimum of key strokes. Reference **ARINC Characteristic 739:** *Multi-Purpose Control and Display Unit.*

COMMENTARY

ARINC Characteristic 739 has limitations related to technology and obsolescence. ARINC Characteristic 739A has been developed to address this short coming. The CMU is expected to support ARINC Characteristic 739A as well.

5.4.2 DCDU Datalink Display Interface

The CMU Mark 2 should be capable of supporting up to two Dedicated Control and Display Units (DCDUs) in addition to or in place of the MCDUs for CMU Level D (and perhaps C) Operations. Two high-speed ARINC 429 ports are reserved for this purpose. These DCDUs are assumed to be mounted in the Primary Field of View, suitable for supporting all ATS datalink services.

COMMENTARY

The DCDUs should be capable of message display and input, such as ROGER, WILCO, and REJECT.

5.4.3 Optional CDU Interface

A CMU Mark 2 may utilize an optional control and display unit. User defined pins are reserved for this interface.

COMMENTARY

This characteristic does not describe the optional CDU interface. Each equipment manufacturer has developed a unique interface to the subject unit, where needed.

5.4.4 ARINC 740/744 Printer Interface

The CMU Mark 2 sends data to the printer and receives status information from the printer. A second printer may be used in some installations for redundancy or to support a Cabin Installation. Reference **ARINC Characteristic 740:** *Multiple-Input Cockpit Printer* and **ARINC Characteristic 744:** *Full-Format Printer*.

5.4.5 ARINC 744A Printer Interface

The CMU Mark 2 may provide the capability to interface with a high speed ARINC 744A Printer, such as for transfer of weather graphics on the ports assigned for Ethernet communications. Reference **ARINC Characteristic 744A:** *Full Format Printer With Ethernet*.

5.4.6 Crew Alerting Interfaces

Alerting systems vary widely from aircraft to aircraft. On newer aircraft external systems typically provide management of most alerts (aural and primary field of view visual alerts). Any new alerting capabilities in the CMU Mark 2 will likely require some modification to these systems.

On older aircraft, the CMU Mark 2 will likely do all management of its alerts. The CMU Mark 2 should ensure that inappropriate alerts are not generated in designated phases of flight, such as take off and landing. In order to accomplish this, access to radio altitude and airspeed may be needed.

COMMENTARY

To provide more system flexibility, it is desirable to develop a digital interface to the display systems that allow transfer of message content to the display systems. This could also apply to retrofit aircraft where EFIS is added. ARINC Specification 656 protocol could be a candidate mechanism.

5.4.6.1 Digital Output Alerts

The CMU Mark 2 should provide digital alert signals using Label 270 and 276 as necessary on its general output buses. This data word has bits assigned for use in support of an alerting system to the flight crew. In this method, bits are converted to pre-defined messages and remotely managed priorities within the alerting systems.

The number of messages that may be enabled at one time depends on the specific alerting system. The CMU Mark 2 should be able to accommodate different flight deck philosophies. That is, in some cases, these messages should be prioritized by the CMU Mark 2, or they may be prioritized by the display system itself. The data associated with Crew Alerting is defined in Section 5.3.3.6.

5.4.6.2 "No Communications" Alert Discrete

An optional "NO COMM" discrete may be supported by the CMU Mark 2. The CMU Mark 2 sets the NO COMM discrete output according to the logic defined in Section 5.3.3.6.

The NO COMM Alert discrete should take the form of a ground on connector pin MP-9K when a NO COMM condition exists. Under datalink service available conditions, the output should be an open.

The switching device in the CMU should be capable of holding off 30 Vdc in the open state. In the ground state, the potential across it should not exceed 2 Vdc, and it should be capable of sinking 200 mA of current.

COMMENTARY

> The current holding capabilities and voltage boundaries of this discrete output are an exception to the Standard Ground and Standard Open. The more stringent criteria are due to the potential for the CMU to be installed on aircraft in which the output is used to sink lamp current directly rather than to control a lamp driver.

Termination of the NO COMM Alert state may be initiated by crew action.

5.4.6.3 Failure Warning Discrete

In the event that a system malfunction is detected (see Section 6.1), it should be annunciated by a dc ground at the Fault Annunciation Discrete Output connector pin MP-9J. An open indicates the absence of a system malfunction. This discrete may be routed to destinations in the aircraft external to the CMU Mark 2, such as the processing unit of a central warning system. The dc ground switching device in the CMU Mark 2 should be capable of holding off 36 Vdc in the open state. In the ground state, the potential across it should not exceed 2 Vdc and it should be capable of sinking 200 milliamperes of current.

COMMENTARY

> The current handling capabilities and voltage boundaries of this discrete output are an exception to the Standard Ground and

Standard Open. The most stringent criteria are due to the potential for the CMU to be installed on aircraft in which the output is used to sink lamp current directly, rather than to control a lamp driver.

5.4.6.4 Open/Short Alert Contacts (Relays)

An AOC or ATS application may need a CMU Mark 2 to interface with a system which uses a continuity (open/short) sensing technique for generation of alerts, such as an aural alert.

Two sets of relay contacts for this purpose should be provided. Each set may be used independently. Typically, these contacts are used to illuminate a "Call" light (MP-9F,G) or to ring a chime (TP-9G,H). Each of these relay contacts when closed should support one amp of current to flow from a 28 Vdc source to an external device. The direction of current flow should be from TP-9G to TP-9H and MP-09F to MP-09G, respectively. In addition, both sets of contacts should be able to provide continuous closure, momentary closure, or a cyclic closure for a specified time or until a reset event occurs.

Trigger events are typically receipt of specific uplink messages, but could also be triggered by logic within the CMU Mark 2. Reset events may be automatic, crew input, or external Alert Reset Input discrete.

5.4.6.5 Alert Reset Discrete Input

Pin MP-9C is for the Alert Reset Discrete. A momentary "ground" of 50 millisecond duration should command the reset condition of crew alerts, including the relay contacts. Other than the momentary nature of the discrete input, this discrete input should be consistent with the Standard Open and Standard Ground Discrete described in Section 2.9, ARINC Standard Interfaces.

5.4.6.6 ATC Uplink Discrete Output

The CMU should provide a discrete output that may be used for ATC message annunciation.

Pin TP12J is used to indicate when an ATN ATC uplink has been received. An open indicates that there are no undisplayed/unprinted ATN ATC uplinks. A ground indicates that there is one or more ATN ATC uplinks that have not bee displayed or printed by the crew. When the crew has responded to all of the ATN ATC uplinks, then the discrete output is set to open.

5.5 ARINC 610A Simulator Interface

The CMU should support the ARINC 610A simulator interfaces defined in the Sections 5.5.1 and 5.5.2.

5.5.1 Installed in Simulator Discrete Input

A discrete input (MP-2C) should be provided to place the CMU Mark 2 in the simulator mode. This discrete input, in conjunction with the ARINC 429 interface, is used to command the CMU Mark 2 to assume the simulator mode. In all cases a

"Standard Open" indicates that the CMU Mark 2 should assume the standard operation (i.e. installed in aircraft). A "Standard Ground" causes the CMU to switch to the simulator mode of operation when there are also ARINC 429 broadcast words on the simulator bus (see Section 5.5.2). "Standard Open" and "Standard Ground" are defined in Section 2.9, ARINC Standard Interface.

5.5.2 Simulator ARINC 429 Interface

The CMU uses both broadcast and file transfer facilities to exchange data over the ARINC 429 interface.

5.5.2.1 Simulator ARINC 429 Physical Layer

The Simulator ARINC 429 Data Bus Group provides one high speed output and one high-speed input. These data bus interfaces are intended for use with an ARINC 610A simulator only. Table 5.5.2.1-1 lists the pins assigned to the Simulator ARINC 429 Data Bus Group.

Table 5.5.2.1-1 – Pins Assigned to the Simulator ARINC 429 Data Bus Group

Bus	Source	Spec	Pins
Output	CMU Mark 2	758	MP-15C,D
Input	Simulator	610A	MP-10E,F

5.5.2.2 Simulator ARINC 429 Link Layer

The CMU and simulator use version 1 of ARINC Specification 429 Williamsburg protocol for file transfer. ARINC Report 610A, Section 5.7, defines the options and data formats for the file transfer protocol.

5.5.3 Simulator ARINC 664 (Ethernet) Interface

Ethernet interface #1 has been allocated for CMU-simulator communication.

5.5.3.1 Simulator ARINC 664 Physical Layer

The CMU provides one ARINC 664 output and one ARINC 664 input for interfacing with the simulator. Table 5.5.3.1-1 lists the pins assigned to the Simulator ARINC 664 interface: Table 5.5.3.1-1 – Pins Assigned to the Simulator Interface

Bus	Source	Spec	CMU Pins
Output	CMU Mark 2	758	MP-11J,K
Input	Simulator	610A	MP-11G,H

5.5.3.2 Simulator ARINC 664 Link Layer

Provisions for this Section will be provided in a future supplement.

6.1 Built-in Test Provisions

6.1.1 General Discussion

The utmost attention should be paid to the need for integrity and availability in all phases of system design, production, and installation.

BITE should closely relate to bench testing. Error modes encountered on the aircraft should be reproducible in the shop. Error messages should be closely related to and assist in bench testing, allowing the error to be duplicated. System faults should be classified based on their effect on the system as debilitating or non-debilitating.

Fault reports should enable the operator to isolate the cause of a fault and provide adequate information for repair of the system.

Where possible, optional functions present in the CMU Mark 2 that are not activated by the operator should be excluded from all testing. Testing components or functions not used by the operator serve only to provide additional nuisance faults.

The self-contained fault detection should incorporate non-volatile memory and logic to identify true hardware faults based on historical trends.

The system should also incorporate built-in debugging tools, annunciators, test buttons, and/or memory readout, to facilitate engineering troubleshooting. These tools should be categorized for line maintenance or engineering use, as appropriate.

COMMENTARY

It is important to remember that all aspects of the testing program (BITE, ramp, and shop testing) contribute to the reliable and profitable operation of a system by the end users. The ability of the program to identify faults and facilitate their repair has a profound affect on maintainability and overall reliability. Attention to a close relationship between aircraft faults and shop testing should help in reducing the number of unscheduled removals.

6.1.2 Self-Contained Fault Detection and Reporting

The CMU Mark 2 should provide BITE capability in accordance with **ARINC Report 604:** *Guidance for Design and Use of Built-In Test Equipment*. The CMU should be capable of reporting the results of the BITE when installed on an aircraft which does not contain an Onboard Maintenance System (OMS).

COMMENTARY

BITE status can be reported in many different ways. For example, BITE status may only be reported via a pass/fail annunciator on the front panel of the CMU Mark 2. Alternatively or in addition, the CMU Mark 2 may contain an extensive set of BITE screens which can be displayed on a CDU/MCDU.

6.1.3 Centralized Fault Reporting Interface (ARINC 604/624)

The CMU Mark 2 unit should contain Built-In Test Equipment (BITE) capability in accordance with **ARINC Report 624:** *Onboard Maintenance System*, **and ARINC Report 604**, *Guidance for Design and Use of Built-In Test Equipment*.

6.1.3.1 Bit-Oriented Fault Reporting

The CMU Mark 2 should contain fault reporting capability in accordance with ARINC Report 624. Maintenance data should be reported using Labels 350 and 351 at a one Hz minimum update rate during all modes of CMU Mark 2 operation. The format and content of these words are described in Section 5.3.3.7.

6.1.3.2 Character-Oriented Fault Reporting

The CMU Mark 2 should, as an option to the user, provide fault reporting capability in accordance with the character-oriented fault reporting protocol contained in ARINC Report 604.

COMMENTARY

New equipment designs should be produced in accordance with ARINC Report 624. The optional use of ARINC Report 604 is to provide for retrofit installations where an OMS is not present and the equipment needs to interact with an ARINC 604 Centralized Fault Display System (CFDS).

6.1.4 Ramp Return to Service Testing

When a CMU Mark 2 is installed on an air transport aircraft, some form of end-to-end testing should be available to:

- Provide an operational verification of the system function prior to return to service.
- Reduce unnecessary removals of the CMU Mark 2 when the fault was actually in another part of the system.

As an end-to-end test, the procedure needs to verify integrity of the LRU, as well as interface with other systems and applicable antenna connections. The CMU Mark 2 should support return to service testing in a line maintenance environment. The CMU Mark 2 ramp test should also have provisions for in hangar testing.

The return to service test results should indicate the probable cause of failure in order to minimize needless replacement of healthy equipment.

COMMENTARY

Emphasis on end-to-end system testing should lead to an increase in the Mean Time Between Unscheduled Removals, especially for removals not related to LRU faults.

6.1.5 Software Configuration Management

It is expected that all software modules and applicable data bases should be aircraft loadable. The CMU Mark 2 should display the part numbers of all software modules and applicable data bases. The CMU Mark 2 should transmit the part numbers when it is installed on an aircraft which contains an OMS that uses this data.

6.2 Provisions For Automatic Test Equipment

6.2.1 General

To enable Automatic Test Equipment (ATE) to be used in bench maintenance, internal circuit functions not available at the unit service connector, and considered by the equipment manufacturer necessary for automatic test purposes, may be brought to pins on an auxiliary connector of a type selected by the equipment manufacturer. This connector should be fitted with an adequate number of contacts to support the ATE functions. The connector should be provided with a protective cover suitable to protect these contacts from damage, contamination, etc., while the unit is installed in the aircraft. The manufacturer should observe ARINC Specification 600 standards for unit projections, etc., when choosing the location for this auxiliary connector.

6.2.2 ATE Testing

Where possible, optional functions present in the CMU Mark 2 that are not activated by the operators should be excluded from all testing. Testing components or functions not used by the operator serves only to provide additional nuisance faults.

A program which loads test software should validate the software load via a checksum, or other method to determine that the load is valid.

In all cases, when loading software or data bases, the procedure should provide a method for recovering from faults. Similarly, when running automatic tests, the procedure should provide a method to abort testing when an obvious fault exists without major disruption to the CMU Mark 2 or the ATE. The CMU Mark 2 and its ATE should support these abilities.

Complete information for test implementation, complying with **ARINC Report 625:** *Industry Guide for Test Program Set (TPS) Quality Management* should be provided to an airline on request.

The CMU Mark 2 should be ATE testable and should have a test specification written in ATLAS in accordance with **ARINC Specification 626:** *Standard ATLAS Subset for Modular Test*. ATLAS is preferred for avionics unit testing and variations from the ATLAS vocabulary are not accepted. The test specification should be developed using the guidelines specified in ARINC Report 625 and **ARINC Report 627:** *Programmer's Guide for SMART Systems Using ARINC 626 ATLAS*. The ATLAS test specification should be shop verified on an **ARINC Specification 608A:** *Design Guidance for Avionics Test Equipment, Part 1 - System Definition* compliant test set.

6.3 Dataloading

The CMU Mark 2 should accept data and program updates from a data loader encoded in accordance with ARINC Specification 615.

The CMU Mark 2 should be software loadable via a front panel connector or the rear ARINC 600 connector. See Section 5.3.17.

It is expected that all software modules and applicable data bases should be aircraft loadable. For Dual LRU installations, all modules should also be cross loadable.

COMMENTARY

Since mixed cases of cross loadable and non-cross loadable software modules present many problems, operators prefer that all or none of the software modules be cross loadable.

In all cases, when loading software or data bases, the procedure should provide a method for recovering from faults. The CMU Mark 2 should be able to abort a software or database loading process without a major disruption of the system (disruption resulting in removal of the CMU Mark 2 from the aircraft).

The CMU Mark 2 should be able to perform a host role for indirect loading of the APM module of airplane configuration data.

6.4 Systems Management Tools

To be added by a future supplement.

6.5 Test Environments

6.5.1 Laboratory Environment

The CMU Mark 2 should be capable of supporting datalink service and datalink applications testing in the laboratory environment. The laboratory environment includes supplier development stations, Datalink Service Provider Laboratories, and Airline/ATS facilities for applications interoperability testing.

Datalink service testing should permit exercising of all datalink subnetworks and protocols independent of the datalink applications. Potentially this could be used by Datalink Service Providers as part of the network qualification process.

Datalink Applications Testing should permit testing of applications message formats, logic, and crew interfaces independent of the Datalink services.

6.5.2 Shop Test Environment

The shop test environment is assumed to be primarily for hardware testing and software loading only of the CMU Mark 2.

COMMENTARY

Correlation of flight crew equipment write-ups in the shop in software intensive LRUs and datalink equipment is an increasingly difficult task.

This can be compounded by shop test stations capable of hardware performance testing and software loading. The shop test environment may also need to encompass some aircraft and/or laboratory simulation capabilities to deal with No Fault Found (NFF) conditions.

6.5.3 Flight Test Environment

The CMU Mark 2 should provide the ability to log datalink traffic (uplinks, downlinks) and performance information to an on-board printer, internal storage or external mass storage devices for use in flight test and certification support.

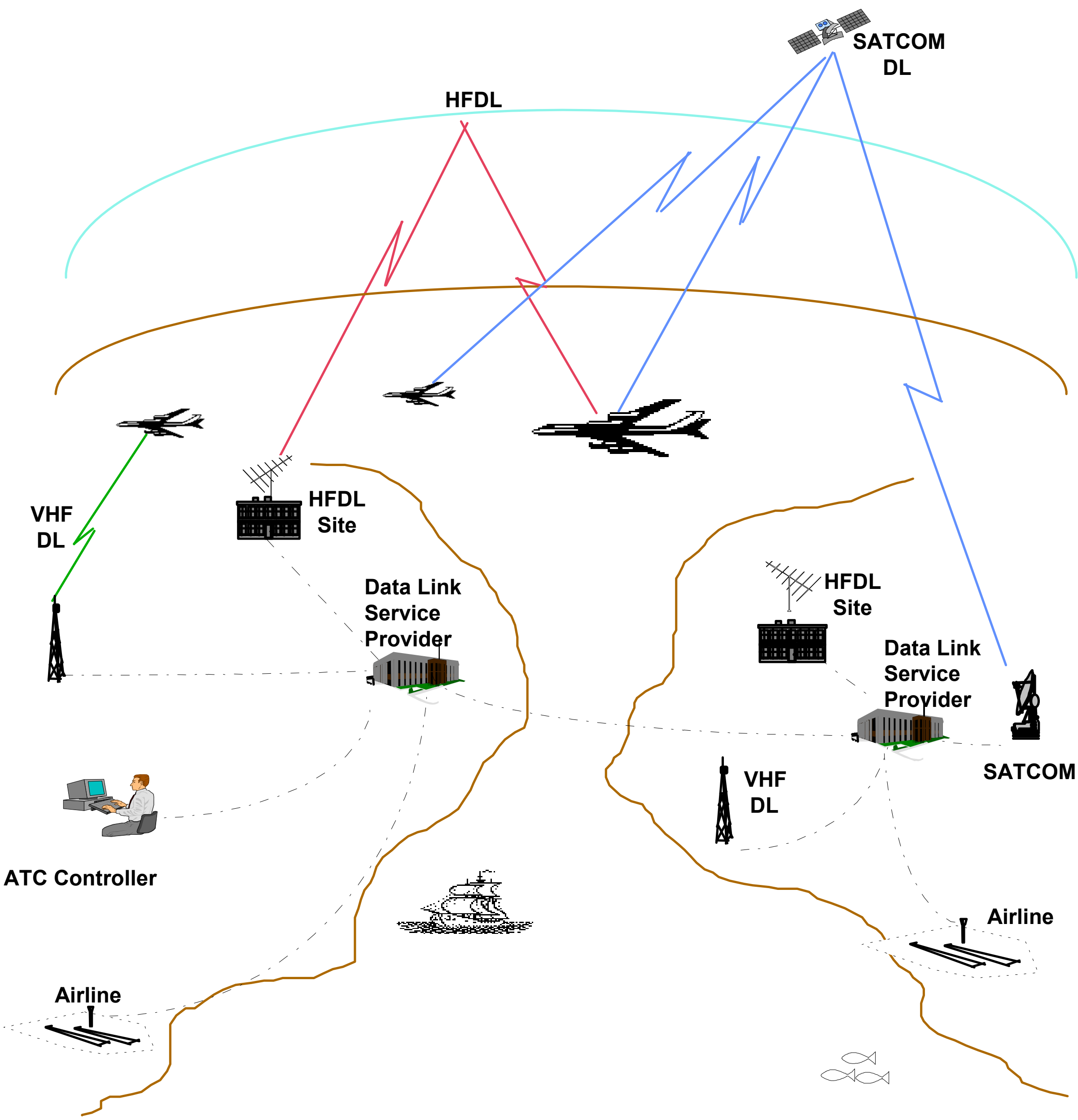
6.5.4 Operational Environment

The CMU Mark 2 may provide the ability to log datalink traffic (uplinks, downlinks) and performance information to an on-board printer, internal storage or external mass storage devices while in the operational environment, provided no adverse flight deck effects occur as a result of this mode of operation.

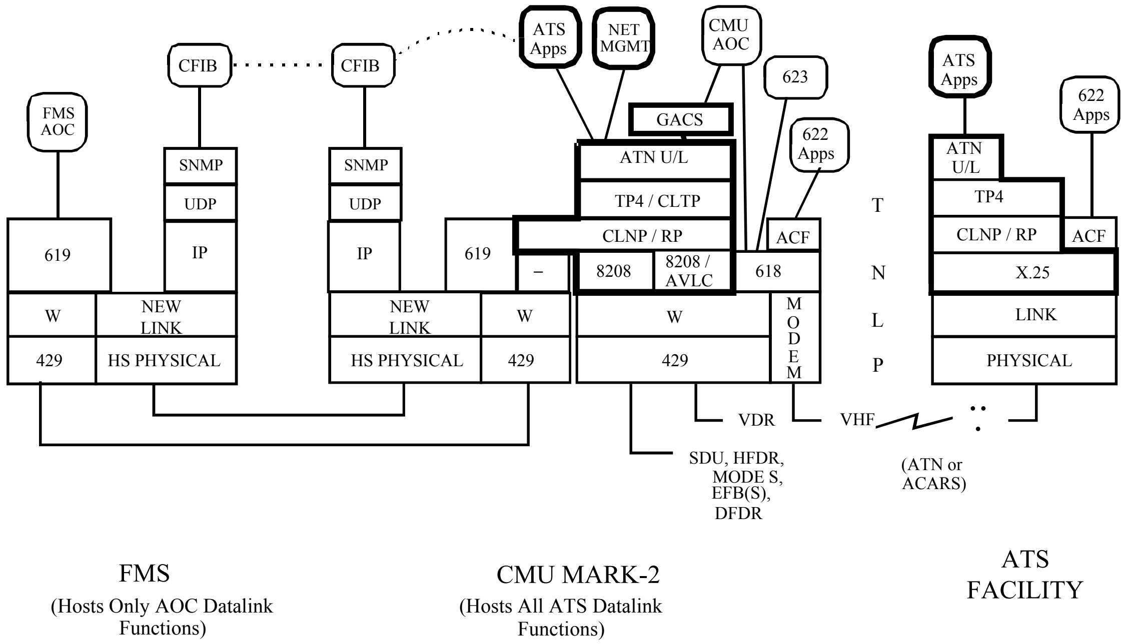
Ideally, internal storage would be utilized (with perhaps reduce data collected) and would primarily be for troubleshooting purposes.

Datalink Service Providers have also expressed some interest in avionics providing network performance monitoring and reporting in the operational environment.

ATTACHMENT 1-1
DATALINK INFRASTRUCTURE



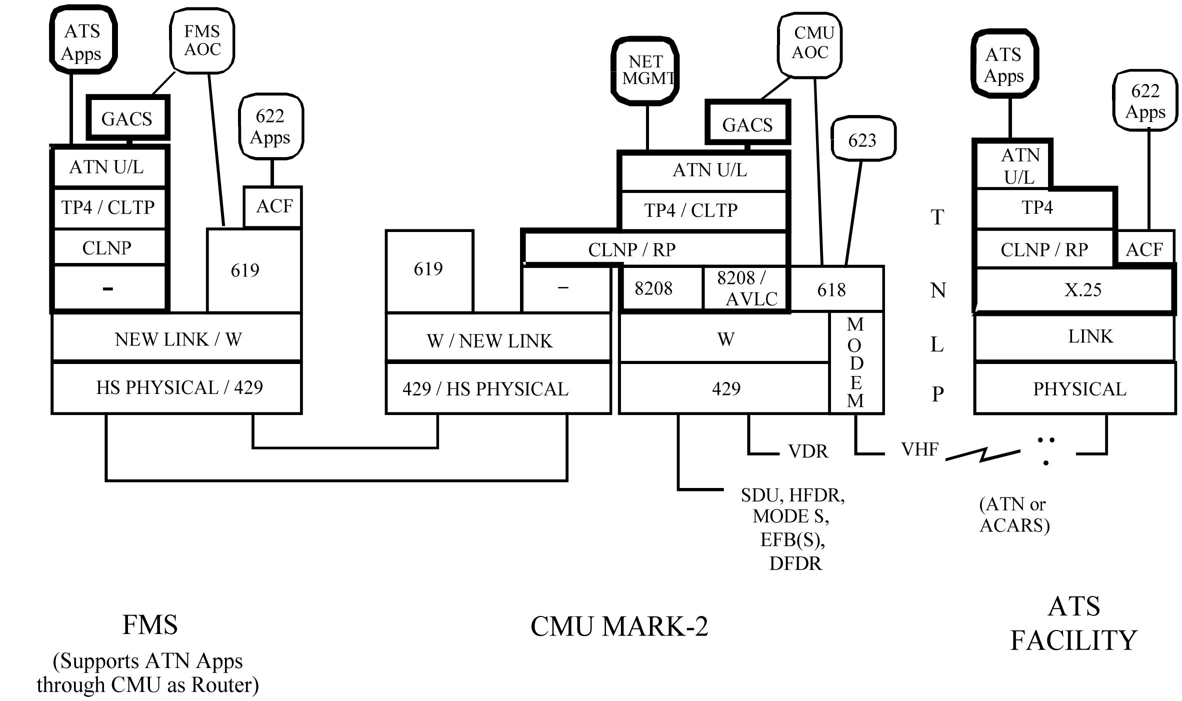
ATTACHMENT 1-2
CMU AS END SYSTEM ARCHITECTURE



Legend:

(bold box)	ATN Protocols and ICAO ATS Applications
CFIB	656 CMU/FMC Information Broker
SNMP	656 Simple Network Management Protocol
UDP	656 User Datagram Protocol
IP	656 Internetworking Protocol
ATS Apps	ICAO CPDLC, ADS, CM, and FIS/A applications
ATN U/L	ICAO ASE, DS/ACSE, Presentation & Session Layers
622 Apps	FANS 1/A (ACARS based) CPDLC, ADS, and AFN
GACS	637A Generic ATN Communications Service
NEW LINK	429 W - Version3 Protocol or IEEE 802.3
W	429 Williamsburg Protocol
HS PHYSICAL	HS 429 or 10-BaseT (Ethernet)

ATTACHMENT 1-3
CMU AS ROUTER ARCHITECTURE

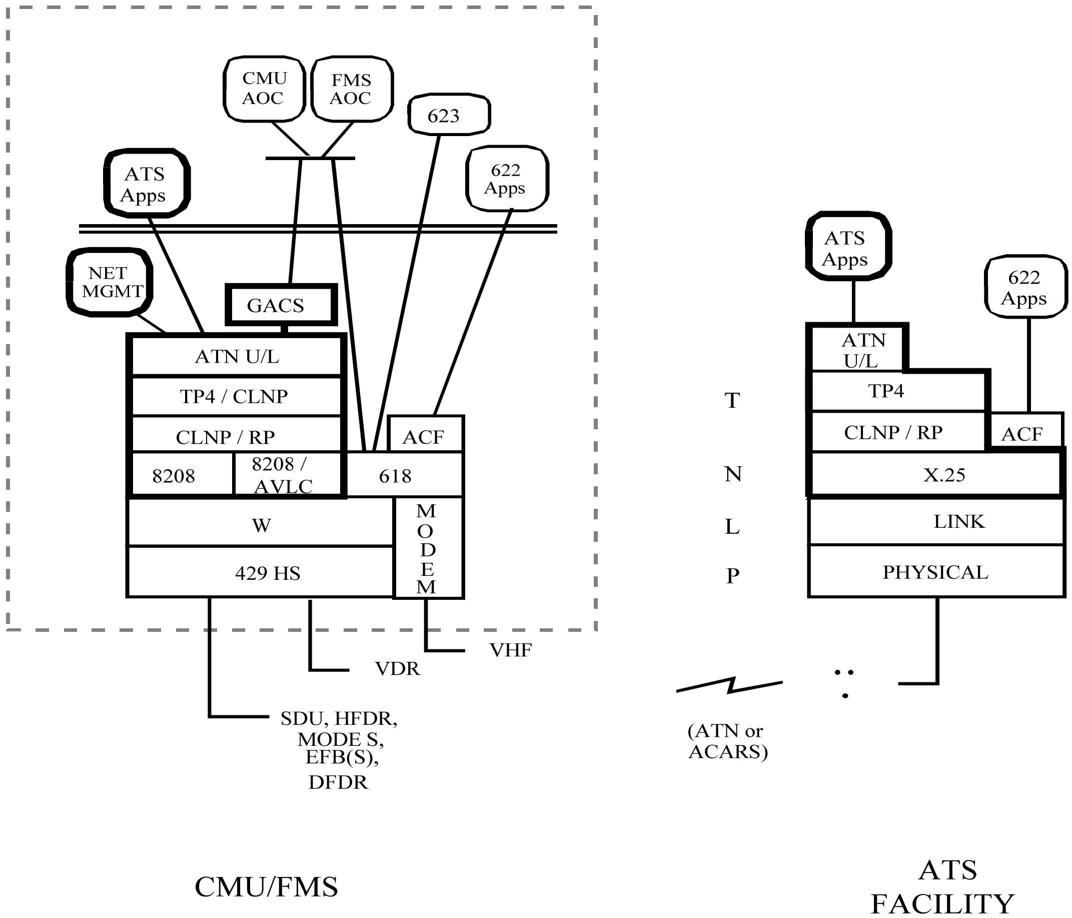


Legend:

(bold box)	ATN Protocols and ICAO ATS Applications
ATS Apps	ICAO CPDLC, ADS, CM, and FIS/A applications
ATN U/L	ICAO ASE, DS/ACSE, Presentation & Session Layers
GACS	637A Generic ATN Communications Service
622 Apps	FANS 1/A (ACARS based) CPDLC, ADS, and AFN
NEW LINK	429 W - Version3 Protocol or IEEE 802.3
W	429 Williamsburg Protocol
HS PHYSICAL	HS 429 or 10-BaseT (Ethernet)

ATTACHMENT 1-4
RESERVED

ATTACHMENT 1-5
CMU AS INTEGRATED ARCHITECTURE

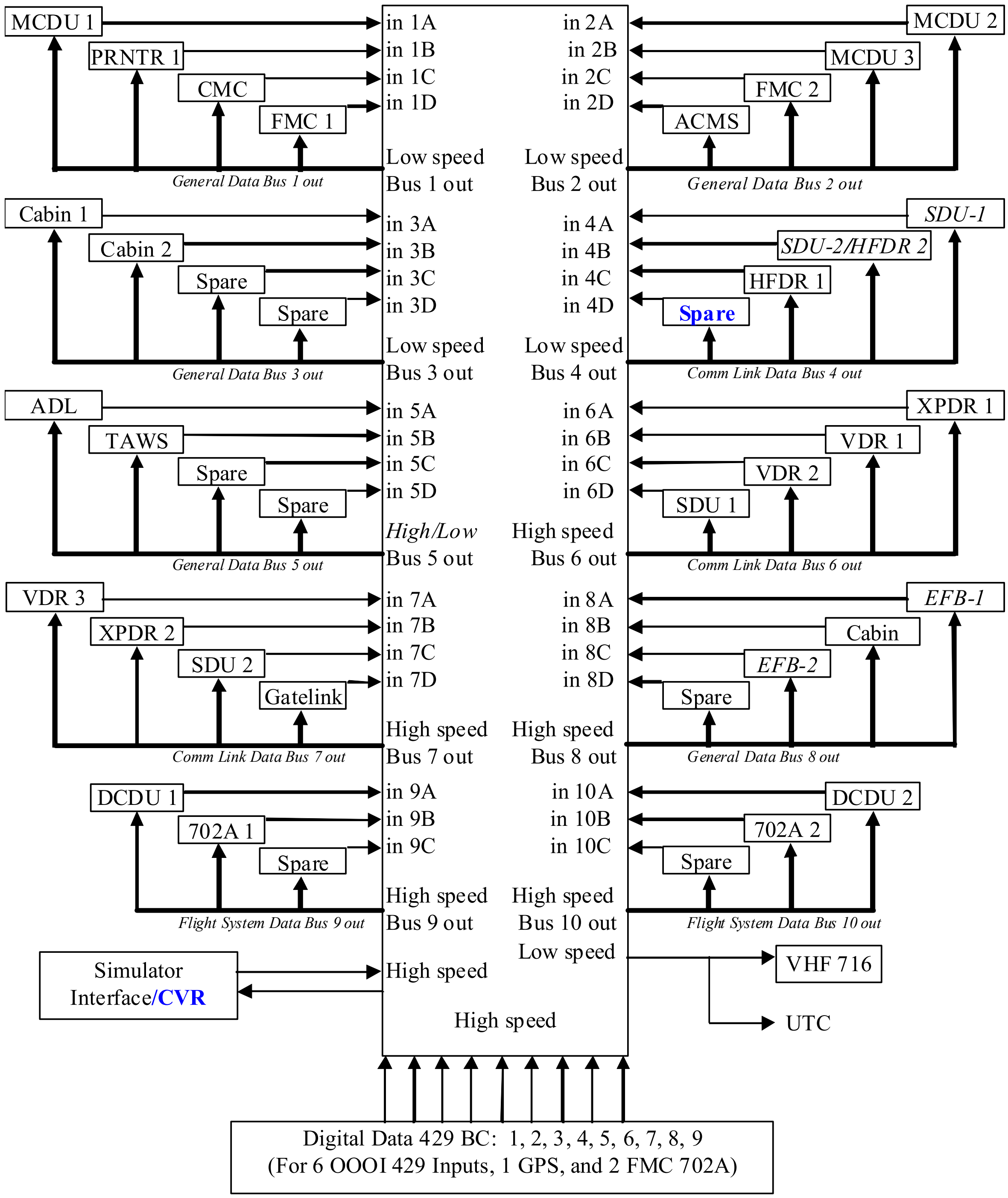


Legend:

(thick box)	ATN Protocols and ICAO ATS Applications
ATS Apps	ICAO CPDLC, ADS, CM, and FIS/A applications
ATN U/L	ICAO ASE, DS/ACSE, Presentation & Session Layers
622 Apps	FANS 1/A (ACARS based) CPDLC, ADS, and AFN
GACS	637A Generic ATN Communications Service
W	429 Williamsburg Protocol

Note: In integrated architectures, ATS and AOC applications receive data parameters, if needed, via internal busses.

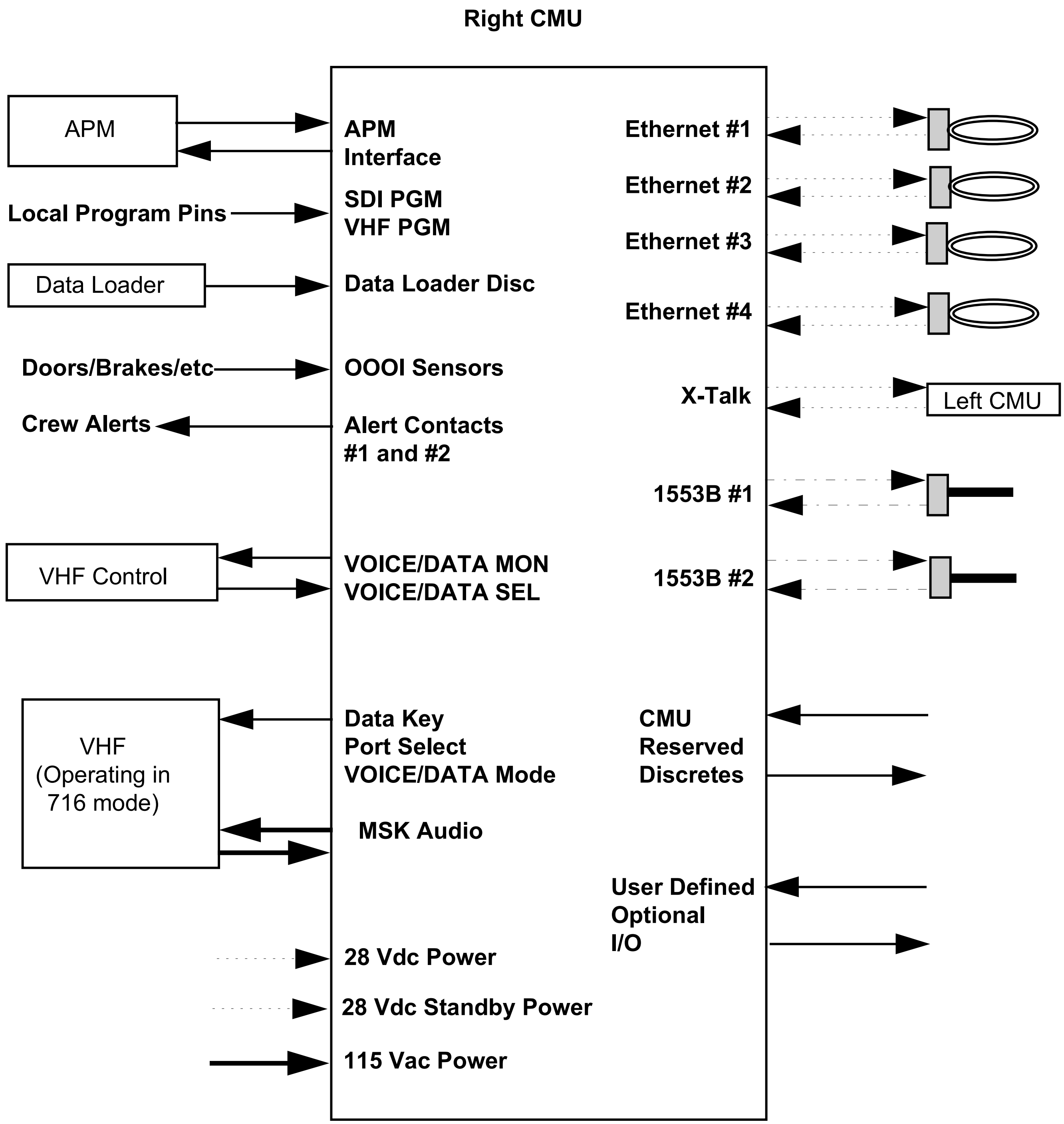
ATTACHMENT 1-6
ARINC 429 BUSES



12 transmitters; 48 receivers

Note: 1=Left, 2=Right, 3= Center System

ATTACHMENT 1-7
NON ARINC 429 INTERFACES



ATTACHMENT 1-8
DUAL INSTALLATIONS

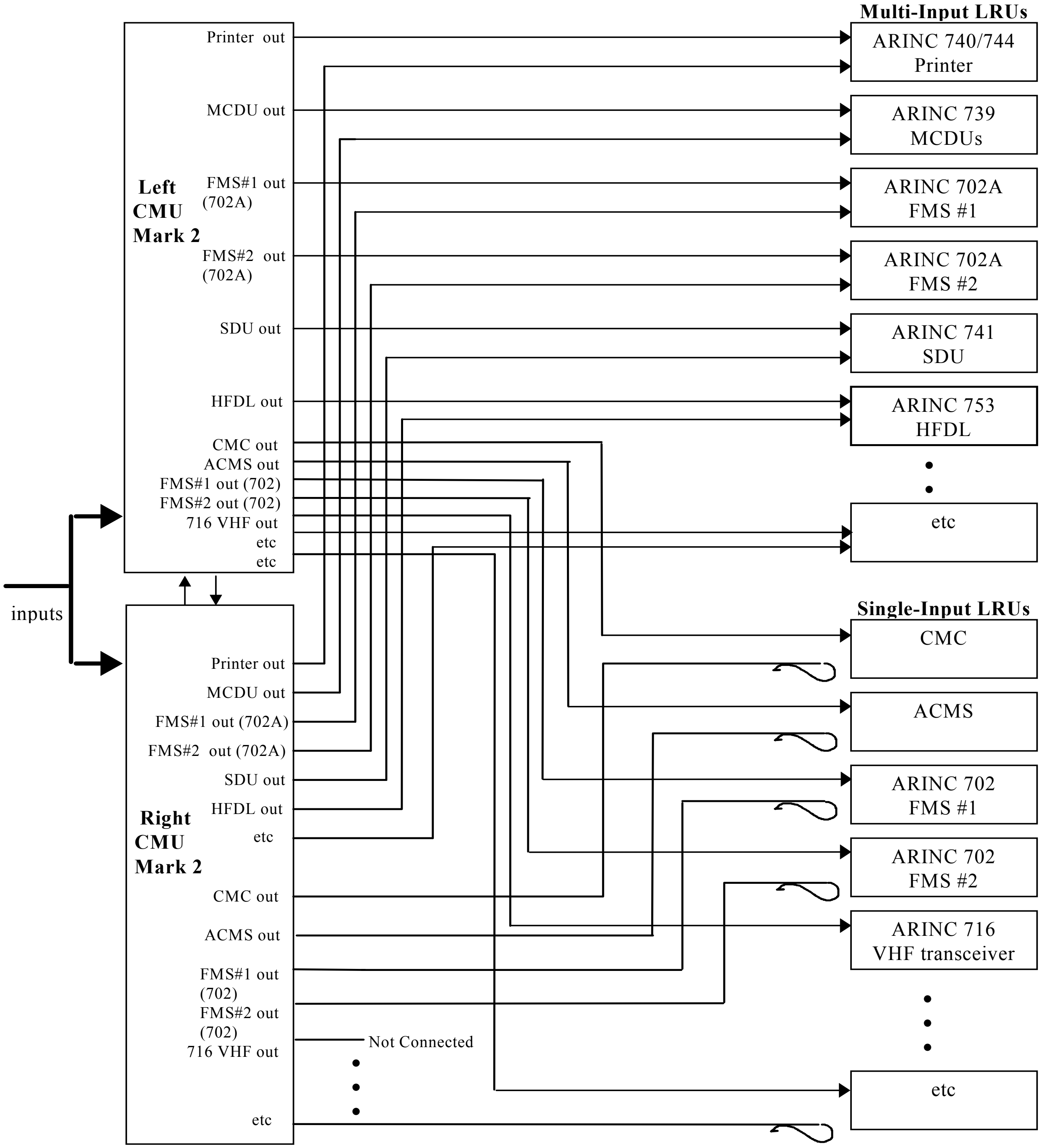


Figure 1-8a - Example of Dual CMU ARINC Specification 429 Connections to Other LRUs

Notes:

1. CMU Mark 2 outputs to devices which support two inputs are wired directly from both CMUs to the device. Devices and discretes, which accept only a single input could be upgraded

ATTACHMENT 1-8
DUAL INSTALLATIONS

to accommodate two ARINC Specification 429 LS inputs, or, are switched through the use of an external switching unit.

2. Single Lines shown above may represent multiple busses, such as for the ARINC 702A FMS.

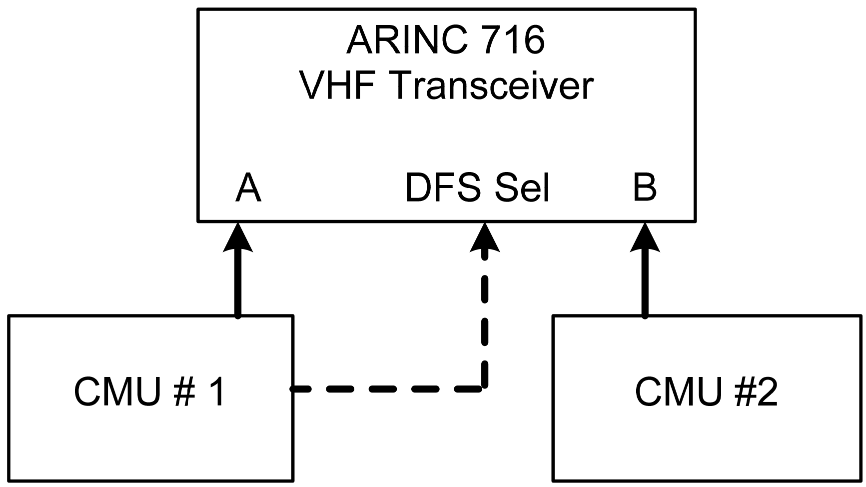


Figure 1-8b - Example of how dual CMUs could be wired to one ARINC 716 VHF Transceiver when the CMUs provide VHF Analog Voice frequency tuning in addition to the VHF data frequency tuning.

ATTACHMENT 1-8
DUAL INSTALLATIONS

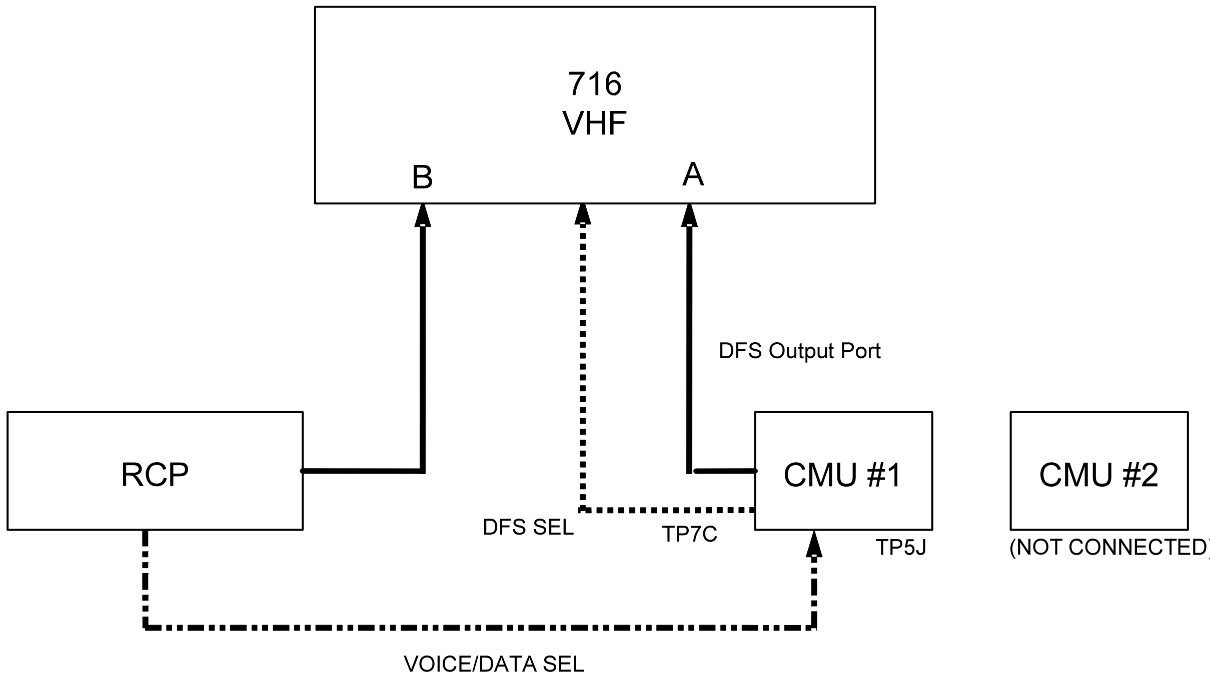
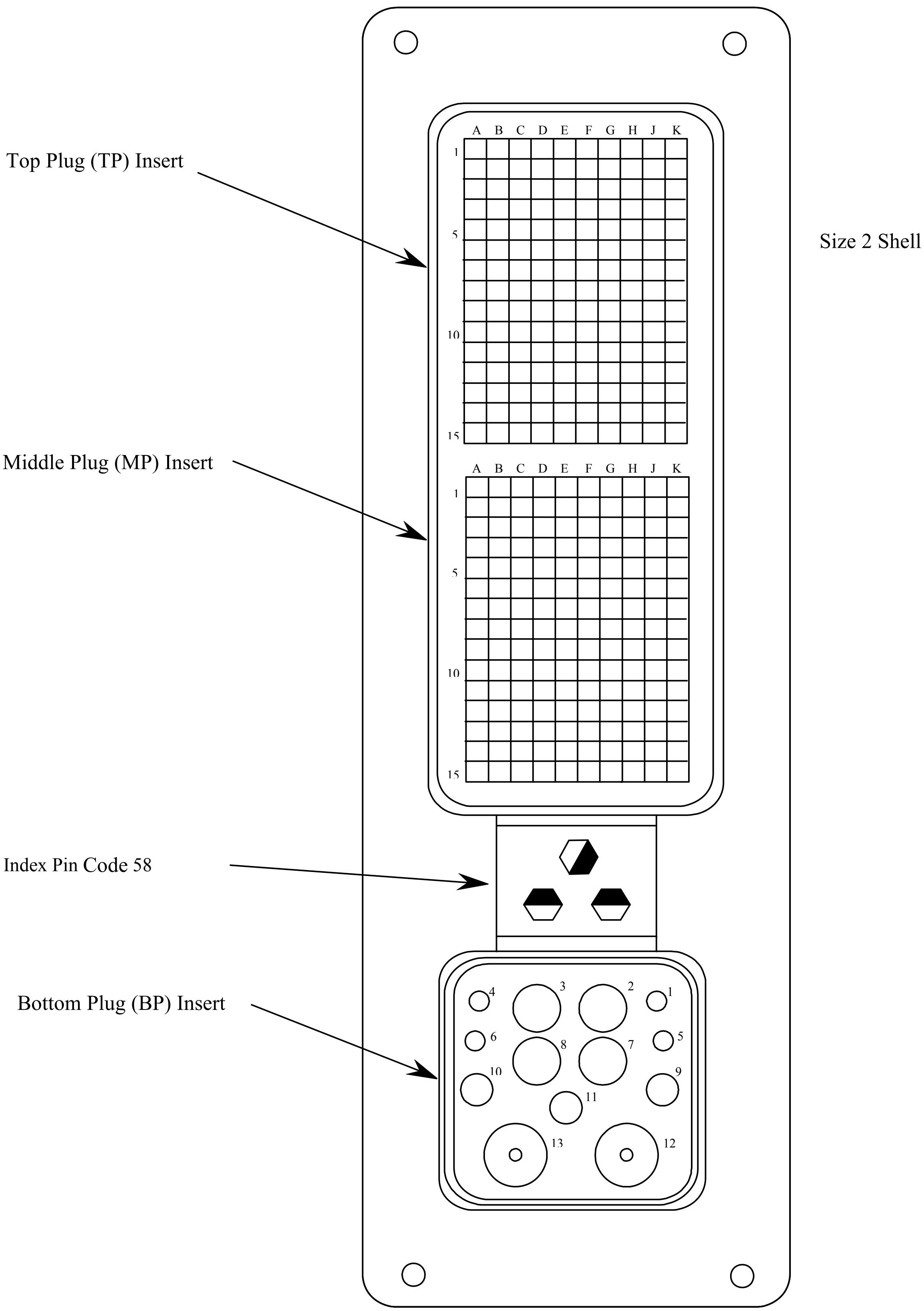


Figure 1-8c - Example of how dual CMUs could be wired to one ARINC 716 VHF Transceiver when the RCPs provide VHF Analog Voice frequency tuning and CMU provides the VHF data frequency tuning.

ATTACHMENT 2-1
REAR CONNECTOR INSERT DIAGRAM



Rear View LRU Connector

ATTACHMENT 2-2
STANDARD INTERWIRING

SIGNAL NAME		PIN	SIGNAL TYPE	SOURCE/SINK	NOTES
APM Power		TP01A	dc Power	607 APM	
APM Power return		TP01B	dc Ground	607 APM	
APM Enable #1		TP01C	APM	607 APM	
APM Enable #2		TP01D	APM	607 APM	
APM Serial Clock Out		TP01E	APM	607 APM	
Digital Data Bus #3 In	A	TP01F	ARINC 429 H/L In	OOOI Source	
Digital Data Bus #3 In	B	TP01G	ARINC 429 H/L In	OOOI Source	
APM Serial Data Out		TP01H	APM	607 APM	
APM Serial Data In		TP01J	APM	607 APM	
APM Write Protect # 1 Out		TP01K	APM	607 APM	
RSVD - APM Write Protect #2 Out		TP02A	APM	607 APM	
RSVD Spare		TP02B	APM	607 APM	
Comm Link Data Bus #4A In	A	TP02C	ARINC 429 L In	741/761 SDU #1	
Comm Link Data Bus #4A In	B	TP02D	ARINC 429 L In	741/761 SDU #1	
Comm Link Data Bus #4B In	A	TP02E	ARINC 429 L In	SDU #2/HFDR #2	
Comm Link Data Bus #4B In	B	TP02F	ARINC 429 L In	SDU #2/ HFDR #2	
User Defined - CMU Crosstalk Data Bus In	A	TP02G	User Defined	758 CMU	
User Defined - CMU Crosstalk Data Bus In	B	TP02H	User Defined	758 CMU	
Dual Active/Standby		TP02J	Discrete Out	758 CMU	
RSVD (Printer Shield Common)		TP02K	dc Ground	dedicated Printer	Optional
RSVD (Printer Data Bus Serial Data Out)	A	TP03A	ARINC 597	dedicated Printer	Optional
. (Printer Data Bus Serial Data Out)	B	TP03B	ARINC 597	dedicated Printer	Optional
for (Printer Paper Low In)		TP03C	Discrete In	dedicated Printer	Optional
. (Printer Ready/Busy In)		TP03D	Discrete In	dedicated Printer	Optional
. (Printer Status A In)		TP03E	Discrete In	dedicated Printer	Optional
(Printer Status B In)		TP03F	Discrete In	dedicated Printer	Optional
. (Printer Status C In)		TP03G	Discrete In	dedicated Printer	Optional
(Printer Common)		TP03H	dc Ground	dedicated Printer	Optional
ARINC (UTC Clock Serial Data Out)	A	TP03J	ARINC 419		Optional
724 (UTC Clock Serial Data Out)	B	TP03K	ARINC 419		Optional
RSVD for ATE		TP04A	User Defined		
RSVD for ATE		TP04B	User Defined		
RSVD for ATE		TP04C	User Defined		
RSVD for ATE		TP04D	User Defined		
Digital Data Bus #5 In	A	TP04E	ARINC 429 H/L In	OOOI Source	
Digital Data Bus #5 In	B	TP04F	ARINC 429 H/L In	OOOI Source	
Digital Data Bus #6 In	A	TP04G	ARINC 429 H/L In	OOOI Source	
Digital Data Bus #6 In	B	TP04H	ARINC 429 H/L In	OOOI Source	
Digital Data Bus #4 In	A	TP04J	ARINC 429 H/L In	OOOI Source	
Digital Data Bus #4 In	B	TP04K	ARINC 429 H/L In	OOOI Source	
Comm Link Data Bus #6B In	A	TP05A	ARINC 429 H In	750 VDR #1	
Comm Link Data Bus #6B In	B	TP05B	ARINC 429 H In	750 VDR #1	
Spare		TP05C			
General Data Bus #5A In	A	TP05D	ARINC 429 H In	615 Data Loader	
General Data Bus #5A In	B	TP05E	ARINC 429 H In	615 Data Loader	
Spare		TP05F			
Spare		TP05G			
VHF Data Key Line		TP05H	Discrete Out	750 VDR	
VHF Voice/Data Remote Select		TP05J	Discrete In	750 VDR	
VHF Voice/Data Remote Annunciation		TP05K	Discrete Out	750 VDR	
Spare		TP06A			
Flight Sys Data Bus #10A In (RSVD)	A	TP06B	ARINC 429 H In	DCDU #2	
Flight Sys Data Bus #10A In (RSVD)	B	TP06C	ARINC 429 H In	DCDU #2	
Dual Inhibit		TP06D	Discrete In	758 CMU	
Data Loader		TP06E	Discrete In	615 Data Loader	
General Data Bus #5 Out	A	TP06F	ARINC 429 H/L Out		
General Data Bus #5 Out	B	TP06G	ARINC 429 H/L Out		

ATTACHMENT 2-2
STANDARD INTERWIRING

SIGNAL NAME		PIN	SIGNAL TYPE	SOURCE/SINK	NOTES
Comm Link Data Bus #6D In	A	TP06H	ARINC 429 H In	741 SDU #1 761 SDU #1	
Comm Link Data Bus #6D In	B	TP06J	ARINC 429 H In	741 SDU #1 761 SDU #1	
Spare		TP06K			
Digital Data Bus #1 Out (DFS/UTC)	A	TP07A	ARINC 429 L Out	716 VHF Transceiver	
Digital Data Bus #1 Out (DFS/UTC)	B	TP07B	ARINC 429 L Out	716 VHF Transceiver	
VHF DFS Port Select		TP07C	Discrete Out	716 VHF Transceiver	
Spare		TP07D			
VHF Voice/Data Mode Monitor		TP07E	Discrete In	716 VHF Transceiver	
VHF Voice/Data Mode Annunciation		TP07F	Discrete Out	716 VHF Transceiver	
Comm Link Data Bus #4 Out	A	TP07G	ARINC 429 L Out	716 VHF Transceiver	
Comm Link Data Bus #4 Out	B	TP07H	ARINC 429 L Out	716 VHF Transceiver	
Spare		TP07J			
VHF Data Key Line Return Common		TP07K	dc Ground	716 VHF Transceiver	
RSVD for ARINC 646 Ethernet #3 In	A	TP08A	Ethernet In		
RSVD for ARINC 646 Ethernet #3 In	B	TP08B	Ethernet In		
RSVD for ARINC 646 Ethernet #3 Ou t	A	TP08C	Ethernet Out		
RSVD for ARINC 646 Ethernet #3 Out	B	TP08D	Ethernet Out		
User Defined		TP08E	User Defined		
User Defined		TP08F	User Defined		
Digital Data Bus #8 In (RSVD)	A	TP08G	ARINC 429 H In	702/A FMC #1	
Digital Data Bus #8 In (RSVD)	B	TP08H	ARINC 429 H In	702/A FMC #1	
Spare		TP08J			
Spare		TP08K			
VHF MSK Audio Out	Hi	TP09A	Analog Out	716 VHF	
VHF MSK Audio Out	Lo	TP09B	Analog Out	716 VHF	
VHF MSK Audio In	Hi	TP09C	Analog In	716 VHF	
VHF MSK Audio In	Lo	TP09D	Analog In	716 VHF	
Spare		TP09E			
Spare		TP09F			
Aural/Visual Alert Contacts #1		TP09G	Relay	EFIS, EICAS, etc.	
Aural/Visual Alert Contacts #1		TP09H	Relay	EFIS, EICAS, etc.	
RSVD for ARINC 724 (RTS)		TP09J	Discrete In	724 MU-OAT	Optional
RSVD for ARINC 724 (CTS)		TP09K	Discrete Out	724 MU-OAT	Optional
Comm Link Data Bus #6C In	A	TP10A	ARINC 429 H In	750 VDR #2	
Comm Link Data Bus #6C In	B	TP10B	ARINC 429 H In	750 VDR #2	
Comm Link Data Bus #4C In	A	TP10C	ARINC 429 L In	753 HFDR #1	
Comm Link Data Bus #4C In	B	TP10D	ARINC 429 L In	753 HFDR #1	
Flight System Data Bus #9B In (RSVD)	A	TP10E	ARINC 429 H In	702/A FMC #1	
Flight System Data Bus #9B In (RSVD)	B	TP10F	ARINC 429 H In	702/A FMC #1	
Flight System Data Bus #9 Out	A	TP10G	ARINC 429 H Out		
Flight System Data Bus #9 Out	B	TP10H	ARINC 429 H Out		
RSVD for MIL STD 1553 #1	Hi	TP10J	MIL STD 1553		Optional
RSVD for MIL STD 1553 #1	Lo	TP10K	MIL STD 1553		Optional
RSVD for ARINC 724 (Data Term Ready)		TP11A	Discrete In	724 MU-OAT	Optional
Spare		TP11B			Optional
VHF Voice Channel Control Program Pin		TP11C	Local Program		Optional
Program Pin Common		TP11D	dc Ground		Optional
RSVD for ARINC 724 (Data Bus In)	A	TP11E	Serial Data	724 MU-OAT	Optional
RSVD for ARINC 724 (Data Bus In)	B	TP11F	Serial Data	724 MU-OAT	Optional
RSVD for ARINC 724 (Data Bus Out)	A	TP11G	Serial Data	724 MU-OAT	Optional
RSVD for ARINC 724 (Data Bus Out)	B	TP11H	Serial Data	724 MU-OAT	Optional
RSVD for ARINC 724 (OAT Shield)		TP11J	dc Ground	724 MU-OAT	Optional
RSVD for MIL STD 1553*B* #1		TP11K	Shield		Optional

ATTACHMENT 2-2
STANDARD INTERWIRING

SIGNAL NAME		PIN	SIGNAL TYPE	SOURCE/SINK	NOTES
Spare		TP12A			
User Defined - CMU Crosstalk Data Bus Out	A	TP12B	User Defined		
User Defined - CMU Crosstalk Data Bus Out	B	TP12C	User Defined		
Comm Link Data Bus #7C In	A	TP12D	ARINC 429 H In	741 SDU #2 761 SDU #2	
Comm Link Data Bus #7C In	B	TP12E	ARINC 429 H In	741 SDU #2 761 SDU #2	
RSVD Discrete Out #1		TP12F	Discrete Out		
RSVD Discrete Out #**2**		TP12G	Discrete Out		
RSVD Discrete Out #3		TP12H	Discrete Out		
ATC Uplink Annunciator		TP12J	Discrete Out		
RSVD Discrete Out Common		TP12K	dc Ground		
RSVD for ARINC 724 (Uplink BCS Indicator)		TP13A	Discrete Out	724 MU-OAT	Optional
RSVD for ARINC 724 (Uplink ACK Indicator)		TP13B	Discrete Out	724 MU-OAT	Optional
RSVD for ARINC 724 (Uplink NAK Indicator)		TP13C	Discrete Out	724 MU-OAT	Optional
RSVD for ARINC 724 (Output Bus)	A	TP13D	User Defined	724 ACARS CU	Optional
RSVD for ARINC 724 (Output Bus)	B	TP13E	User Defined	724 ACARS CU	Optional
RSVD for ARINC 724 (Input Bus)	A	TP13F	User Defined	724 ACARS CU	Optional
RSVD for ARINC 724 (Input Bus)	B	TP13G	User Defined	724 ACARS CU	Optional
Comm Link Data Bus #7 Out	A	TP13H	ARINC 429 H Out		
Comm Link Data Bus #7 Out	B	TP13J	ARINC 429 H Out		
Spare		TP13K			
General Data Bus #8C In (Spare)	A	TP14A	ARINC 429 H In	EFB-2 Data Input	
General Data Bus #8C In (Spare)	B	TP14B	ARINC 429 H In	EFB-2 Data Input	
General Data Bus #8D In (Spare)	A	TP14C	ARINC 429 H In		
General Data Bus #8D In (Spare)	B	TP14D	ARINC 429 H In		
SDI Program Pin #1		TP14E	Local Program		
SDI Program Pin #2		TP14F	Local Program		
Spare		TP14G			
General Data Bus #5B In	A	TP14H	ARINC 429 H/L In	TAWS	
General Data Bus #5B In	B	TP14J	ARINC 429 H/L In	TAWS	
RSVD - Discrete In		TP14K	Discrete In		
RSVD for ARINC 724/B		TP15A	Discrete In	OOOI Sensor In #1	Optional
RSVD for ARINC 724/B		TP15B	Discrete In	OOOI Sensor In #2	Optional
RSVD for ARINC 724/B		TP15C	Discrete In	OOOI Sensor In #3	Optional
RSVD for ARINC 724/B		TP15D	Discrete In	OOOI Sensor In #4	Optional
RSVD for ARINC 724/B		TP15E	Discrete In	OOOI Sensor In #5	Optional
RSVD for ARINC 724/B		TP15F	Discrete In	OOOI Sensor In #6	Optional
RSVD for ARINC 724/B		TP15G	Discrete In	OOOI Sensor In #7	Optional
RSVD for ARINC 724/B		TP15H	Discrete In	OOOI Sensor In #8	Optional
RSVD for ARINC 724/B		TP15J	Discrete In	OOOI Sn In On/Off	Optional
RSVD for ARINC 724/B		TP15K	dc Ground	OOOI Sensor Rtn	Optional
Spare		MP01A			
Spare		MP01B			
Spare		MP01C			
Spare		MP01D			
Spare		MP01E			
Spare		MP01F			
Spare		MP01G			
Spare		MP01H			
Spare		MP01J			
RSVD Discrete In Common		MP01K	dc Ground		

ATTACHMENT 2-2
STANDARD INTERWIRING

SIGNAL NAME		PIN	SIGNAL TYPE	SOURCE/SINK	NOTES
RSVD Discrete In #1		MP02A	Discrete In		
RSVD Discrete In #2		MP02B	Discrete In		
8.33 kHz Tuning		MP02C	Discrete In	716 VHF Transceiver	
Installed In Simulator		MP02D	Discrete In	Simulator	
RSVD Discrete In #5		MP02E	Discrete In		
RSVD Discrete In #6		MP02F	Discrete In		
RSVD Discrete In #7		MP02G	Discrete In		
RSVD Discrete In #8		MP02H	Discrete In		
Spare		MP02J			
User Defined		MP02K			
RSVD for ARINC 646 Ethernet #2 In	A	MP03A	Ethernet In		
RSVD for ARINC 646 Ethernet #2 In	B	MP03B	Ethernet In		
RSVD for ARINC 646 Ethernet #2 Out	A	MP03C	Ethernet Out		
RSVD for ARINC 646 Ethernet #2 Out	B	MP03D	Ethernet Out		
User Defined		MP03E			
User Defined		MP03F			
RSVD for ARINC 646 Ethernet #4 In	A	MP03G	Ethernet In		
RSVD for ARINC 646 Ethernet #4 In	B	MP03H	Ethernet In		
RSVD for ARINC 646 Ethernet #4 Ou t	A	MP03J	Ethernet Out		
RSVD for ARINC 646 Ethernet #4 Out	B	MP03K	Ethernet Out		
Spare		MP04A			
Spare		MP04B			
Flight Sys Data Bus #10B In (RSVD)	A	MP04C	ARINC 429 H In	702/A FMC #2	
Flight Sys Data Bus #10B In (RSVD)	B	MP04D	ARINC 429 H In	702/A FMC #2	
Spare		MP04E			
Spare		MP04F			
Spare		MP04G			
Spare		MP04H			
Spare		MP04J			
Spare		MP04K			
Flight Sys Data Bus #9C In (Spare)	A	MP05A	ARINC 429 H In		
Flight Sys Data Bus #9C In (Spare)	B	MP05B	ARINC 429 H In		
Spare		MP05C			
Spare		MP05D			
General Data Bus #5C In (Spare)	A	MP05E	ARINC 429 H/L In		
General Data Bus #5C In (Spare)	B	MP05F	ARINC 429 H/L In		
Spare		MP05G			
Spare		MP05H			
Spare		MP05J			
Spare		MP05K			
General Data Bus #5D In (Spare)	A	MP06A	ARINC 429 H/L In		
General Data Bus #5D In (Spare)	B	MP06B	ARINC 429 H/L In		
Spare		MP06C			
Spare		MP06D			
Digital Data Bus #7 In (RSVD)	A	MP06E	ARINC 429 H/L In	743/A GPS	
Digital Data Bus #7 In (RSVD)	B	MP06F	ARINC 429 H/L In	743/A GPS	
Spare		MP06G			
Spare		MP06H			
Digital Data Bus #9 In (RSVD)	A	MP06J	ARINC 429 H/L In	702/A FMC #2	
Digital Data Bus #9 In (RSVD)	B	MP06K	ARINC 429 H/L In	702/A FMC #2	
Spare		MP07A			
Spare		MP07B			
Comm Link Data Bus #7A In	A	MP07C	ARINC 429 H In	750 VDR #3	
Comm Link Data Bus #7A In	B	MP07D	ARINC 429 H In	750 VDR #3	
ARINC 724B Discrete Common		MP07E	dc Signal Ground		
RSVD for MIL STD 1553 #2	Hi	MP07F	MIL STD 1553		Optional
RSVD for MIL STD 1553 #2	Lo	MP07G	MIL STD 1553		Optional

ATTACHMENT 2-2
STANDARD INTERWIRING

SIGNAL NAME		PIN	SIGNAL TYPE	SOURCE/SINK	NOTES
RSVD for MIL STD 1553B #2		MP07H	Shield		Optional
General Data Bus #3D In (Spare)	A	MP07J	ARINC 429 L In		
General Data Bus #3D In (Spare)	B	MP07K	ARINC 429 L In		
Flight Sys Data Bus #9A In (RSVD)	A	MP08A	ARINC 429 H In	DCDU #1	
Flight Sys Data Bus #9A In (RSVD)	B	MP08B	ARINC 429 H In	DCDU #1	
Comm Link Data Bus #6A In	A	MP08C	ARINC 429 H In	718A XPDR #1/**TCAS # 1**	
Comm Link Data Bus #6A In	B	MP08D	ARINC 429 H In	718A XPDR #1/**TCAS # 1**	
Flight Sys Data Bus #10C In (Spare)	A	MP08E	ARINC 429 H In		
Flight Sys Data Bus #10C In (Spare)	B	MP08F	ARINC 429 H In		
General Data Bus #8B In (RSVD)	A	MP08G	ARINC 429 H In	746 Cabin System	
General Data Bus #8B In (RSVD)	B	MP08H	ARINC 429 H In	746 Cabin System	
Comm Link Data Bus #7D In	A	MP08J	ARINC 429 H In	751 Gatelink	
Comm Link Data Bus #7D In	B	MP08K	ARINC 429 H In	751 Gatelink	
Spare		MP09A			
Spare		MP09B			
Aural/Visual Alert Reset		MP09C	Discrete In	EFIS, EICAS, etc.	
VHF Voice Mode Isolation		MP09D	Program Logic	Aircraft wiring	Optional
Spare		MP09E			
Aural/Visual Alert Contacts #2		MP09F	Relay	EFIS, EICAS, etc.	
Aural/Visual Alert Contacts #2		MP09G	Relay	EFIS, EICAS, etc.	
Spare		MP09H			
Fault Annunciation		MP09J	Discrete Out		
RSVD for ARINC 724 (NO COMM)		MP09K	Discrete Out	EFIS, EICAS, etc.	Optional
Comm Link Data Bus #7B In	A	MP10A	ARINC 429 H In	718A XPDR #2/**TCAS # 2**	
Comm Link Data Bus #7B In	B	MP10B	ARINC 429 H In	718A XPDR #2/**TCAS # 2**	
General Data Bus #8A In	A	MP10C	ARINC 429 H In	EFB-1 Data Input	
General Data Bus #8A In	B	MP10D	ARINC 429 H In	EFB-1 Data Input	
Simulator Data Bus In	A	MP10E	ARINC 429 H In	610A Simulator	
Simulator Data Bus In	B	MP10F	ARINC 429 H In	610A Simulator	
Comm Link Data Bus #4D In	A	MP10G	ARINC 429 L In	**Spare**	
Comm Link Data Bus #4D In	B	MP10H	ARINC 429 L In	**Spare**	
General Data Bus #8 Out	A	MP10J	ARINC 429 H Out	Data Out for EFB(s)	
General Data Bus #8 Out	B	MP10K	ARINC 429 H Out	Data Out for EFB(s)	
Flight Sys Data Bus #10 Out	A	MP11A	ARINC 429 H Out		
Flight Sys Data Bus #10 Out	B	MP11B	ARINC 429 H Out		
General Data Bus #2C In	A	MP11C	ARINC 429 L In	702/A FMC #2	
General Data Bus #2C In	B	MP11D	ARINC 429 L In	702/A FMC #2	
General Data Bus #2D In	A	MP11E	ARINC 429 L In	717 ACMS	
General Data Bus #2D In	B	MP11F	ARINC 429 L In	717 ACMS	
Ethernet #1 In (Simulator)	A	MP11G	646 Ethernet In	Simulator/615A Data Loader	
Ethernet #1 In (Simulator)	B	MP11H	646 Ethernet In	Simulator/615A Data Loader	
Ethernet #1 Out (Simulator)	A	MP11J	646 Ethernet Out	Simulator/615A Data Loader	
Ethernet #1 Out (Simulator)	B	MP11K	646 Ethernet Out	Simulator/615A Data Loader	
Comm Link Data Bus #6 Out	A	MP12A	ARINC 429 H Out		
Comm Link Data Bus #6 Out	B	MP12B	ARINC 429 H Out		
General Data Bus #2A In	A	MP12C	ARINC 429 L In	739 MCDU #2	
General Data Bus #2A In	B	MP12D	ARINC 429 L In	739 MCDU #2	
General Data Bus #2 Out	A	MP12E	ARINC 429 L Out		
General Data Bus #2 Out	B	MP12F	ARINC 429 L Out		
General Data Bus #2B In	A	MP12G	ARINC 429 L In	739 MCDU #3	
General Data Bus #2B In	B	MP12H	ARINC 429 L In	739 MCDU #3	
General Data Bus #1B In	A	MP12J	ARINC 429 L In	740/744A Printer	
General Data Bus #1B In	B	MP12K	ARINC 429 L In	740/744A Printer	

ATTACHMENT 2-2
STANDARD INTERWIRING

SIGNAL NAME		PIN	SIGNAL TYPE	SOURCE/SINK	NOTES
Spare		MP13A			
Spare		MP13B			
Spare		MP13C			
Spare		MP13D			
Spare		MP13E			
Spare		MP13F			
General Data Bus #1C In	A	MP13G	ARINC 429 L In	604 CFDIU (CMC)	
General Data Bus #1C In	B	MP13H	ARINC 429 L In	or 624 OMS	
General Data Bus #3C In (Spare)	A	MP13J	ARINC 429 L In		
General Data Bus #3C In (Spare)	B	MP13K	ARINC 429 L In		
General Data Bus #1A In	A	MP14A	ARINC 429 L In	739 MCDU #1	
General Data Bus #1A In	B	MP14B	ARINC 429 L In	739 MCDU #1	
General Data Bus #3A In	A	MP14C	ARINC 429 L In	Cabin Terminal #1	
General Data Bus #3A In	B	MP14D	ARINC 429 L In	Cabin Terminal #1	
Digital Data Bus #1 In	A	MP14E	ARINC 429 H or L In	OOOI Source	
Digital Data Bus #1 In	B	MP14F	ARINC 429 H or L In	OOOI Source	
Digital Data Bus #2 In	A	MP14G	ARINC 429 H or L In	OOOI Source	
Digital Data Bus #2 In	B	MP14H	ARINC 429 H or L In	OOOI Source	
General Data Bus #3B In	A	MP14J	ARINC 429 L In	Cabin Terminal #2	
General Data Bus #3B In	B	MP14K	ARINC 429 L In	Cabin Terminal #2	
RSVD for ARINC 724 (Data Bus In)	A	MP15A	Serial Data	573 AIDS	Optional
RSVD for ARINC 724 (Data Bus In)	B	MP15B	Serial Data	573 AIDS	Optional
Simulator/**CVR** Data Bus Out	A	MP15C	ARINC 429 H Out	610A Simulator/**CVR**	
Simulator/**CVR** Data Bus Out	B	MP15D	ARINC 429 H Out	610A Simulator/**CVR**	
General Data Bus #1 Out	A	MP15E	ARINC 429 L Out		
General Data Bus #1 Out	B	MP15F	ARINC 429 L Out		
General Data Bus #3 Out	A	MP15G	ARINC 429 L Out		
General Data Bus #3 Out	B	MP15H	ARINC 429 L Out		
General Data Bus #1D In	A	MP15J	ARINC 429 L In	702/A FMC #1	
General Data Bus #1D In	B	MP15K	ARINC 429 L In	702/A FMC #1	
Primary Power 115 Vac Hot (400 Hz)		BP01	ac Power	Aircraft Power	Gen Av
RSVD - 28 Vdc Primary Power Hot		BP02	dc Power	Aircraft Power	Gen Av
RSVD - 28 Vdc Primary Power Return		BP03	dc Power Ground	Aircraft Power	
Spare		BP04			
Spare		BP05			
Spare		BP06			
Primary Power 115 Vac Cold (400 Hz)		BP07	ac Power	Aircraft Power	
Chassis Ground		BP08	dc Signal Ground	Aircraft Power	
Spare		BP09			
Standby Power 28 Vdc Positive In		BP10	dc Power	Aircraft Power	
Standby Power 28 Vdc Return		BP11	dc Power Ground	Aircraft Power	
User Defined		BP12			
Spare		BP13			

ATTACHMENT 2-2
STANDARD INTERWIRING

The following should be considered on all installations:

1. Wire Size

   The size (gauge) of wire selected for aircraft installations should be considered carefully. Factors to be considered include current handling capacity, attenuation, insulation, weight, and flexibility. Over the years, the airlines have reported a number of sad experiences with aircraft where small (less than #22 gauge) wire was used. Although the airlines are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are quickly nullified by maintenance costs if frequent breakage occurs.

2. Twisted Shielded Wire

   Digital data bus shields should be grounded to the aircraft structure at both ends of the cable run. Further, digital data bus shields should be grounded to the aircraft structure on both sides of each production break.

ATTACHMENT 2-3
REAR CONNECTOR INSERT LAYOUT

Table 1 – Top Plug (TP) Insert

	A	B	C	D	E	F	G	H	J	K
1	----------APM----------					OOOI #3 In		----------APM----------		
	Power	Power Return	Enable #1	Enable #2	Clock Out	A	B	Data Out	Data In	Write Prot #1 Out
2	-------RSVD APM-------- Write Prot #2 Out	Spare	SDU # 1 CL Data Bus #4A In A	B	HFDR #2/SDU #2 CL Data Bus #4B In A	B	CMU Crosstalk In A	B	ACT/STY Out	OPT-724 Printer Common
3	----------RSVD Optional ARINC 724 Printer Data Bus Out---------- A	B	Disc In	Disc In	Disc In	Disc In	Disc In	Common	Optional 419 UTC Out A	B
4	---------RSVD User Defined ATE---------				OOOI #5 In A	B	OOOI #6 In A	B	OOOI #4 In A	B
5	VDR #1 CL Data Bus #6B A	B	Spare	Data Loader #5A In A	B	---------Spare----------		VHF Data Key Line Disc Out	VHF V/D Remote Disc In	VHF V/D Remote Disc Out
6	Spare	RSVD DCDU #2 FS Data Bus #10A A	B	Dual Inhibit Disc In	Data Loader Disc In	Gen Data Bus #5 Out A	B	SDU #1 CL Data Bus #6D in A	B	Spare
7	DFS/UTC Dig Data Bus #1 Out A	B	DFS Port Select Disc Out	Spare	V/D Mode Monitor Disc In	V/D Mode Annun Disc Out	CL Data Bus #4 Out A	B	Spare	VHF Data Key Line Rtn Common
8	RSVD Ethernet #3 In A	B	RSVD Ethernet #3 Out A	B	User Defined		RSVD 702 FMC #1 Dig Data Bus #8 In A	B	---------Spare---------	
9	VHF MSK Audio Out Hi	Lo	VHF MSK Audio In Hi	Lo	---------Spare----------		A/V Alert Contacts #1 Relay	Relay	RSVD Optional OAT Disc In	Disc Out
10	VDR #2 CL Data Bus #6C In A	B	HFDR #1 CL Data Bus #4C In A	B	RSVD 702A FMC #1 FS Data Bus #9B In A	B	FS Data Bus #9 Out A	B	RSVD MIL STD 1553 #1 Hi	Lo
11	RSVD Optional OAT Disc In	Spare	OPT VHF Voice Chnl Ctrl Prgm	Program Pin Common	---------RSVD Optional for ARINC 724 OAT--------- A	Data Bus In B	A	Data Bus Out B	Shield	RSVD MIL STD 1553*B* #1 Shield
12	Spare	CMU Crosstalk Data Bus Out A	B	SDU #2 CL Data Bus #7C In A	B	**RSVD** **#1** **Disc Out**	RSVD **#2** Disc Out	RSVD #3 Disc Out	ATC Uplink Disc Out	RSVD Disc Out Common
13	RSVD Optional for 724 OAT Disc Out	Disc Out	Disc Out	RSVD Optional 724 CU Data Bus Out A	B	RVSD Optional 724 CU Data Bus In A	B	CL Data Bus # 7 Out A	B	Spare
14	EFB-2 Data In Gen Data Bus #8C In A	B	Spare Gen Data Bus #D In A	B	SDI Prgm Pin #1	SDI Prgm Pin #2	Spare	TAWS Gen Data Bus #5B In A	B	RSVD Disc In
15	----------OOOI Sensor Discrete Input---------- #1	#2	#3	#4	#5	#6	#7	#8	On/Off	Return

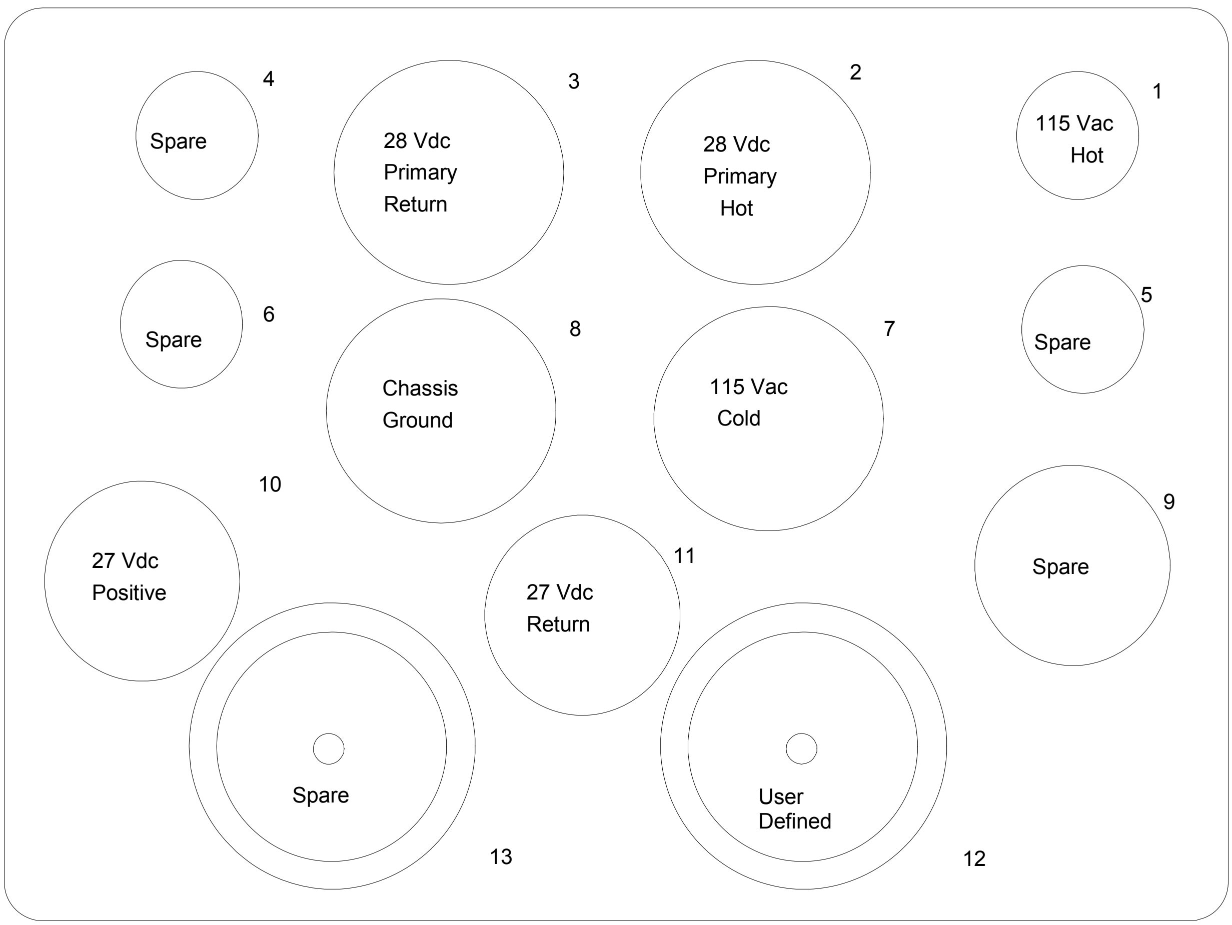
ATTACHMENT 2-3
REAR CONNECTOR INSERT LAYOUT

Table 2 – Middle Plug (MP) Insert

	A	B	C	D	E	F	G	H	J	K
1	----------Spare----------									RSVD Disc In Common
2	RSVD Disc #1 In	8.33 kHz Disc In	Installed in Simulator Disc In	----RSVD Discrete Input---- #4	#5	#6	#7	#8	Spare	User Defined
3	RSVD Ethernet #2 In A	B	RSVD Ethernet #2 Out A	B	User Defined		RSVD Ethernet #4 In A	B	RSVD Ethernet #4 Out A	B
4	Spare		702A FMC #2 FS Data Bus #10B In A	B	----------Spare----------					
5	Spare FS Data Bus #9C In A	B	Spare		Spare Gen Data Bus #5C In A	B	----------Spare----------			
6	Spare Gen Data Bus #5D In A	B	Spare		743A GPS Dig Data Bus #7 In A	B	Spare		702A FMC #2 Dig Data Bus #9 In A	B
7	Spare		VDR #3 CL Data Bus #7A In A	B	724 Disc Common	RSVD MIL STD 1553*B* #2 Hi	Lo	*Shield*	Spare Gen Data Bus #3D In A	B
8	DCDU #1 FS Data Bus #9A In A	B	XPDR #1/**TCAS # 1** CL Data Bus #6A In A	B	Spare FS Data Bus #10C In A	B	RSVD for Cabin Sys Gen Data Bus #8B In A	B	Gatelink CL Data Bus #7D In A	B
9	Spare		A/V Alert Reset Disc In	OPT VHF Voice Mode Isolation Program	Spare	A/V Alert Contacts #2 Relay	Relay	Spare	Fault Annunc Disc Out	RSVD - Opt NO COMM Disc Out
10	XPDR #2/**TCAS # 2** CL Data Bus #7B In A	B	EFB-1 Data Input Gen Data Bus #8A In A	B	RSVD 610A SIM In A	B	**Spare** CL Data Bus #4D In A	B	Gen Data Bus #8 Out for EFB(s) A	B
11	FS Data Bus #10 Out A	B	FMC #2 Gen Data Bus #2C In A	B	ACMS Gen Data Bus #2D In A	B	Simulator/615A Data Loader Ethernet #1 In A	B	Simulator/615A Data Loader Ethernet #1 Out A	B
12	CL Data Bus #6 Out A	B	MCDU #2 Gen Data Bus #2A In A	B	Gen Data Bus #2 Out A	B	MCDU #3 Gen Data Bus #2B In A	B	740/744A Printer Gen Data Bus #1B In A	B
13	----------Spare----------						CMC Gen Data Bus #1C In A	B	Spare Gen Data Bus #3C In A	B
14	MCDU #1 Gen Data Bus #1A A	B	Cabin Terminal #1 Gen Data Bus #3A In A	B	OOOI #1 Dig Data Bus #1 In A	B	OOOI #2 Dig Data Bus #1 In A	B	Cabin Terminal #2 Gen Data Bus #3B In A	B
15	RSVD OPT 724 - 573 Serial Data In A	B	610 Simulator/**CVR** Out A	B	Gen Data Bus #1 Out A	B	Gen Data Bus #3 Out A	B	FMC #1 Gen data Bus #1D In A	B

ATTACHMENT 2-3
REAR CONNECTOR INSERT LAYOUT

Table 3 – Bottom Plug (BP) Insert



ATTACHMENT 3
CMIS NETWORK MANAGEMENT SERVICES

Table 3-1 - Management-Notification Service

Service	Type	Definition
M-EVENT-REPORT	Confirmed/nonconfirmed	Reports an event about a managed object to a peer CMISE-service user.

Table 3-2 - Management-Operation Services

Service	Type	Definition
M-GET	Confirmed	Request the retrieval of management information from peer CMISE-service user.
M-SET	Confirmed/nonconfirmed	Requests the modification of management information by a peer CMISE-service user.
M-ACTION	Confirmed/nonconfirmed	Requests that a peer CMISE-service perform an action.
M-CREATE	Confirmed	Requests that a peer CMISE-service user create an instance of a managed object.
M-DELETE	Confirmed	Requests that a peer CMISE-service user delete an instance of a managed object.
M-CANCEL-GET	Confirmed	Requests that a peer CMISE-service user cancel a previously requested and currently outstanding invocation of the M-GET service.

ATTACHMENT 4
HF DATA RADIO CONTROL LOGIC TABLES

Table 4-1 - HFDR 1 Fault Logic Reported By CMU 1:

CMU 1 Inputs					CMU 1 Output
CMU 1 Label 276, bit 22	HFDR 1 Label 270, bit 16	HFDR 1 Label 270, bit 12	HFDR 1 429 Activity	HFDR 1 Label 270 SSM bits	Label 276, bit 24
0 (not installed)	x (don't care)	x	x	x	0 (no fault)
1 (installed)	x	x	not	x	1 (fault)
1	1 (fault)	1 (fault)	active	00 (normal)	1
1	1	0 (no fault)	active	00	1
1	0 (no fault)	1	active	00	1
1	0	0	active	00	0
1	x	x	active	01 (ncd)	0
1	x	x	active	10 (test)	0
1	x	x	active	11 (failure)	1

Table 4-2 - HFDR 2 Fault Logic Reported By CMU 1:

CMU 1 Input					CMU 1 Output
CMU 1 Label 276, bit 23	HFDR 2 Label 270, bit 16	HFDR 2 Label 270, bit 12	HFDR 2 429 Activity	HFDR 2 Label 270 SSM bits	Label 276, bit 25
0 (not installed)	x (don't care)	x	x	x	0 (no fault)
1	x	x	not	x	1
1 (installed)	1 (fault)	1 (fault)	active	00 (normal)	1 (fault)
1	1	0 (no fault)	active	00	1
1	0 (no fault)	1	active	00	1
1	0	0	active	00	0
1	x	x	active	01 (ncd)	0
1	x	x	active	10 (test)	0
1	x	x	active	11 (failure)	1

ATTACHMENT 4
HF DATA RADIO CONTROL LOGIC TABLES

Table 4-3 - HFDR 1 Fault Logic Reported By CMU 2:

CMU 2 Inputs					CMU 2 Output
CMU Label 276, bit 22	HFDR 1 Label 270, bit 16	HFDR 1 Label 270, bit 19	HFDR 1 429 Activity	HFDR 1 Label 270 SSM bits	Label 276, bit 24
0 (not installed)	x (don't care)	x	x	x	0 (no fault)
1 (installed)	x	x	not	x	1 (fault)
1	1 (fault)	1 (fault)	active	00 (normal)	1
1	1	0 (no fault)	active	00	1
1	0 (no fault)	1	active	00	1
1	0	0	active	00	0
1	x	x	active	01 (ncd)	0
1	x	x	active	10 (test)	0
1	x	x	active	11 (failure)	1

Table 4-4 - HFDR 2 Fault Logic Reported By CMU 2:

CMU 2 Inputs					CMU 2 Output
CMU 2 Label 276, bit 23	HFDR 2 Label 270, bit 16	HFDR 2 Label 270, bit 19	HFDR 2 429 Activity	HFDR 2 Label 270 SSM bits	Label 276, bit 25
0 (not installed)	x (don't care)	x	x	x	0 (no fault)
1	x	x	not	x	1
1 (installed)	1 (fault)	1 (fault)	active	00 (normal)	1 (fault)
1	1	0 (no fault)	active	00	1
1	0 (no fault)	1	active	00	1
1	0	0	active	00	0
1	x	x	active	01 (ncd)	0
1	x	x	active	10 (test)	0
1	x	x	active	11 (failure)	1

ATTACHMENT 4
HF DATA RADIO CONTROL LOGIC TABLES

Table 4-5 - HFDR 1 Voice/Data logic:

CMU Inputs						CMU Output
HFDR 1 Voice/Data Status from HFDR 1 Label 270, bit 13	HFDR 1 Label 270 SSM	HFDR 1 Label 270 Activity	HFDR 1 Voice/Data Status from HFDR 2 Label 270, bit 13	HFDR 2 Label 270 SSM	HFDR 2 Label 270 Activity	Label 276, bit 20
1 (voice)	valid data	active	x (don't care)	x (don't care)	x (don't care)	1 (voice)
0 (data)	valid data	active	x	x	x	0 (data)
x	other	active	x (don't care)	x	x (don't care)	1 (voice)
x	x	not active	1	valid data	active	1
x	x	not active	0	valid data	active	0
x	x	not active	x	other	active	1
x	x	not active	x	x	not active	1

Table 4-6 - HFDR 2 Voice/Data logic:

CMU Inputs						CMU Output
HFDR 2 Voice/Data Status from HFDR 1 Label 270, bit 25	HFDR 1 Label 270 SSM	HFDR 1 Label 270 Activity	HFDR 2 Voice/Data Status from HFDR 2 Label 270, bit 25	HFDR 2 Label 270 SSM	HFDR 2 Label 270 Activity	Label 276, bit 21
1 (voice)	valid data	active	x (don't care)	x (don't care)	not active	1 (voice)
0 (data)	valid data	active	x	x	not active	0 (data)
x	other	active	x	x	not active	1
x	x	x	1	valid data	active	1
x	x	x	0	valid data	active	0
x	x	x	x	other	active	1
x	x	not active	x	x	not active	1

ATTACHMENT 4
HF DATA RADIO CONTROL LOGIC TABLES

The following table states the logic for HFDR Master/Slave determination in truth table format.

Table 4-7 - HFDR Master/Slave Selection Table
(all bits refer to Label 276 from MU)

HFDR 1 Installed bit 22	HFDR 2 Installed bit 23	HFDR 1 Fault bit 24	HFDR 2 Fault bit 25	HFDR 1 Voice bit 20	HFDR 2 Voice bit 21	HFDR 1 Master bit 26	HFDR 2 Master bit 27
not (0)	not (0)	x	x	x	x	slave (0)	slave(0)
installed (1)	not	x	x	x	x	master(1)	slave
not	installed (1)	x	x	x	x	slave	master(1)
installed	installed	fault (1)	x	voice (1)	x	slave	master
installed	installed	fault	x	data (0)	voice (1)	master	slave
installed	installed	fault	x	data	data (0)	slave	master
installed	installed	op(0)	x	voice	voice	master	slave
installed	installed	op	x	voice	data	slave	master
installed	installed	op	x	data	voice	master	slave
installed	installed	op	op(0)	data	data	x *	alternate state
installed	installed	op	fault(1)	data	data	master	slave

* Consideration should be given to not altering the pre-existing master/slave state when entering the condition defined by this row.

ATTACHMENT 5
EXAMPLE OF APM MEMORY MAP

Table 5-1 – Minimum Data Required In APM

Address	Category	Fields	Size/Format
	APM Config Block	APM Config Block Length	
		Version (Supplier Defined) (end of APM Config block)	
	Identity Block	Identify Block Length	
		ICAO 24-bit aircraft address	
		56 bit Official Registration Mark (Seven Character Registration Number)	
		AVLAN MAC Address	
		Aircraft Model/Type	
		2 character Airline Identifier	
		3 character ICAO Airline Identifier	
		VHF Control Configuration	
		HFDR #1 Installed	
		HFDR #2 Installed	

Table 5-2 – Example of APM Memory Map with Extended Data Fields

Address	Category	Fields	Size/Format
	APM Config Block	APM Config Block Length	
		Version (Supplier Defined) (end of APM Config block)	
	Identity Block	Identify Block Length	
		ICAO 24-bit aircraft address	
		56 bit Official Registration Mark (Seven Character Registration Number)	
		AVLAN MAC Address	
		Aircraft Model/Type	
		2 character Airline Identifier	
		3 character ICAO Airline Identifier	
		VHF Control Configuration	
		HFDR #1 Installed	
		HFDR #2 Installed	
	Options Block	Options Block Length	
		SDU 1 Installed	
		SDU 2 Installed	
		VHF Analog Voice External Select	
		Radio Management Preset Enable	
		VHF 3 Installed	
		VDR 3 Installed	
		CMU Services Enabled	
		ATN Services Enabled	
		ATS CPDLC Enabled	
		740/744 Printer Installed	
		744A Printer Installed	
	User Block	User Block Length	
		Airline Fleet Identifier Number (FIN)	
	Integrity Block	CRC	
	Reserved	Future Use	

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-1 – ARINC 429 Input Port Monitoring

The following defines criteria for determining whether an input port is active.

CMU Input Port	Activity Label	Min Update Rate
Cabin Terminal #1	172	1 Hz
Cabin Terminal #2	172	1 Hz
CFDIU	125	1 Hz
X-Talk Bus	N/A	N/A
ACMS	172	1 Hz
FMC #1	270	1 Hz
FMC #2	270	1 Hz
HFDR #1	270	1 Hz
HFDR #2	270	1 Hz
MCDU #1	172	1 Hz
MCDU #2	172	1 Hz
MCDU #3	172	1 Hz
OOOI #1	Aircraft specific	1 Hz
OOOI #2	Aircraft specific	1 Hz
Printer	350	1 Hz
SDU #1	270	1 Hz
SDU #2	270	1 Hz
OOOI #3	Aircraft Specific	1 Hz
OOOI #4	Aircraft Specific	1 Hz
OOOI #5	Aircraft Specific	1 Hz
OOOI #6	Aircraft Specific	1 Hz
VDR #1	270	1 Hz
VDR #2	270	1 Hz
VDR #3	270	1 Hz
XPDR/ICAO #1	275	1 Hz
XPDR/ICAO #2	275	1 Hz
FMC HS #1	270	1 Hz
FMC HS #2	270	1 Hz
EFB-1	172	1 Hz
EFB-2	172	1 Hz

Note: A Bus is generally declared active when three consecutive words at the specified rate are received. A bus is declared inactive when three consecutive samples fail.

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-2 – ARINC Specification 429 Broadcast Output Map

Label	Name	Rate	General Output Buses 1,2	General Output Buses 3,8	DFS/ UTC	Comm Output Bus 4	Comm Output Buses 6,7	General Output Buses 5,9,10	Simulator/ CVR Output Bus
030	DFS Tuning Word	5/S			X				
172	Subsystem Identifier	1/S	X	X		X	X	X	
377	Equipment Identifier	1/S	X						
350	BITE Word #1 (Binary)	1/S	X						
351	BITE Word #2 (Binary)	1/S	X						
352	**BITE Word #3 (Binary)**	**1/S**	**X**						
125	UTC BCD	1/S			X				
150	UTC Binary	1/S			X				
260	UTC BCD Date	1/S			X				
270	Status Output #1	1/S	X	X		X	X	X	**X**
276	Status Output #2	1/S	X	X		X	X	X	**X**
214	ICAO 24-bit aircraft address Word #1	1/S	X	X		X	X	X	
216	ICAO 24-bit aircraft address Word #2	1/S	X	X		X	X	X	
047	DFS Autotune Word 8.33 kHz	5/S			X				

DFS = Digital Frequency Select

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-3 – Label 030 - DFS AUTO-TUNE Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		10 MHz			1 MHz				0.1 MHz				0.01 MHz				0.001 MHz				SDI		Octal Label							
			3			1				5				5				0						030							
0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0

Notes:

1. This example illustrates the coding for VHF Communications frequency 131.550 MHz. The valid frequency range is 118.000 to 136.975 MHz.

2. The 100 MHz digit is defined as “1” and not transmitted.

3. Frequency Selection Increments 25 kHz.

4. SDI 00 is output (all call). Some radios do not respond to all call properly and require the SDI bits be set for their installed position.

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-4 – Label 047 – DFS AUTO-TUNE Word 8.33 kHz

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		10 MHz			1 MHz				0.1 MHz				0.01 MHz				0.001 MHz				SDI		Octal Label							
			3			1				5				5				0						047							
0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	1	1	1	0	0	1	0	0

Notes:

1. This example illustrates the coding for VHF Communications frequency 131.550 MHz. The valid frequency range and channel naming are provided in ARINC Characteristic 716 Appendix 1.

2. The 100 MHz digit is defined as “1” and not transmitted.

3. Frequency Selection Increments 8.33 kHz.

4. SDI 00 is output (all call).

5. The 8.33 kHz channel pairing definition is provided in Appendix 1 of ARINC Characteristic 716.

6. Label 047 is only used for tuning voice channels.

Table 6-5 – Label 125 - UTC Time (BCD) Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		10 Hours			1 Hours				10 Minutes				1 Minutes				0.1 Minutes				SDI		Octal Label							
			2			3				5				9				9						125							
0	0	0	0	1	0	0	0	1	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	1	0	1	0	1	0	1	0

Notes:

1. This example illustrates the coding for UTC BCD Time (Data 23:59:.9) All Pad bits are set to binary 0.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

3. SSM per ARINC Specification 429.

Table 6-6 – Label 150 - UTC Time (Binary) Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM			Hours					Minutes						Seconds						Pad	SDI		Octal Label							
				23					59						59									150							
0	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0	1	1	0

Notes:

1. This example illustrates the coding for UTC Time (binary). All Pad bits are set to binary 0.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

3. SSM per ARINC Specification 429.

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-7 – Label 260 - UTC Date Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		10 days		1 day				10 mo	1 month				10 years				1 year				SDI		Octal Label							
			2		5				1	2				8				8						260							
1	0	0	1	**0**	0	1	0	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**	1	**0**	**1**

Notes:

1. This example illustrates the coding for UTC BCD Date. All Pad bits are set to binary 0.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation

3. SSM per ARINC Specification 429.

Table 6-8 – Label 270 - Output Status Word #1

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	SSM		Discrete Data																			SDI		Octal Label							
																								270							
																						0	0	0	0	0	1	1	1	0	1

Bit	Description	Content = 1
11	Message Waiting	Message Waiting
12	Link Availability	No Links Available
13	VHF VOICE	VHF in VOX Mode
14	Analog VOICE Go Ahead	VOX Go-Ahead (SELCAL)
15	(Reserved)	
16	CMU Fail	CMU Failed
17	HF/SAT Link Status	HFDL or SATCOM Link Not Available
18	VHF Link Status	VHF Link Not Available
19	Mode-S Link Status	Mode-S Link Not Available
20	Active/Standby (DUAL)	CMU in Active Mode
21	Printer Message	Printer MSG Received
22	Printer Status	Printer Failure
23	Alert	Alert (logic triggered)
24	HF Data Link Status	HFDL Available
25	Gatelink Status	Gatelink Available
26	(Reserved)	
27	(Reserved)	
28	(Reserved)	
29	(Reserved)	

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Notes:

1. This example illustrates the coding for Output Status Word #1. Bits 11, 21, 22, 23 are reserved for backwards compatibility with existing alerting systems.

2. All Pad bits are set to binary 0.

3. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

4. SSM per ARINC Specification 429.

Table 6-9 – Label 276 - Output Status Word #2

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		Discrete Data																			SDI		Octal Label							
																								276							
																						0	0	0	1	1	1	1	1	0	1

Bit	Description	Content = 1
11	Med Level Message	Message Waiting
12	Low Level Message	Message Waiting
13	Med Level ATC Message	Message Waiting
14	Low Level ATC Message	Message Waiting
15	Med Level Printer Message	Message Waiting
16	Low Level Printer Message	Message Waiting
17	Med Level ATC Print Message	Message Waiting
18	Low Level ATC Print Message	Message Waiting
19	SAT Link	Not Available
20	HF #1 Voice	Voice
21	HF #2 Voice	Voice
22	HFDL #1 Installed	Installed
23	HFDL #2 Installed	Installed
24	HFDL #1 Fault	Fault
25	HFDL #2 Fault	Fault
26	HFDL #1 Master	Master
27	HFDL #2 Master	Master
28	HFDL #1 SSM bits	Normal
29	HFDL #2 SSM bits	Normal

Notes:

1. This example illustrates the coding for Output Status Word #2. All "Med" Level Messages should trigger automatic aural alert.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

3. SSM per ARINC Specification 429. See Section 5.2.3 for bits 20 through 27.

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-10 – Label 214 - ICAO 24-Bit Aircraft Address Word #1

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		A16-- A1																					Octal Label							
			--MSB																					214							
																								0	0	1	1	0	0	0	1

Bit	Function	Coding		Notes
1	Label		1	
2	.	2	0	
3	.		0	
4	.		0	
5	.	1	1	
6	.		1	
7	.		0	
8	Label	4	0	
9	PAD			2
10	.			
11	.			
12	.			
13	PAD			
14	ICAO 24-Bit Aircraft Address (Part 1)	A1 (MSB)		
15	.	A2		
16	.	A3		
17	.	A4		
18	.	A5		
19	.	A6		
20	.	A7		
21	.	A8		
22	.	A9		
23	.	A10		
24	.	A11		
25	.	A12		
26	.	A13		
27	.	A14		
28	.	A15		
29	ICAO 24-Bit Aircraft Address (Part 1)	A16		
30	SSM			1
31	SSM			1
32	Parity	Odd		

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Notes:

1. Sign Status Matrix (SSM) Definition per ARINC Specification 429.

BIT		
31	30	**MEANING**
0	0	Normal Operation
0	1	NCD
1	0	Functional Test
1	1	Failure Warning

2. All PAD bits are set to binary 0.

Table 6-11 – Label 216 - ICAO 24-Bit Aircraft Address Word #2

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM											A24---------------------------------------A17												Octal Label							
												LSB												216							
																								0	1	1	1	0	0	0	1

Bit	Function		Coding	Notes
1	Label		1	
2	.	2	0	
3	.		0	
4	.		0	
5	.	1	1	
6	.		1	
7	.		1	
8	Label	6	0	
9	PAD			
10	.			
11	.			
12	PAD			
13	ICAO 24-Bit Aircraft Address (Part 2)		A17	
14	.		A18	
15	.		A19	
16	.		A20	
17	.		A21	
18	.		A22	
19	.		A23	
20	ICAO 24-Bit Aircraft Address (Part 2)		A24 (LSB)	
21	PAD			
22	.			
23	.			
24	.			
25	.			
26	.			
27	.			
28	.			
29	PAD			
30	SSM			1
31	SSM			1

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Bit	Function	Coding	Notes
32	Parity	Odd	

Notes:

1. Sign Status Matrix (SSM) Definition per ARINC Specification 429.

BIT		MEANING
31	30	
0	0	Normal Operation
0	1	NCD
1	0	Functional Test
1	1	Failure warning

2. All PAD bits are set to binary 0.

Table 6-12 – Label 350 - Maintenance Word #1

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		Discrete Data																			SDI		Octal Label							
																								350							
																						0	0	0	0	0	1	0	1	1	1

Bit	Description	Content = 1
11	CMU	Failure
12	OOOI #1 Input	Inactive
13	OOOI #2 Input	Inactive
14	MCDU #1 Input	Inactive
15	Printer Input	Inactive
16	FMC #1 Input	Inactive
17	DFDAU Input	Inactive
18	MCDU #2 Input	Inactive
19	MCDU #3 Input	inactive
20	FMC #2 Input	Inactive
21	CFDIU Input	Inactive
22	Cabin Terminal 1 Input	Inactive
23	SDU #1 Input (Input Port 4A or 6D)	Inactive
24	X-Talk Input	Inactive
25	HFDL #1 Input	Inactive
26	SDU #2 Input (Input Port 4B or 7C)	Inactive
27	HFDL #2 Input	Inactive
28	Cabin Terminal #2 Input	Inactive
29	CMD Word	ACK

Notes:

1. This example illustrates the coding for Maintenance Word #1. Digital Bus inputs are faulted based on activity label monitoring as defined in Attachment 6, Table 6-1.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

3. SSM per ARINC Specification 429

4. SSM should be set to NCD until sampling is completed on power up.

Table 6-13 – Label 351 - Maintenance Word #2

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		Discrete Data																			SDI		Octal Label							
																								351							
																						0	0	1	0	0	1	0	1	1	1

Bit	Description	Content = 1
11	(Reserved)	Inactive
12	(Reserved)	Inactive
13	VDR #1 (L)	Inactive
14	VDR #2 (R)	Inactive
15	VDR #3 (C)	Inactive
16	XPDR #1	Inactive
17	XPDR #2	Inactive
18	OOOI #3	Inactive
19	OOOI #4	Inactive
20	OOOI #5	Inactive
21	OOOI #6	Inactive
22	APM	No Data
23	FMC #1 HS	Inactive
24	FMC #2 HS	Inactive
25	DCDU #1	Inactive
26	DCDU #2	Inactive
27	Digital Data Bus #7 (GPS)	Inactive
28	Digital Data Bus #8 (ARINC 702A FMC #2)	Inactive
29	Digital Data Bus #9 (ARINC 702A FMC #2)	Inactive

Notes:

1. This example illustrates Maintenance Word #2. Digital Bus inputs are faulted based on activity label monitoring as defined in Attachment 6, Table 6-1.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

3. SSM per ARINC Specification 429.

4. SSM should be set to NCD until sampling is completed on power ups.

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-14 – Label 352 - Maintenance Word #3

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		Discrete Data																			SDI		Octal Label							
																								352							
																						0	0	0	1	0	1	0	1	1	1

Bit	Description	Content = 1
11	Input 3C	Inactive
12	Input 3D	Inactive
13	Input 5B (TAWS)	Inactive
14	Input 5C	Inactive
15	Input 5D	Inactive
16	Input 8A (EFB-1)	Inactive
17	Input 8D	Inactive
18	Input 9C	Inactive
19	Input 10C	Inactive
20	Input 8C (EFB-2)	Inactive
21	Spare	
22	Spare	
23	Spare	
24	Spare	
25	Spare	
26	Spare	
27	Spare	
28	Spare	
29	Spare	

Notes:

1. **This example illustrates Maintenance Word #3. Digital Bus inputs are faulted based on activity label monitoring as defined in Attachment 6, Table 6-1.**
2. **SDI per Section 5.3.16.4, the values shown are for a single CMU installation.**
3. **SSM per ARINC Specification 429, Part 2, Discrete word.**
4. **SSM should be set to NCD until sampling is completed on power ups.**

Table 6-15 – Label 377 - Equipment Identifier Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		PAD							Equipment ID (MSD)				Equipment ID				Equipment ID (LSD)				SDI		Octal Label							
										0				2				4						377							
			0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	1	1	1	1

ATTACHMENT 6
ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Notes:

1. This example illustrates the coding for the Equipment Identifier Word. All Pad bits are set to binary 0.

2. SDI per Section 5.3.16.4, the values shown are for a single CMU installation.

3. SSM per ARINC Specification 429.

Table 6-16 – Label 172 - Subsystem Identifier Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		PAD											**	*	Subsystem SAL								Octal Label							
																304								172							
			0	0	0	0	0	0	0	0	0	0	0	X	X	0	0	1	0	0	0	1	1	0	1	0	1	1	1	1	0

* See Note 3.

** See Note 4.

Notes:

1. This example illustrates the coding for the Subsystem Identifier Word. All Pad bits are set to binary 0.

2. SSM per ARINC Specification 429.

3. On all outputs, setting bit 17 to the 1 state indicates that the CMU supports the SATCOM Multi-Bearer System (MBS) protocol, as defined in ARINC Characteristic 761 Attachment 2 Item3. Reference Sections 5.2.6 and 5.3.3.3.

4. On all outputs, setting bit 18 to the 1 state indicates that the CMU supports the new Signal Quality Parameter scale, as defined in ARINC Characteristic 750 Attachment 10, Sections A10.4.7 and A10.5.10.

ATTACHMENT 7
ONBOARD ROUTING LABELS/SUB-LABELS

Device	Sublabel	Origin/ Destination	SAL
ATSU		J	
CMU		M	304
CDU		C	
CFDIU	CF	F	303
DFDAU	DF	D	302
EFB-1 (Left)	F1	Y	255
EFB-2 (Right)	F2	Z	256
FMC 1	M1	A	300
FMC 2	M2	B	301
FMC	MD	A/B	300 / 301
HFDR L	H1	T	340
HFDR R	H2	U	344
MCDU 1			220
MCDU 2			221
MCDU 3			222
Printer		P	223
OAT	YC		
Cabin Term 1	T1	1	374
Cabin Term 2	T2	2	375
Recorder		X	157
Send via SAT		S	307/173
Send via VHF		V	
Send via HF		H	340/344
Send via VDR		V	251/252/253
Send to Ground		G	
SDU 1	S1	Q	307
SDU 2	S2	R	173
SDU	SD	Q/R	307/173
TAWS	TA	W	310

ATTACHMENT 8
ISO CHARACTER SET REFERENCE

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
b_4	b_3	b_2	b_1	b_5	0	1	0	1	0	1	0	1
0	0	0	0		00 NUL	10 DLE	20 SP	30 0	40 @	50 P	60 `	70 p
0	0	0	1		01 SOH	11 DC1	21 !	31 1	41 A	51 Q	61 a	71 q
0	0	1	0		02 STX	12 DC2	22 "	32 2	42 B	52 R	62 b	72 r
0	0	1	1		03 ETX	13 DC3	23 #	33 3	43 C	53 S	63 c	73 s
0	1	0	0		04 EOT	14 DC4	24 $	34 4	44 D	54 T	64 d	74 t
0	1	0	1		05 ENQ	15 NAK	25 %	35 5	45 E	55 U	65 e	75 u
0	1	1	0		06 ACK	16 SYN	26 &	36 6	46 F	56 V	66 f	76 v
0	1	1	1		07 BEL	17 ETB	27 '	37 7	47 G	57 W	67 g	77 w
1	0	0	0		08 BS	18 CAN	28 (	38 8	48 H	58 X	68 h	78 x
1	0	0	1		09 HT	19 EM	29)	39 9	49 I	59 Y	69 i	79 y
1	0	1	0		0A LF	1A SUB	3A *	3A :	4A J	5A Z	6A j	7A z
1	0	1	1		0B VT	1B ESC	3B +	3B ;	4B K	5B [	6B k	7B {
1	1	0	0		0C FF	1C FS	2C ,	3C <	4C L	5C \	6C l	7C |
1	1	0	1		0D CR	1D GS	2D -	3D =	4D M	5D]	6D m	7D }
1	1	1	0		0E SO	1E RS	2E .	3E >	4E N	5E ^	6E n	7E ~
1	1	1	1		0F SI	1F US	2F /	3F ?	4F O	5F _	6F o	7F DEL

NUL	Null, or all zeros	DC1	Device control 1
SOH	Start of heading	DC2	Device control 2
STX	Start of text	DC3	Device control 3
ETX	End of text	DC4	Device control 4
EOT	End of transmission	NAK	Negative acknowledge
ENQ	Enquiry	SYN	Synchronous idle
ACK	Acknowledge	ETB	End of transmission
BEL	Bell, or alarm	CAN	Cancel
BS	Backspace	EM	End of medium
HT	Horizontal tabulation	SUB	Substitute
LF	Line feed	ESC	Escape
VT	Vertical tabulation	FS	File separator
FF	Form feed	GS	Group separator
CR	Carriage return	RS	Record separator
SO	Shift out	US	Unit separator
SI	Shift in	SP	Space
DLE	Data link escape	DEL	Delete

ATTACHMENT 9
ENVIRONMENTAL TEST CATEGORIES

The latest version of RTCA DO-160 applies.

RTCA DO-160C Section	Test	Level
4.0	Temperature and Altitude	A2
5.0	Temperature Variation	B
6.0	Humidity	A
7.0	Shock	YES
8.0	Vibration	B
9.0	Explosion	X
10.0	Waterproofness	X
11.0	Fluids Susceptibility	X
12.0	Sand and Dust	X
13.0	Fungus Resistance	X
14.0	Salt Spray	X
15.0	Magnetic Effect	A
16.0	Power Input	A
17.0	Voltage Spike	A
18.0	Audio Frequency Conducted Susceptibility	Z
19.0	Induced Signal Susceptibility	Z
20.0	Radio Frequency Susceptibility	U
21.0	Emission of Radio Frequency Energy	Z
22.0	Lightning Induced Transient Susceptibility	A3C3
23.0	Lightning Direct Effects	N/A
24.0	Icing	X

APPENDIX A
THE CMU MARK 2 AND ITS POSITION IN CNS/ATM

A-1 Introduction

CNS/ATM requires aircraft to have seamless Data Link Services and interoperable Applications (ground based and airborne). The concept of the CMU Mark 2 is to provide Data Link service access to the on-board Data Link Applications through various subnetworks to their peer systems on the ground. Initially, the CMU Mark 2 will be a replacement of conventional ACARS MU's (724/724B) with growth in memory, processor, and I/O for future enhancements, protocols, applications and the ATN router using peer to peer protocols.

A-2 The World Today

The CMU Mark 2 will initially perform as an ACARS Management Unit (MU). This provides the channel through which all character based and bit-oriented applications are transmitted to and from the ground. VHF (AM-MSK at 2400 bps) and SATCOM are the two ACARS subnetworks available to date. HF, however, should join them soon as it is well into its proving trials. On the ground side, ARINC, SITA, Avicom Japan, Mascom and other Data Service Providers (DSP) are currently involved in conveying and processing messages and providing the link to and from the peer system (ATC, airline host, maintenance base, etc.). Because ACARS is not a peer to peer network, like ATN, the CMU Mark 2 does not act like an entry point for a communication "pipe". It does subnetwork header switching/processing in order to adapt the on-board message structure to the one used for the air-to-ground link, to determine the most appropriate subnetwork based upon multiple criteria (availability or cost, just to name a few) or to distribute the messages on-board, when needed. In communications nomenclature, it acts more like a bridge than a router. On the ground side such conversions may also take place.

A-3 The World with CNS/ATM and Utilizing ATN

This is the environment the CMU Mark 2 has been designed to transition to. Internally, the CMU Mark 2 comprises not only the ACARS functions such as ARINC Specifications 618/619 protocols and AOC End System functions such as OOOI reports and others, but also - and foremost - the ATN router. In some aircraft it may also host ATC applications.

This creates additional capability options within the CMU Mark 2 as follows:

a) ATN Router

In the ATN Router configuration the CMU Mark 2 hosts the Open System Interconnection (OSI) Router, i.e. the Layer 3 suite of protocols (connectionless IS-ES, interdomain routing) and all the Layer 2 datalink protocols (ARINC Specifications 429 & 646) required to be linked to the on-board peripherals (FMC, CMC, ACMS, and others; (Figures A1 and A2) and subnetworks like VHF Data Radio (VDR), HF and SAT. Consequently, any peripheral which uses the CMU Mark 2 as router acts as its own “communication end system” and thus has to contain the OSI communication stack required to support it’s OSI application. According to "OSI theory", this would be the most elegant system design.

In short: Peripheral = Application End System AND Communication End System.

b) ATN End-System

If the CMU Mark 2 hosts the ATN end-system it "encapsulates" the OSI communication and interfaces to the peripherals via a specialized transport layer (Layer 4) protocol. To perform this function the CMU Mark 2 contains the "full" OSI communication stack as required for the applications which reside in the peripherals as well as some of the router protocols (since there is no external IS to ES connection no s/w has to be installed in that area). Since the application end system (on-board peer) resides within the peripheral the file has to be forwarded. Here, ARINC Specification 656 comes into play. It provides some sort of lean transport protocol which interfaces directly to the datalink layer, thus eliminating much of the burden OSI protocols would impose onto the peripheral.

In short: Peripheral = Application End System; CMU Mark 2 = ATN Communication End System.

c) Peer Applications and Data Manager

ATC End Systems applications for CNS/ATM were considered when growth potential was determined. If ATC applications reside within the CMU Mark 2, then data, parameters and the like need to be derived from those peripherals where they are gathered. In order to provide the service of requesting and delivering information between peripherals and the CMU Mark 2 a special application has to be installed at both ends: a Data Manager (DM). Like in option b) there must be some sort of link between those peers of the DM. Again, ARINC Specification 656 performs the transport. The impact to the peripheral has been kept minimal, the major share of the burden of the implementation of additional applications has been put onto the CMU Mark 2.

In short: CMU Mark 2 = Application End System AND ATN Communication End System; Peripheral = Data Back-End.

These three options have been collaboratively developed within the FMS, CMU Mark 2 and FMS/CMU Interface Subcommittees/Working Groups and are being documented primarily in ARINC Specification 656. All of the various options may potentially be found in the variety of aircraft currently in service depending upon the capabilities of the LRU's involved. Consequently, the reader has to be aware that the CMU Mark 2 Levels describe the actual capability and characteristics of the CMU Mark 2.

APPENDIX A
THE CMU MARK 2 AND ITS POSITION IN CNS/ATM

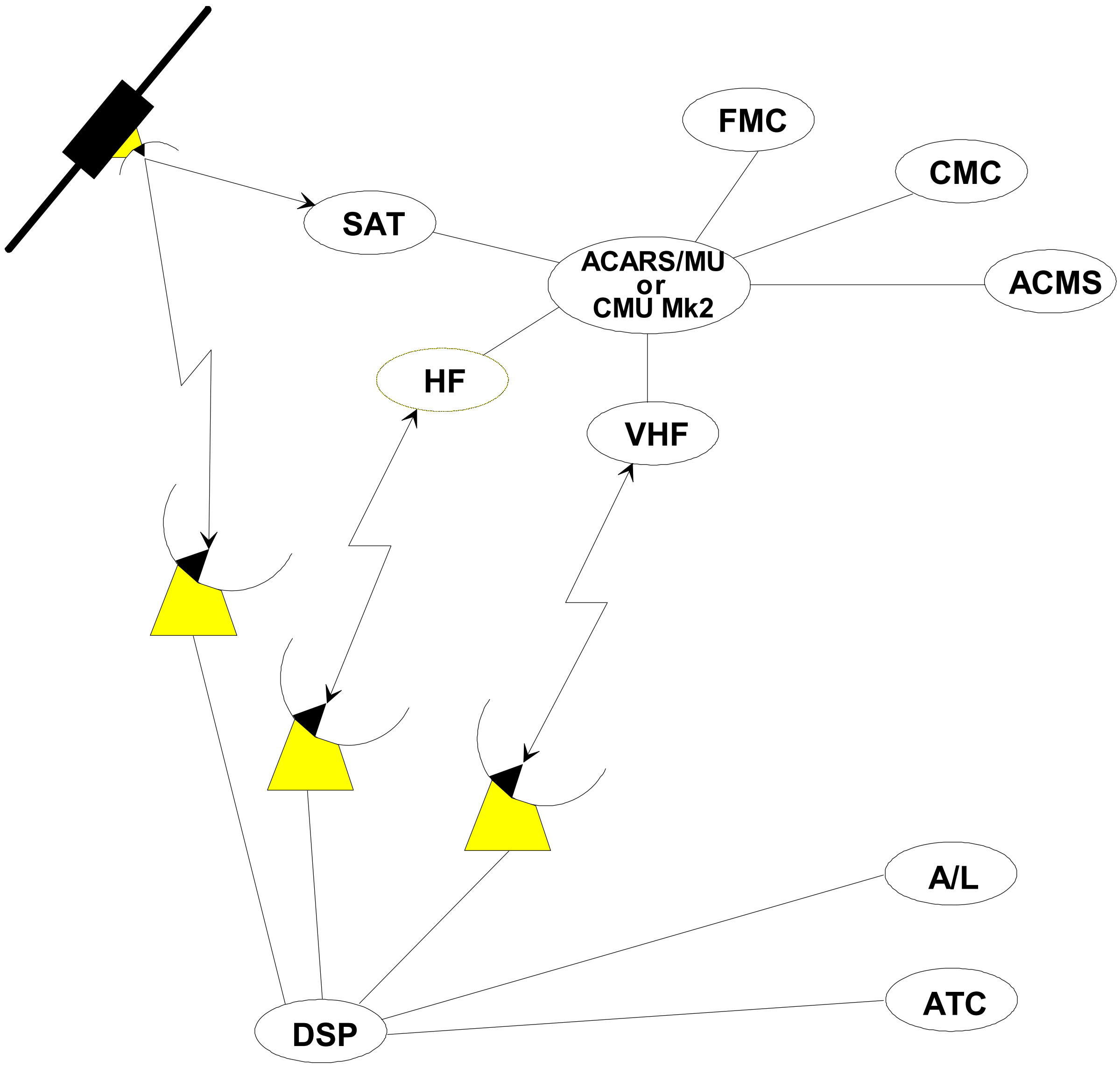


Figure A-1 - The World Today

APPENDIX A
THE CMU MARK 2 AND ITS POSITION IN CNS/ATM

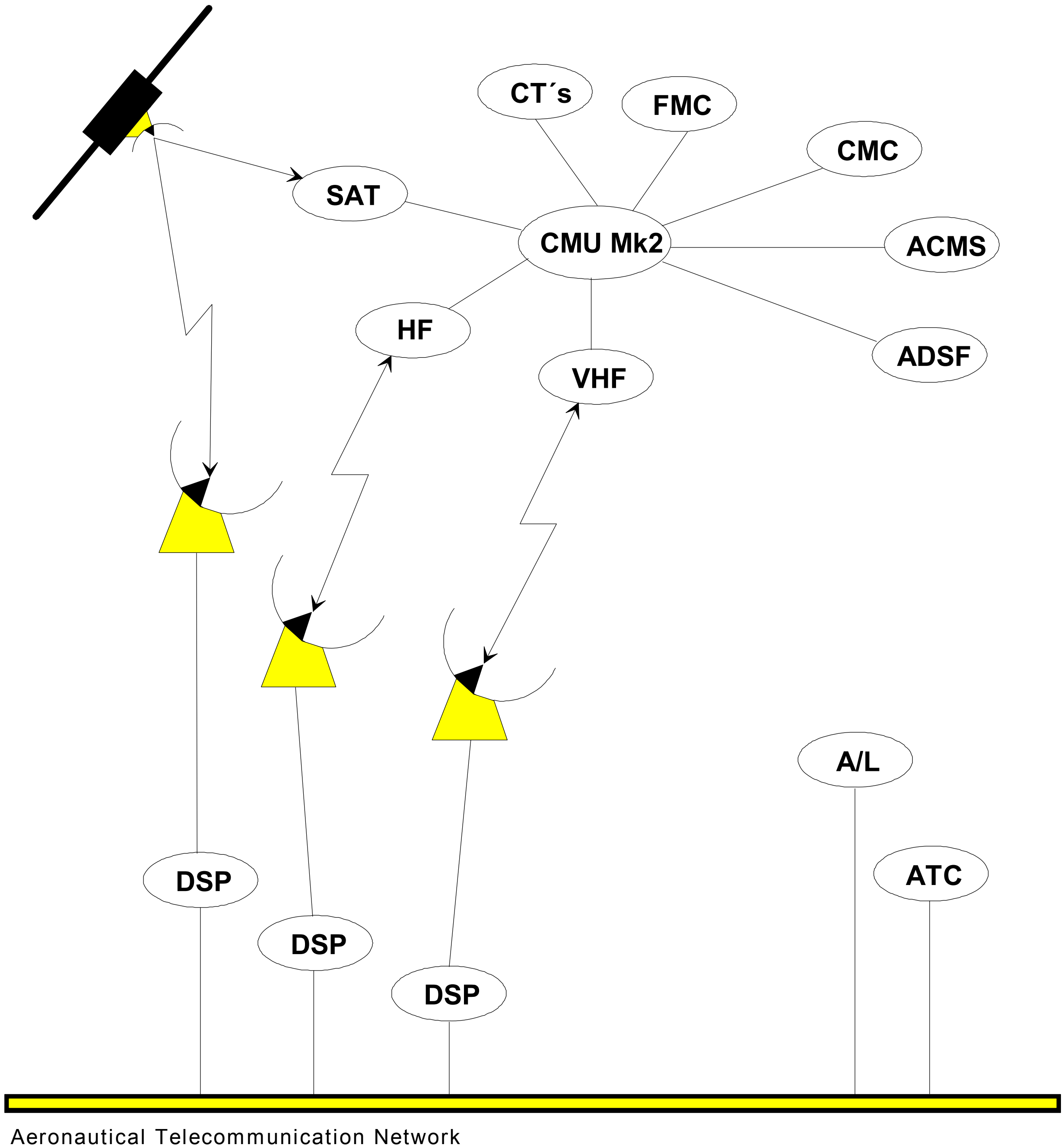
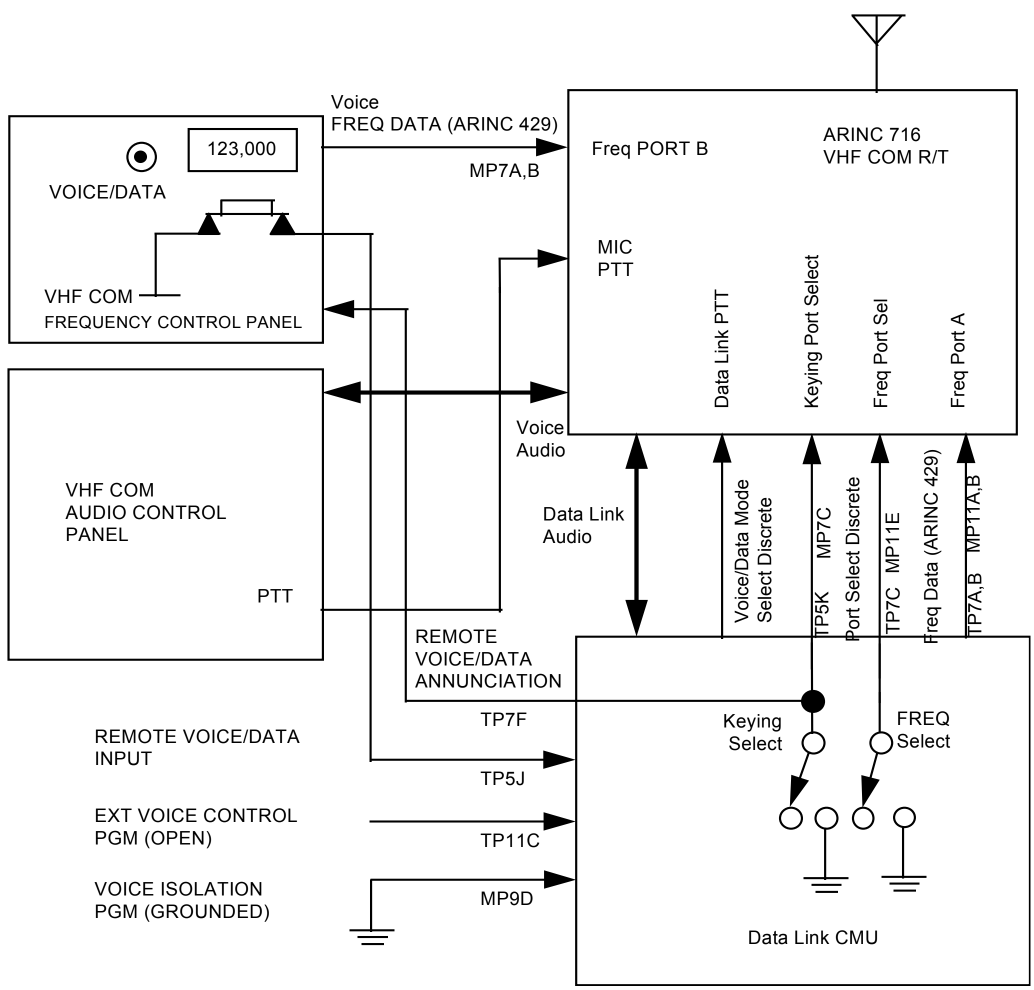


Figure A-2 - The World With ATN

APPENDIX B
ARINC 716 VHF VOICE CONFIGURATION

The diagram below shows a possible configuration for shared Data/Voice use of an ARINC 716 VHF COM transceiver (or an ARINC 750 VHF COM Transceiver operating in the ARINC 716 mode). The transceiver is tuned to the channel selected on the VHF COM control panel for voice communications and to the channel defined in the CMU Mark 2 for data communications. Voice operations using this transceiver should typically only occur when VHF 1 or VHF 2 has failed. The arrangements indicate that the CMU Mark 2, when installed, has ultimate control over the VHF radio frequency and mode. To prevent downgrading the VHF radio certification level, it is recommended that the CMU Mark 2, protect the radio from interference due to a CMU Mark 2 malfunction. This protection should be at level of integrity equal to, or higher than, the VHF radio (improbable failure rate). It may be noted that either or both CMU Mark 2 units may be removed from the aircraft without compromising the availability of the VHF transceiver for voice communications.



APPENDIX C
REFERENCED DOCUMENTS

The latest versions of the following documents apply to the development of equipment initialized to meet ARINC Characteristic 758.

1. RTCA/DO-160 EUROCAE ED-14 “Environmental Conditions and Test Procedures for Airborne Equipment”
2. RTCA/DO-223 “MOPS for Aircraft Management (CM) Equipment”
3. RTCA/DO-219 “MOPS for ATC Controller/Pilot Data Link Communications (CPDLC)”
4. RTCA/DO-178 EUROCAE ED-12 - Software Considerations in Airborne Systems and Equipment Certification
5. RTCA/DO-212 - Automatic Dependent Surveillance (ADS)
6. RTCA Report “Required Communications Performance Standards”
7. RTCA Task Force 2 Final Report “Transition to Digital Communications”
8. RTCA Task Force 3 Final Report “Free Flight Implementation”
9. **ARINC Report 413A:** *Guidance For Aircraft Electrical Power Utilization and Transient Protection*
10. **ARINC Specification 429:** *Mark 33 Digital Information Transfer System (DITS)*
11. **ARINC Report 600:** *Air Transport Avionics Equipment Interfaces*
12. **ARINC Report 604:** *Guidance for Design and Use of Built-In Test Equipment (BITE)*
13. **ARINC Report 607:** *Design Guidance for Avionic Equipment*
14. **ARINC Specification 608A**: *Design Guidance for Avionics Test Equipment, Part 1 System Definition*
15. **ARINC Report 609:** *Design Guidance for Aircraft Electrical Power Systems*
16. **ARINC Report 610A:** *Guidance for Use of Avionics Equipment and Software in Simulators*
17. **ARINC Report 615**: *Airborne Computer High Speed Data Loader*
18. **ARINC Specification 618**: *Air-Ground Character-Oriented Protocol Specification*
19. **ARINC Specification 619:** *ACARS Protocols For Avionic End Systems*
20. **ARINC Specification 620**: *Data Link Ground System Standard and Interface Specification*
21. **ARINC Specification 622:** *ATS Data Link Applications Over ACARS Air-Ground Network*
22. **ARINC Specification 623:** *Character-Oriented Air Traffic Service (ATS) Applications*
23. **ARINC Report 624:** *Design Guidance for Onboard Maintenance System*
24. **ARINC Report 625:** *Industry Guide for Test Program Set (TPS) Quality Management*
25. **ARINC Specification 626:** *Standard ATLAS for Modular Test*
26. **ARINC Report 627:** *Programmers Guide for SMART Systems Using ARINC 626 ATLAS*
27. **ARINC Specification 631**: *VHF Digital Link (VDL) Mode 2 Implementation Provisions*

APPENDIX C
REFERENCED DOCUMENTS

28. **ARINC Characteristic 635:** *HF Data Link Protocols*
29. **ARINC Report 651:** *Design Guidance for Integrated Modular Avionics*
30. **ARINC Report 652:** *Guidance for Avionics Software Management*
31. **ARINC Specification 656:** *Avionics Interface Definition for Flight Management and Communications Management Functions*
32. **ARINC Report 660A:** *CNS/ATM Avionics, Functional Allocation and Recommended Architectures*
33. **ARINC Specification 664:** *Aircraft Data Network (Parts 1-8)*
34. **ARINC Characteristic 702A**: *Advanced Flight Management Computer System*
35. **ARINC Characteristic 724B:** *Aircraft Communications Addressing and Reporting System (ACARS)*
36. **ARINC Characteristic 739**: *Multi-Purpose Control and Display Unit*
37. **ARINC Characteristic 739A**: *Multi-Purpose Control and Display Unit*
38. **ARINC Characteristic 740:** *Multiple-Input Cockpit Printer*
39. **ARINC Characteristic 741:** *Aviation Satellite Communication System*
40. **ARINC Characteristic 743A:** *GNSS Sensor*
41. **ARINC Characteristic 744:** *Full Format Printer*
42. **ARINC Characteristic 744A:** *Full Format Printer With Graphic Capability*
43. **ARINC Characteristic 745:** *Automatic Dependent Surveillance*
44. **ARINC Characteristic 748:** *Communications Management Unit (CMU)*
45. **ARINC Characteristic 750:** *VHF Data Radio (VDR)*
46. **ARINC Characteristic 753:** *HF Data Link System*
47. **ARINC Characteristic 755:** *Multi-Mode Landing System*
48. **ARINC Characteristic 756**: *GNSS Navigation and Landing System (GNLS)*
49. **ARINC Characteristic 757:** *Cockpit Voice Recorder (CVR)*
50. **ARINC Characteristic 758:** *Communications Management Unit (CMU) Mark 2*
51. **ARINC Characteristic 760:** *GNSS Navigation Unit (GNU)*
52. **ARINC Characteristic 761:** *Second Generation Aviation Satellite Communication System, Aircraft Installation Provisions*
53. FAA Notice 8110.50 “Guidelines for Airworthiness Approval of Airborne Data Link Systems and Applications”
54. FAA C/SOIT Package B - Oceanic Data Link Applications
55. FAA C/SOIT Package C - Aeronautical Telecommunications Network (ATN) Services
56. FAA C/SOIT Package E - Near Term Data Link Applications
57. SAE 922003 Certification of Airborne Data Link Equipment
58. SAE ARP4791 Human Engineering Recommendations for Data Link Systems
59. ICAO Aeronautical Telecommunication Network (ATN) Standards and Recommended Practices (SARPs), Amendment 76 to Annex 10 to the Chicago Convention, Fall 2001
60. ICAO VDL SARPs

APPENDIX C
REFERENCED DOCUMENTS

61. ICAO 9705 Manual of Technical Provisions for the Aeronautical Telecommunications Network (ATN), Third Edition-2001
62. ICAO 9705 Manual of Technical Provisions for the Aeronautical Telecommunications Network (ATN), Third Edition-2001
63. ISO 7498 Information Technology-Open Systems Interconnection-Basic Reference, Basic Model
64. ISO 8073 Information Technology-Open Systems Interconnection-Protocol for providing the Connection Mode transport service
65. ISO 8208 Information Technology- Data Communications-X.25 Packet layer protocol for Data terminal Equipment
66. ISO 8327 Information Technology-Open Systems Interconnection-Connection Oriented Presentation Protocol Specification
67. ISO 8473 Information Technology-Protocol For providing The Connectionless-Mode Network Service: Protocol Specification
68. Ref 70 ISO 8602 Information Technology-Protocol For providing The OSI Connectionless-Mode Transport Service
69. ISO 8823 Information Technology-Open Systems interconnection-Connection Oriented Presentation Protocol specification
70. ISO 9542 Information processing Systems-Telecommunications and information exchange between Systems-End System to Intermediate System Routing Exchange Protocol for Use in conjunction with the protocol providing the Connectionless-Mode Network service
71. ISO 9596 Information Processing Systems-Open Systems Interconnection-Common Management Information Protocol
72. ISO 10747 Information Technology- Telecommunications and Information Interchange between Systems-Protocol for exchange of Inter-Domain Routing Information among intermediate Systems to support forwarding of ISO 8473 PDUs

APPENDIX D
ACRONYMS

A/V	Aural/Visual Alert
AAC	Aeronautical Administrative Communications
ACARS	Aircraft Communications Addressing and Reporting System
ACF	ACARS Convergence Function
ACMS	Airplane Condition Monitoring System
ACSE	Association-Control-Service-Element
ADL	Airborne Data Loader
ADLP	Airborne Data Link Processor
ADS	Automatic Dependent Surveillance
ADS-B	Broadcast Automatic Dependent Surveillance
ADSP	ADS Panel
AEEC	Airlines Electronic Engineering Committee
AEIT	Aircraft Equipment Interoperability Test
AFMC	Advanced Flight Management Computer System
AFN	ATS Facility Notification
AIDS	Aircraft Integrated Data (Recording) System
AMSS	Aeronautical Mobile Satellite Services
ANP	Actual Navigation Performance
AOA	ACARS over AVLC
AOC	Aeronautical Operational Communications
APC	Aeronautical Passenger Communications
APM	Aircraft Personality Module
APPS	Applications
APU	Auxiliary Power Unit
AQP	Avionics Qualification Program
ARINC	Aeronautical Radio, Inc.
ATC	Air Traffic Control
ATE	Automatic Test Equipment
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSC	Air Traffic Services Communications
AVLAN	Avionics LAN
AVLC	Aviation VHF Link Control
AVPAC	Aviation VHF Packet Communication
BITE	Built-In Test Equipment

APPENDIX D
ACRONYMS

BOP	ARINC 429 Bit Oriented Protocol (Williamsburg)
BP	Bottom Plug (ARINC 600 Connector)
CAA	Civil Aviation Administration
Cab Term	Cabin Terminal
CATT	CNS/ATM Transition Team
CCITT	International Telegraph and Telephone Consultative Committee
CDTI	Cockpit Display of Traffic Information
CDU	Control & Display Unit
CFDS	Centralized Fault Display System
CFIB	CMU/FMC Information Broker
CL	Connectionless Mode
CLNP	CL Network Protocol
CLNS	Connectionless Network Service
CLTP	CL Transport Protocol
CLTS	CL Transport Service
CM	Context Management
CMA	Common Mode Analysis
CMC	Central Maintenance Computer
CMD	Command
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CMISE	CMIS Element
CMU	Communication Management Unit
CNS	Communications, navigation, and surveillance
CPDLC	Controller/Pilot DL Communications
CRC	Cyclic Redundancy Check
CSMA	Carrier Sense Multiple Access
CVR	Cockpit Voice Recorder
DCDU	Dedicated Control & Display Unit
dc	Direct Current
DFDAU	Digital Flight Data Acquisition Unit
DFS	Digital Frequency Selection
DGNSS	Differential GNSS
DITS	Digital Information Transfer System
DL	Data Link
DM	Data Manager

APPENDIX D
ACRONYMS

DMF	Data Management Function
DMU	Data Management Unit
EDMS	Electronic Data Management System
EEPROM	Electrically Erasable Programmable Read Only Memory
EFIS	Electronic Flight Instrumentation System
EICAS	Engine Indication Crew Alert System
EIU	EFIS/EICAS Interface Unit
ELAN	Ethernet LAN
EMI	Electromagnetic Interference
ES	End System
EUROCAE	European Organization for Civil Aviation Electronics
FAA	Federal Aviation Administration
FANS	Future Air Navigation Systems
FDDI	Fiber Distributed Data Interface
FIN	Airline Fleet Identifier Number
FIR	Flight Information Region
FIS	Flight Information Service
FMC	Flight Management Computer
FMS	Flight Management System
FoM	Figure of Merit
FWC	Flight Warning Computer
GA (Gen Av)	General Aviation
GIU	Gatelink Interface Unit
GLS	GNSS-based Landing System
GLU	GNSS-based Landing Unit
GNLS	GNSS Navigator and Landing System
GNLU	GNSS Navigator and Landing Unit
GNSS	Global Navigation Satellite System
GNU	GNSS Navigator Unit
GPBOP	General Purpose Bit Oriented Protocol, ARINC 429
GPS	Global Positioning System
GPU	Ground Power Unit
GRNDS	Grounds
GW	Gate Way
HF	High Frequency
HFDL	HF Data Link

APPENDIX D
ACRONYMS

HFDR	HF Data Radio
HFDU	HF Data Unit
HS Physical	High Speed 429 or 10-Base T (Ethernet)
Hz	Hertz
I/O	Input/Output
IATA	International Air Transport Association
IC	Integrated Circuit
ICAO	International Civil Aviation Organization
ICD	Interface Control Drawing
ID	Identifier
IDRP	Interdomain Routing Protocol
IDU	Link Data Unit
INS	Inertial Navigation System
IOC	Internet Operations Center
IP	Internetwork Protocol
IRS	Inertial Reference System
IS	Intermediate System
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISOPA	ISO Protocol Architecture
ITU	International Telecommunication Union
JAA	Joint Aviation Authorities
k	Kilo (1,000)
LAAS	Local Area Augmentation System
LAN	Local area network
LME	Link Management Entity
LOC	Location Identifier
LOS	Loss Of Signal
LRU	Line Replaceable Unit
M	Mega (1,000,000)
MAC	Medium Access Control
MCDU	Multipurpose Control & Display Unit
MCP	Mode Control Panel
MCU	Modular Concept Unit
MD	Management Domain
MGMT	Management

APPENDIX D
ACRONYMS

MIB	Management Information Base
MIDS	Management Information Definition Statement
MIS	Management Information Service
MMR	Multi-Mode Landing System Receiver
MO	Managed Object
MODEM	Modulator/Demodulator
MOPS	Minimum Operational Performance Standards
MP	Middle Plug (ARINC 600 Connector)
MSK	Minimum Shift Keying
MTBR	Mean Time Between Removals
MTBUR	Mean Time Between Unscheduled Removals
MU	Management Unit
N/A	Not Applicable
NDA	Non-developmental Aircraft
NIC	New Installation Concept
NM	Network Management
NOTAM	Notice to Airmen
NVM	Non-volatile Memory
OEM	Original Equipment Manufacturer
OLAN	Onboard LAN
OMD	Onboard Maintenance Documentation
OMS	Onboard Maintenance System
OOOI	Out-Off-On-In Message (ACARS)
OSI	Open Systems Interconnection
PBX	Private Branch Exchange
PC	Personal Computer
PDC	Predeparture Clearance
PDL	Portable Data Loader
PDN	Public Data Network
PDU	Protocol Data Unit
PGM	Program
PICS	Protocol Implementation Conformance Statement
PSDN	Packet Switched Data Network
PTT	Push-to-Talk
PVTI	Position/Velocity/Time Indicator
PWR	Power

APPENDIX D
ACRONYMS

QOS	Quality of Service
RAM	Random Access Memory
RCP	Required Communications Performance
RD	Routing Domain
RDF	Routing Domain Format
RDFD	RDF Domain [Flag]
RF	Radio Frequency
RFI	Radio Frequency Interference
RMP	Required Monitoring Performance
RNP	Required Navigation Performance
ROSE	Remote Operation Service Element
RP	Routing Information Exchange Protocol
RSVD	Reserved
RTA	Required Time of Arrival
RVSM	Reduced Vertical Separation Minimal
SAE	Society of Automotive Engineers
SAL	System Address Label
SARPS	Standards and Recommended Practices
SATCOM	Satellite Communication System
SATP	Simple Application Transfer Protocol
SCAT	Special Category
SDAC	System Data Acquisition Concentrator
SDI	Source/Destination Identifier
SDU	Satellite Data Unit
SELCAL	Selective Calling
SM	Systems Management
SMGCS	Surface Movement Guidance and Control System
SMI	Standard Message Identifier
SN	Subnetwork
STBY	Standby
TP	Top Plug (ARINC 600 Connector)
TP4	Transport Protocol Class 4
TWIP	Terminal/Enroute Weather Information for Pilots
U/L	Upper Layer (OSI Layers)
UHF	Ultra High Frequency
UTC	Universal Time Coordinate

APPENDIX D
ACRONYMS

Vac	Volt alternating current
Vdc	Volt direct current
VDL	VHF Digital Link
VDR	VHF Data Radio
VER	Version Identifier
VHF	Very High Frequency
429W	ARINC 429 Williamsburg Protocol
WAAS	Wide Area Augmentation System
WAN	Wide Area Network
WX	Weather
XPDR	Transponder

APPENDIX E
DOCUMENT HISTORY

Status	Date	Change Description
Draft 5	Sept 6, 1996	Updated according to CMU Subcommittee meeting recommendations July 17-18, 1996 in Tiburon, California.
Draft 4	June 21, 1996	Updated according to comments provided by CMU S/C May 14-15, 1996 in Paris, France and follow-up comments in ad hoc CMU Working Group May 29-31, 1996 in Seattle, Washington.
Draft 3	April 18, 1996	Updated according Mar 12-14 New Orleans Meeting comments. Updated acronym list. Updated interconnect with segregated busses, added connector diagrams, updated architectures and descriptions, rewrite to HF Interface section, added ATN information, added 429 output word definitions, added Configuration Database (APM), added VHF Voice Drawing, add CNS/ATM White paper, updated Simulator and Test descriptions.
Draft 2	Feb 23, 1996	Updated according Jan 15-16 MLB Meeting comments. Updated overall styles for a more ARINC look and language adjustments (shalls, etc). Levels in Chapter 4 made to be "incremental". Significant update to Chapter 5 text, especially VHF and discretes. Update to Rear interconnect, including isolation of some functions.
Draft 1/ Strawman #4	Dec 20, 1995	Updated according to Nov 15-17 Atlanta Meeting comments. Chapter 4 Changes - significant rewrite and outline changes to create "CMU LEVELS". Added Data Management Function. Chapter 5 - primarily outlined changes to separate air/ground side. Updated APM Function, interface and added sample memory map. Inserted new System Architecture diagrams. Incorporated Allied Signal inputs on Pinouts. Corrected some X-references and heading errors. NO CHANGES made related to DUAL ARCHITECTURE.
Strawman #3	Oct 6, 1995	Updated Chapters 1, 2, and 3 according to Sep 12-13 San Diego Meeting. Inserted Harris inputs on ATN Net MGMT. Inserted Allied Signal inputs on partitioning and CMU options. Included ARINC 600 pinouts. Misc updates to chapter 5 in some rough areas. Updated reference doc list. Created two new Word 6 styles: Action Item and Revisions for "blame management".
Strawman #2	Sep 1, 1995	Updated Chapters 1, 2, 3, and 4 according to Aug 15, 16 Ad Hoc Meeting. Added new proposal material in Section 6.7 regarding ARINC 610 Simulation.
Strawman #1	Aug 4, 1995	Made additional formatting changes, mostly related to section numbering method. Changed Mark II to Mark 2. Cleaned up various sections so they are at least readable. Created a different style [ref] to insert cross references.
Strawman	July 28, 1995	Initial Integration with Sextant CMU Mark 2 Strawman following initial CMU Mark 2 Working Group meeting. Considerable reorganization of document structure and development of a AEEC.DOT template for support.
Strawman	March 17, 1995	Updated after meeting review in Chicago (Allied, Collins, Aerospatiale, Delta) Moved Date with draft Revision to hold constant Created new Section 5 - GLUE - pulling things from old 4 and 5
Strawman	Feb 15, 1995	Revised Outline after Collins, Allied joint review. Raw 748 text added into more or less appropriate section, but not reviewed.
Strawman	Feb 8, 1995	Initial Strawman outline, prepared by Collins, contained outline only

APPENDIX F
MIL-STD-1553B INTERFACES IN THE CMU

This paper presents a short background on MIL-STD-1553B for those who may not be familiar with the military standard, analyzes some architectures in which dual buses are of interest, and recommends some changes in the wording of the characteristic to eliminate confusion.

F-1 1553 Basics Electrical Characteristics

MIL-STD-1553B specifies a two-conductor, shielded, jacketed cable. Distributed capacitance, nominal characteristic impedance, and cable attenuation are all specified. Terminals are connected to the data bus using either direct or transformer coupling. Transformer coupling is preferred, and is illustrated in Figure F-1.

The MIL-STD-1553B data bus is a differential line with line-to-line voltages in the range $\pm$ 18 to 27 volts peak-to-peak. Data is encoded using Manchester II bi-phase level. The 1553B data bus operates at 1 megabit per second. Each word is 20 bits long, including a 3-bit sync waveform, 16 data bits, and a parity bit. MIL-STD-1553B defines three types of words: Command Word (CW), Status Word (SW), and Data Word (DW). These are illustrated in Figure F-2.

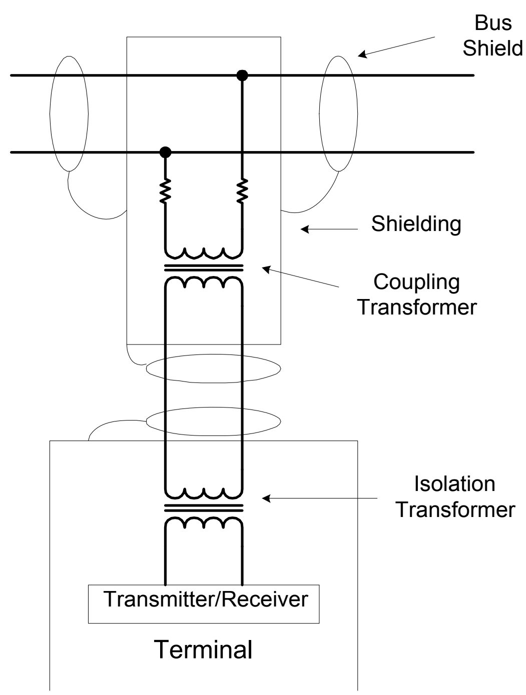


Figure F-1 – Data Bus Interface Using Transformer Coupling

APPENDIX F
MIL-STD-1553B INTERFACES IN THE CMU

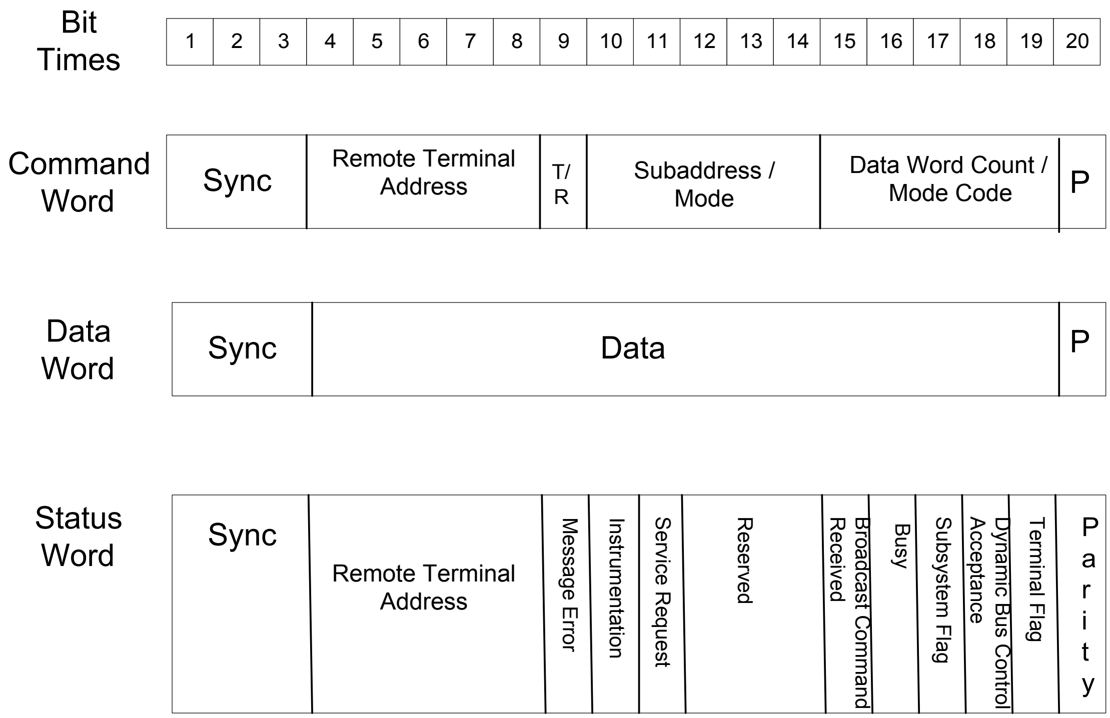


Figure F-2 – MIL-STD-1553B Word Formats

F-2 Protocol

The 1553B data bus is a digital, command/response, time division multiplexed data bus. There are three types of terminals:

1. The Bus Controller (BC) initiates information transfers on the data bus.
2. A Bus Monitor (BM) receives bus traffic and extracts selected information for use later. A BM is not directly addressed, listens to all transmissions on the bus, and never transmits.
3. All terminals that are not a BC or BM are Remote Terminals (RT). An RT is adressed by its 5-bit RT Address. The CMU is always configured as an RT.

All information transfers are initiated by the BC, using a Command Word addressed to the one or two RTs participating in the transfer. Each addressed RT responds with a Status Word before it transmits Data Words, or after it has received Data words. A message consists of one or more CW, one or more SW, and from 1 to 32 DW. Content of the data contained in the message DW is identified by a subaddress field in the message CW. Various types of information transfer formats are illustrated in Figure F-3.

APPENDIX F
MIL-STD-1553B INTERFACES IN THE CMU

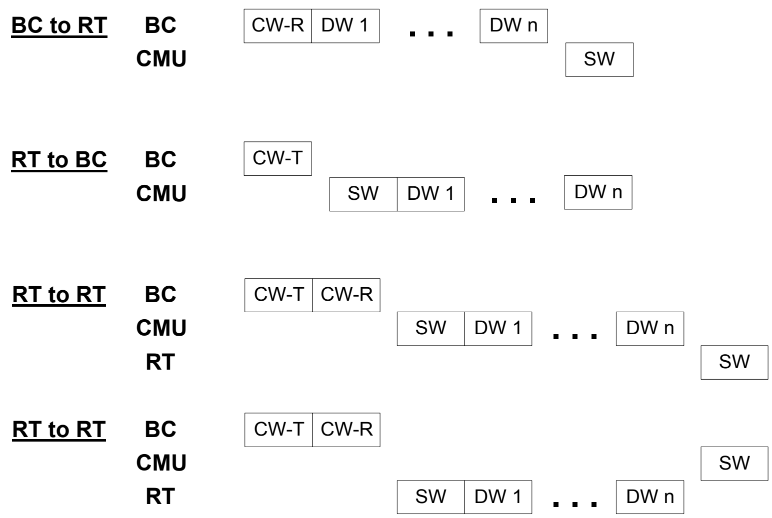


Figure F-3 – MIL-STD-1553B Information Transfer Formats

F-3 Redundancy

MIL-STD-1553B recommends the use of the dual standby redundancy technique for integrating mission avionics. This technique provides for two data bus outputs from the terminal with the following characteristics:

- Minimum of 45 dB isolation between the data buses.
- Only one data bus can be active at any given time.
- If while operating on a command, a terminal receives another command on the other data bus, it shall reset and respond to the new command on the data bus on which the new command is received.

Note that while this technique utilizes two data buses, there is only one RT, with a single RT address.

F-4 How many Buses in the CMU?

This section addresses system integration issues. A number of data bus architectures are presented and analyzed with respect to 1553 data bus requirements in the CMU.

- Case I: Single standby redundant data bus.
- Case II: Two standby redundant data buses with a single CMU.
- Case III: Two standby redundant data buses with dual CMUs.

F-5 Case I: Single Standby Redundant Data Bus (Figure F-4)

This architecture is typical of smaller aircraft which have a minimal number of redundant LRUs. Each RT is connected to both Bus #1 and Bus #2 in a standby redundant architecture as specified in MIL-STD-1553B. Such an architecture typically has a backup bus controller (BBC) which picks up for the BC in the event of a failure.

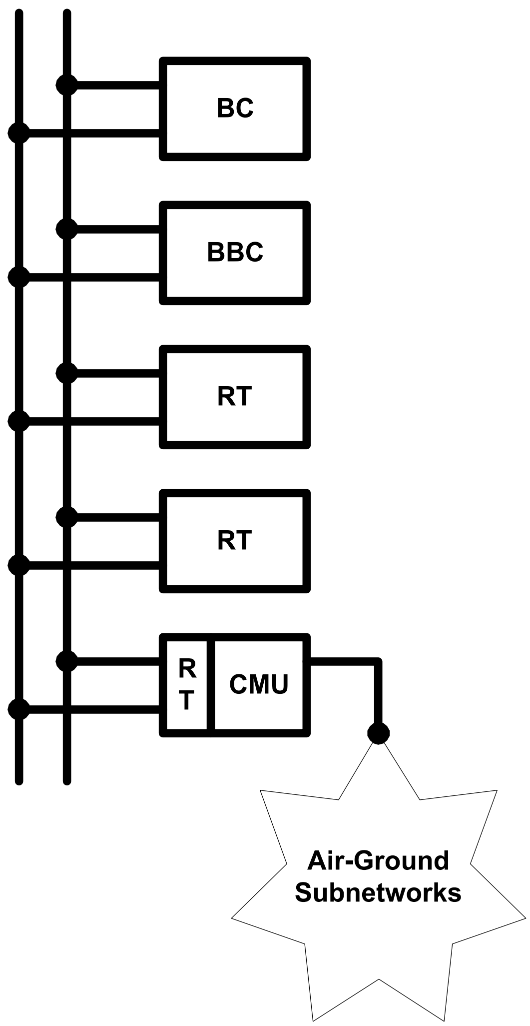


Figure F-4 – Single Standby Redundant Data Bus

F-6 Case II: Two Standby Redundant Buses with a Single CMU

This architecture is illustrated in Figure F-5. Such an architecture is typical of larger aircraft where nearly all LRUs are redundant. The benefit of this architecture is that the Left set of standby redundant buses could be lost entirely, but the aircraft could maintain operation using the Right set of standby redundant buses. However, a CMU with only one set standby redundant buses could connect only to the Right or the Left side, not both. Loss of the bus set to which the CMU is connected would result in the loss of the CMU function.

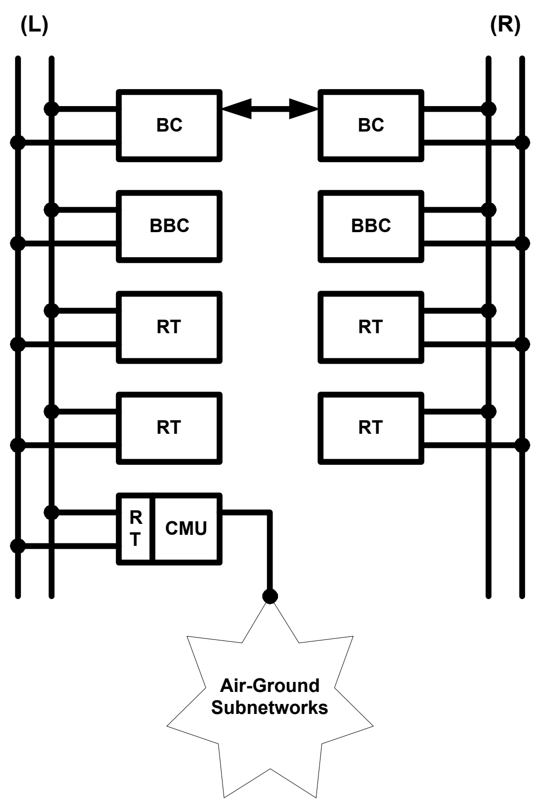


Figure F-5 – Dual Standby Redundant Data Bus with Single CMU

APPENDIX F
MIL-STD-1553B INTERFACES IN THE CMU

One solution is to provide two Remote Terminals in a single CMU, as illustrated in Figure F-6. Each RT would contain dual standby redundant buses. One RT would be connected to the Left bus set, and the other to the Right bus set. In the event of loss of the Right bus set, CMU functionality would be maintained through the Left bus set. This solution requires allocation of six more pins at the external connector for the two additional 1553 buses. The CMU would also be required to include a second set of RT hardware.

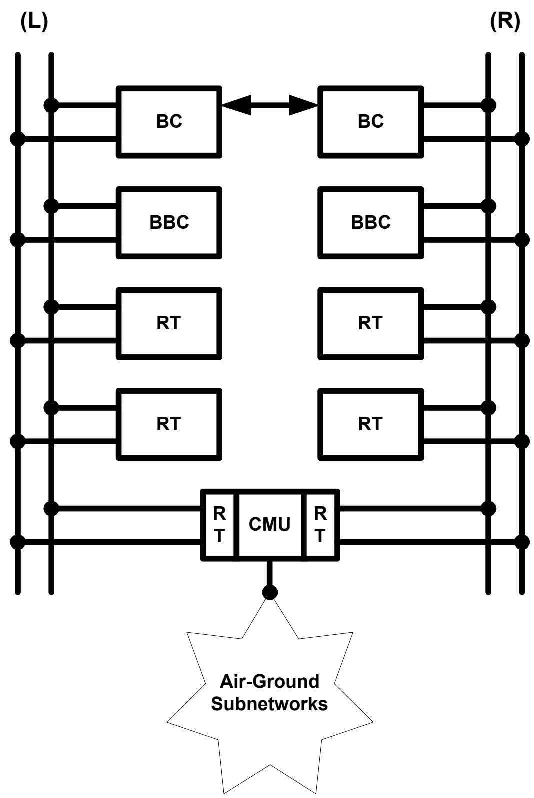


Figure F-6 – CMU with Dual RTs

A variation of the above solution is to provide two RTs in the CMU, but no bus redundancy. While this solution does not require additional I/O pins, it still requires a second set of RT hardware in the CMU. It also is non-compliant with the dual standby redundancy technique recommended by MIL-STD-1553B.

F-7 Case III: Two Standby Redundant Buses with Dual CMUs (Figure F-7)

Adding a second CMU easily solves the problems with the Case II architecture. Each CMU is connected to one standby redundant bus set. The two CMUs are synchronized by means of a crosstalk bus. In the event of loss of either the Left or Right data bus set, CMU functionality is maintained by the CMU connected to the operational data bus set.

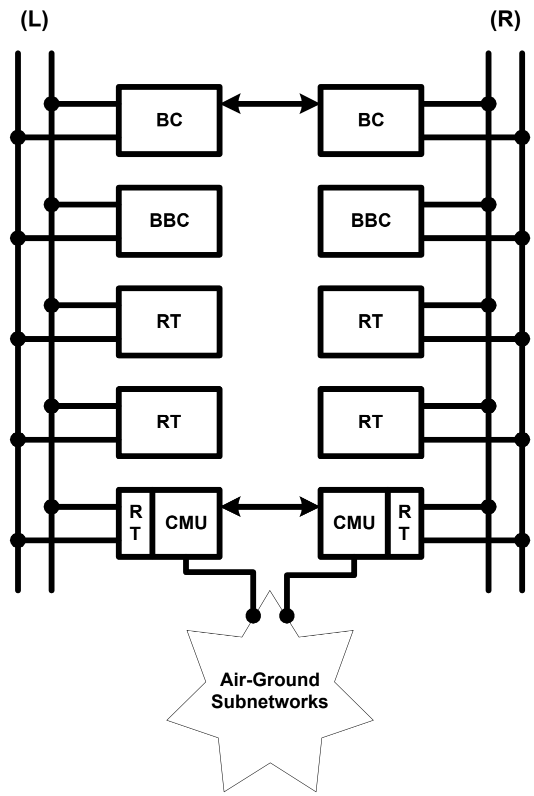


Figure F-7 – Dual Data Buses with Dual CMUs

F-8 Conclusion

Neither Case I nor Case III presents a problem to a CMU with a single RT and dual standby redundant buses. Case II presents a problem only because an architecture which uses multiple redundancy in data buses and LRUs is attempting to get by with a single CMU. A system integrator should add a second CMU to the Case II architecture, thus bringing it to a Case III and eliminating the problem.

A single RT with dual standby redundant 1553B data buses is sufficient for the CMU to operate in all reasonable avionics architectures. No changes should be made to the technical specification in ARINC 758. However, some clarifications should be made to the wording in ARINC 758.

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SUPPLEMENT 1
TO
ARINC CHARACTERISTIC 758

COMMUNICATIONS MANAGEMENT UNIT (CMU) MARK 2

Published: February 13, 1988

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: October 14, 1997

A. PURPOSE OF THIS DOCUMENT

This Supplement introduces the addition of the VDR Mode A interface and operation, Simulator support, and Second Generation SATCOM support. The Level B application definition was revised.

B. ORGANIZATION OF THIS SUPPLEMENT

In the past, changes introduced by a Supplement to an ARINC Standard were identified by vertical change bars with an annotation indicating the change number. Electronic publication of ARINC Standards has made this mechanism impractical.

In this document, vertical change bars in the margin will indicate those areas of text changed by the current Supplement only.

C. CHANGES TO ARINC CHARACTERISTIC 758 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete listing of the changes to the document introduced by this Supplement. Each change is identified by the section number and the title as it will appear in the complete document. Where necessary, a brief description of the change is included.

1.6 Interchangeability

Editorial revision.

2.3 Power

Editorial revision.

2.8 IMA Packaging Considerations

Editorial revision.

2.9.5 Standard Discrete Input

Editorial revision.

3.1.5 Data Bus Architecture

Editorial revision.

3.2.1.1 Operational Transitional Considerations

Editorial revison.

3.3 Certification and Partitioning Considerations

Editorial revision.

4.1 Functional Description

Added Service Functional Capability Level 0.1.

4.2 Level 0 and Level 0.1 Data Link Functions

Added “and Level 0.1” to Section title. Added Level 0.1 definition and commentary.

4.2.1 ACARS “Network” Function

Updated to include Level 0.1 and ARINC 761.

4.2.2 ACARS VHF Sub-network Function

Rewrote section. Deleted 716 from Section title. Expanded definition of ACARS operation support. Deleted first commentary and second paragraph. Moved third paragraph, commentary, and fourth paragraph to Section 4.2.2.1.

4.2.2.1 ARINC 716 Support

Created new section with text from Section 4.2.2.

4.2.2.2 ARINC 750 Mode A Functions (Level 0.1)

Added new Section.

4.2.3 ACARS SATCOM Sub-network Function

Added ARINC 761 reference. Moved second paragraph and commentary to Section 4.2.3.1.

4.2.3.1 ACARS ARINC 741 SATCOM Sub-network Function

Created new Section with text from Section 4.2.3.

4.2.3.2 ACARS ARINC 761 SATCOM Sub-network Function

Added new Section.

4.2.4 ACARS HF-Sub-network Function

Editorial revision.

4.3.2 ATN Join/Leave Events

Editorial revisions.

4.3.3 ATN Internetworking Function

Editorial revision.

4.5.1 ACARS End System Function

Added ARINC 761 protocol interfaces.

4.6 Level B Application Functions

Revised third paragraph. Added commentary.

4.6.1 ACARS Convergence Function (ARINC 622)

Editorial revision.

4.6.3.1 Air Traffic Facilities Notification (ARINC 622)

Editoral revisions. Added commentary. Revised third paragraph.

4.6.3.2 CPDLC Function

Editorial revision. Revised text in third paragraph with CMU/FMC interface conditions so that the avionics may be able to obtain information from the FMC.

4.6.3.3 ADS-A Function

Editorial revision. Changed “ADS” to ADS-A” in title and text. Revised text in third paragraph to indicate that FMC interface implementations, other than ARINC 656, are possible.

4.10.2.1 Identification Data

Editorial revision.

4.12.3 Validation and Automated Correction

Editorial revisions.

4.17 MU Simulator Functions

Added new Section.

5.1.1 ACARS Air/Ground Protocols

Added third paragraph on VHF Mode A. Deleted references to ARINC Characteristic 741P2 and ARINC Specification 635 in last paragraph.

5.1.4 ATN Air/Ground Protocols

Deleted references to ARINC Specifications 637 and 638 in third paragraph.

5.1.4.2.1 Full Stack

Editorial revisions.

5.1.4.2.2 Fast Byte Stack or ICAO U/L

Deleted references to ARINC Specification 638 and the ATN manual in the second paragraph.

5.1.4.2.3 Short Stack

Deleted reference to ARINC Specification 638 in fourth paragraph. Editorial revisions.

5.1.4.3 ATN - Network/Sub-network Layer Protocol

Deleted reference to ARINC Specification 637.

5.1.4.4 ATN - Internetworking

Deleted reference to ARINC Specification 637.

5.2.1 VHF Radio Interface

Added radio configuration item b. and re-lettered remaining items. Added two paragraphs on ARINC Characteristic 750 interface.

5.2.1.1.1 ARINC 716 Modem Interface

Added text on bit 15 of the CMU status word in first paragraph. Deleted last paragraph and commentary.

5.2.1.1.5 Remote Voice/Data Mode Annunciation Ouput Discrete

Editorial revision.

5.2.1.1.7 DFS ARINC 429 Tuning Interface

Added 750 in two places in commentary. Added “and 25 kHz voice channel frequencies” to commentary.

5.2.1.1.11 8.33 kHz Tuning Discrete Input Pin

Added new Section.

5.2.1.2 ARINC 750 VHF Transceiver (Level 0.1)

Added “(Level 0.1)” to section title. Added new text on ARINC 750 VHF transceiver and air/ground protocol support.

5.2.1.2.1 Physical Interface

Changed section title and replaced text with new text.

5.2.1.2.2 Link Layer Interface

Added new section. Former Section 5.2.1.2.2 changed to Section 5.2.1.2.3.

5.2.1.2.3 ARINC 750 Status Exchange

Formerly Section 5.2.1.2.2. Added Labels 172 and 377.

5.2.1.2.4 ARINC 750 Control And Configuration

Added new Section.

5.2.1.2.4.1 VDR Configuration

Added new Section.

5.2.1.2.4.2 VDR Protocol Initialization

Added new Section.

5.2.1.2.4.2.1 VDR Mode A (ACARS Protocol)

Added new Section.

5.2.1.2.4.2.2 VDR Modes 1 and 2 (AVPAC Protocol)

Added new Section.

5.2.1.3 VHF Loadable Options

Added “ARINC 716” and reference to Section 5.2.1.1.11 in second paragraph. Deleted third paragraph. Revised fourth paragraph and added commentary.

5.2.3 HF Data Link ARINC 753 Interface

Editorial revisions.

5.2.3.1 HFDL Air/Ground Messages

Editorial revision.

5.2.3.4 HF Data Link Fault Status Determination

Changed reference in last paragraph.

5.2.3.6 HF in Voice Reporting

Editorial revisions in first paragraph and commentary.

5.2.3.7 HFDR Master/Slave Determination Logic

Changed “Altering” to “Alerting” in commentary.

5.2.3.8 HFDR/HFDU BITE Support

Editorial revision in subparagraph a.

5.2.5 Transponder

Editorial revisions. Changed “different” to “similar” in last paragraph.

5.2.6 ARINC 761 STU Interface

Added new Section.

5.2.6.1 SATCOM Data 2

Added new Section.

5.2.6.2 SATCOM Data 3

Added new Section.

5.2.6.3 STU as an End System

Added new Section.

5.3.2.4 Comm Data Bus #4

Added STU and 761 to table.

5.3.2.6 Comm Data Bus #6

Added STU and 761 to table.

5.3.2.7 Comm Data Bus #7

Added STU and 761 to table.

5.3.3.2 DFS/UTC Output Data Bus

Changed “or” to “and” in last paragraph.

5.3.3.5 ICAO 24-bit Aircraft Address Word Definition

Editorial revisions.

5.3.3.6 Status Output Word #1 (270)

Editorial revisions.

5.3.6 ARINC 646 ELAN Interfaces

Added simulator support in commentary.

5.3.15.1 ATN - ES/IS Protocol

Editorial revision.

5.5 ARINC 610A Simulator Interface

Added new Section.

5.5.1 Installed in Simulator Discrete Input

Added new Section.

5.5.2 Simulator ARINC 429 Interface

Added new Section.

5.5.2.1 Simulator ARINC 429 Physical Layer

Added new Section.

5.5.2.2 Simulator ARINC 429 Link Layer

Added new Section.

5.5.3 Simulator ARINC 646 (Ethernet) Interface

Added new Section.

5.5.3.1 Simulator ARINC 646 Physical Layer

Added new Section.

5.5.3.2 Simulator ARINC 646 Link Layer

Added new Section.

ATTACHMENT 1-8 - DUAL INSTALLATIONS

Editorial revisions.

ATTACHMENT 2-2 - STANDARD INTERWIRING

Added 761 source/sink, 8.33 kHz tuning for VHF transceiver, and simulator support provisions. Editorial changes made.

ATTACHMENT 2-3 - REAR CONNECTOR INSERT LAYOUT

Table 1, Added STU.

Table 2, Added simulator/615A data loader support and 8.33 kHz tuning discrete.

ATTACHMENT 4 - HF DATA RADIO CONTROL LOGIC TABLES

Table 4-1, Added “HFDR 1 Label 270 SSM bits” column. Added bottom three rows. Revised second and third rows.

Table 4-2, Added “HFDR 2 Label 270 SSM bits” column. Added bottom three rows.

Table 4-3, Added “HFDR 1 Label 270 SSM bits” column added bottom three rows. Revised second and third rows.

Table 4-4, Added “HFDR 2 Label 270 SSM bits” column. Added bottom three rows. Deleted third row. Reversed fourth and fifth rows.

Table 4-5, Added “HFDR 1 Label 270 SSM” and “HFDR 2 Label 270 SSM” columns. Added third and sixth rows.

Table 4-6, Added “HFDR 1 Label 270 SSM” and “HFDR 2 Label 270 SSM” columns. Added third and sixth rows.

Table 4-7, Editorial revisions.

ATTACHMENT 5 - EXAMPLE OF APM MEMORY MAP

Made identity blocks the same for Tables 5-1 and 5-2.

ATTACHMENT 6 - ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

Table 6-1, Changed XPDR/ICAO #2 Activity Label from “275” to “276”. Added “SDU#3/STU#3” and “SDU#4/STU#4”.

Table 6-2, Editorial changes.

Table 6-4, Editorial changes and revised note 1.

Table 6-8, Changed bit 15 from “Voice Busy” to “Reserved”.

Table 6-9, Changed bit 19 from “SAT Link Available” to “SAT Link Not Available”. Changed bit 28 from “HFDL #1 Master” to “HFDL #1 SSM bits”. Changed bit 29 from “HFDL #2 Master” to “HFDL #2 SSM bits”.

Table 6-10, Revised bit ordering of ICAO 24-bit Aircraft Address Label 214 to be consistent with ARINC 429 Label 275.

Table 6-11, Revised bit ordering of ICAO 24-bit Aircraft Address Label 216 to be consistent with ARINC 429 Label 276.

Table 6-12, Editorial change. Added “STU#1” to bit 23. Added “STU#2” to bit 26.

Table 6-13, Changed bit 11 from “Cabin Terminal 2” to “SDU#3/STU#3”. Changed bit 12 from “Reserved” to “SDU#4/STU#4”. Editorial revisions to notes.

APPENDIX C - REFERENCED DOCUMENTS

Deleted references to ARINC Specifications 637 and 638. Renumbered references. Editorial revisions.

APPENDIX D - ACRONYMS

Editorial revision.

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SUPPLEMENT 2 TO ARINC CHARACTERISTIC 758

COMMUNICATIONS MANAGEMENT UNIT (CMU) MARK 2

Published: July 8, 2005

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: October 24, 2004

A. PURPOSE OF THIS DOCUMENT

This Supplement replaces references to “SATP and Data Management” with references to “CFIB, SNMP, UDP, and IP.” All occurrences of “STU” were changed to be “SDU.”

Level 0.2 Service Functional Capability was added. References and commentary for clarification of the ACARS SATCOM Sub-Network Function were added. Air/Ground Sub-Networks for Level 1 were added.

Commentary concerning the recommended use of ARINC 429 Labels (030 or 047) or ARINC 429 SSM for the DFS ARINC 429 Tuning Interface was added. The VDR System Address Label table was corrected.

Provisions were added for operation with SATCOM SDU’s with optional multi-bearer system (MBS) capability. Up to two SDU’s are supported, using only high-speed ARINC 429 buses (previous low-speed bus options have been eliminated). Provisions are also added to determine the aeronautical service currently being provided by Inmarsat-compatible SDU’s in order to assist the CMU in making routing decisions based upon cost criteria.

The SDU and HFDR Digital ARINC 429 device interfaces for Comm Data buses #4, #6, and #7 were corrected. TAWS was added to General Data Bus #5 and to the onboard routing Labels/Sub-Labels.

This Supplement refines the system architectures that are possible for the CMU. It also introduces the concept of Distributed Application Architecture that has two variants, Dialog Service Interface and Application Service Interface.

The CMU Architectural diagrams in Attachment 1 were revised. The standard interwiring and associated attachments were revised. The rear connector insert diagram pin index coding polarization positions were corrected. Several ARINC Specification 429 Broadcast Word Definitions were updated including the addition of “Label 277 - Output Status Word #3” and “Label 352 - Maintenance Word #3.”

The section on Join/Leave Events has been expanded for clarity. Details have been included for triggers to the Join/Leave Events.

Data link recording has been added to the Characteristic. Included is information for triggering recording as well as the types of messages to be recorded.

Interfaces to Electronic Flight Bags have been defined.

The references and acronyms lists were updated. Appendix F - MIL-STD 1553B Interfaces in the CMU was added.

B. ORGANIZATION OF THIS SUPPLEMENT

In the past, changes introduced by a Supplement to an ARINC Standard were identified by vertical change bars with an annotation indicating the change number. Electronic publication of ARINC Standards has made this mechanism impractical.

In this document, vertical change bars in the margin will indicate those areas of text changed by the current Supplement only.

C. CHANGES TO ARINC CHARACTERISTIC 758 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete listing of the changes to the document introduced by this Supplement. Each change is identified by the section number and the title as it will appear in the complete document. Where necessary, a brief description of the change is included.

2.9.5 Standard Discrete Input

In the third sentence of the first paragraph, “in the "ground" state” was changed to “in the steady state "ground" state”.

A third paragraph was added stating “The maximum input capacitance to ground should be less than 1 microfarad.”

In the second paragraph, first sentence of the COMMENTARY, the word “resistance’s” was changed to “impedances”.

2.9.6 Standard Discrete Input

The first Commentary was changed to state that some Discrete outputs are defined in this document. A caution to the designer was added concerning causes of current spikes.

3.1.1 CMU As End System Architecture

Revised fourth paragraph by replacing references to SATP and Data Management with references to CFIB, SNMP, UDP, and IP.

3.1.2 CMU As Router Architecture

Revised first sentence in fourth paragraph by replacing references to SATP and Data Management with references to CFIB, SNMP, UDP, and IP.

3.1.3 CMU in Distributed Application Architecture (DAA)

Section 3.1.3 was renamed “CMU in Distributed Application Architecture (DAA).” The previous title of this section was “CMU as a Remote Stack (Gateway) Architecture.

Text defining DAA will be introduced in a future supplement.

3.1.4 CMU/FMS As Integrated Architecture

Revised third paragraph by replacing references to SATP and Data Management with references to CFIB, SNMP, UDP, and IP.

3.2.1.1 Operational Transitional Considerations

In 1st paragraph of text, 1st sentence, add “analog” before “voice communications.

4.1 Functional Description

Level 0.2 was added to the table. The terminology for defining Level 1 was revised to describe the new AOA configuration. Added Level 1.1 with a definition. Changed the Level 2 items and the term VDR Mode 2 to VDL Mode 2.

Modified the definition of Level 0.2. Added Level 0.3 with a definition. Added Level 1.2 with a definition. In Level 2 definition, changed Mode 2 to Mode 3.

Added clarifying comments to the first table of the section. The service functional capabilities column is clarified for levels 0.1, 0.2, and 0.3.

The third paragraph of Section 4.1 was eliminated.

4.2 Level 0, 0.1, 0.2, and 0.3 Service Functional Capabilities

New section title to be consistent with table in Section 4.1 and to reflect new contents.

At the very end of Section 4.2 added descriptions of Levels 0.2 and 0.3, as well as a new Commentary.

In the second paragraph of Section 4.2, the last sentence was removed.

Changes were made to items c and d of the Commentary.

4.2.1 ACARS "Network" Function

Amended the items in d. Under item I, changed Level 0 and Level 0.1 items. Added Level 1.

Added further description to item d. In item I, increased interfaces to Levels 0.1 and 0.2.

4.2.2 ACARS VHF Sub-Network

First paragraph adds VDLM2 operation. Item d modified to provide more detail.

4.2.2.1 ARINC 716 Support (Level 0)

New section title.

4.2.2.2 ARINC 618 Mode A Functions (Level 0.1)

New section title.

4.2.2.3 ARINC 618 In An AOA Configuration (Level 0.2)

New section added.

4.2.3 ACARS SATCOM Sub-Network Function

Added references to Sections 5.3.2.4, 5.3.2.6, 5.3.2.7, and ARINC Specification 618. Added the words "up to two" to the second sentence of the first paragraph. Added Commentary.

4.2.3.1 ACARS ARINC 741 SATCOM Sub-Network Function

Deleted Section.

4.2.3.2 ACARS ARINC 761 SATCOM Sub-Network Function

Deleted Section.

4.3 Level 1 Service Functional Capabilities

New section title consistent with the table in Section 4.1.

4.3.2 Air/Ground Sub-Networks

New section added. Remove the "TBD" and replace it with " To be supplied in a future supplement."

4.3.2.1 SATCOM Data Sub-Network Function

New section added. Remove the "TBD" and replace it with " To be supplied in a future supplement."

4.3.2.2 VDL Mode 2 Sub-Network Function

New section added.

4.3.2.3 HFDL RLS Sub-Network Function

New section added. Remove the "TBD" and replace it with " To be supplied in a future supplement."

4.3.3 ATN Join/Leave Events

New section number. Formerly Section 4.3.2. Section 4.3.3 has been completely rewritten.

4.3.4 ATN Internetworking Function

New section number. Formerly Section 4.3.3.

4.3.5 Multiple Network Function (ATN/ACARS)

New section number. Formerly Section 4.3.4. The term "Gatelink" was updated to"RF Gatelink" to clarify that the reference is to an RF wireless LAN rather than the previously intended IR link.

4.4 Level 2 Service Functional Capabilities

New section title consistent with the table in Section 4.1.

4.5 Level A Application Functional Capabilities

New section title consistent with the table in Section 4.1.

4.5.1 ACARS End System Function

Changed "STU" to "SDU." Deleted last two sentences.

4.6 Level B Application Functional Capabilities

New section title consistent with the table in Section 4.1.

4.6.3.2 CPDLC Function

1st paragraph, 2nd sentence, add "analog" before "voice communications."

In the last sentence of the first paragraph the following was added at the end ", (and optionally, by RTCA DO-280/ERUOCAE ED-110)."

4.6.3.3 ADS-A Function

The second paragraph of Section 4.6.3.3 was modified.

4.7 Level C Application Functional Capabilities

New section title consistent with the table in Section 4.1.

4.8 Level D Application Functional Capabilities

New section title consistent with the table in Section.

Section 4.8 was modified.

4.10.1 Simple Network Management Protocol (SNMP) and CMU/FMC Information Broker (CFIB)

New section title. Replaced references to Data Management with references to SNMP and CFIB.

4.10.3 Dynamic Data

In second Section a., replaced references to Data Management with references to CFIB and SNMP. The last paragraph of Section 4.10.3 was edited for readability.

4.13.1 Data Link Services Flight Deck Support

In 4th paragraph, add “Analog” before “VHF Voice Control,” and also before “Frequency.”

4.13.2.1 ATC Uplink Discrete Output

Section 4.13.2.1 was deleted.

4.13.4 VHF Analog Voice Flight Deck Support

The word “Analog” was added to the tile. The term “Voice” was replaced by “Analog Voice” in five places.

4.18 Data Link Recording

A major new section and its subsections has been added to describe what data is recorded, and what events trigger the recording.

A paragraph was added under Section 4.18 introducing Data Link recording.

4.18.1 Data To Be Recorded

New Section added.

4.18.2 Events That Trigger Recording

New Section added.

4.18.3 Multiple Recording Events

New Section added.

5.1.1 ACARS Air/Ground Protocols

Paragraph 4 is added to describe ACARS over AVLC.

5.1.4 ATN Air/Ground Protocols

Added explanation details to paragraphs one and two. Deleted paragraph three.

5.1.4.2 ATN Protocol Stack

Section title changed. Old text was deleted and replaced. New text addresses two levels of service.

5.1.4.2.1 Internet Communications Service

Section title changed. The old section was deleted and replaced by new text that more fully and accurately describes the service.

5.1.4.2.2 Upper layer Communications Service

Section title changed. The old section 5.1.4.2.2 First Byte Stack or OCAO U/L was deleted and replaced by new text that more fully and accurately describes the service.

5.1.4.2.3 Short Stack

Section entirely deleted.

5.1.4.3 ATN Network/Sub Network Layer Protocol

Section entirely deleted.

5.1.4.4 ATN Internetworking

Section entirely deleted.

5.1.4.5 ATN VHF Protocol

Section entirely deleted.

5.2.1 VHF Radio Interface

Changed the last paragraph to indicate the primitive PR_Set.

Change item b. to read: Radio configuration (750 Mode 0/Mode A/Mode 2).

Change item d. to read: Air/ground protocols and speeds, including MSK ACARS, AVLC Mode2 and 3.

Text added to middle of last paragraph.

5.2.1.1.1 ARINC 716 Modem Interface

Second sentence was removed.

5.2.1.1.2 Voice/Data Mode Input Discrete

Eliminate superfluous phrase at the end of Section 5.2.1.1.2, “TP-7F on the aircraft side of the connector.”

5.2.1.1.4 Voice/Data Mode Annunciation Output Discrete

In the second paragraph the end of the first sentence was changed from “ Voice mode” to “Analog Voice mode”.

5.2.1.1.7 DFS ARINC 429 Tuning Interface

Added “Analog” before Voice” in text of second paragraph of Commentary.

Added new third paragraph to Commentary concerning the recommended use of ARINC 429 Labels 030 or 047 or ARINC 429 SSM.

5.2.1.1.10 Voice Channel Frequency Control Program Pin

Add “analog” before “voice” in the text.

In the second sentence change “provide Voice” to “provide Analog Voice”. In the third sentence change “VHF Voice tuning” to “VHF Analog-Voice tuning”.

5.2.1.1.11 8.33 kHz Tuning Discrete Input Pin

Add “analog” before “voice” in text.

5.2.1.2 ARINC 750 VHF Transceiver

Deleted Level 0.1 from the title. Added verbage in first paragraph in regard to the PR_Set. Changed AVPAC to AVLC 2 places.

In second paragraph change “level 1” to “level 0.2 or higher” and in the last sentence of the second paragraph, change “level 2” to “level 1”.

5.2.1.2.2 Link Layer Interface

Added a new Paragraph 2 that discusses CMU interface to a Mode A VDR.

In the table of Section 5.2.1.2.2, the SAL column, “250” is changed to “251,” “251” is changed to “252,” and “252” is changed to “253.”

5.2.1.2.2.1 BOP Version 1

New Section title was inserted int the existing material.

In the table of Section 5.2.1.2.2.1, for the O12 Option, Change “No” to “Yes” in the Default column.

5.2.1.2.2.2 BOP Version 3

New Section added.

5.2.1.2.3 ARINC 750 Status Exchange

Add “Analog” before “Voice” in text.

5.2.1.2.4 ARINC 750 Control and Configuration

Phrase added after the words Section 3 and 5.

5.2.1.2.4.1 VDR Configuration

Clarifying words added in paragraphs two and three. Add “Analog” before “Voice” in text.

5.2.1.2.4.2.1 VDL Mode A (ACARS Protocol)

Change in Section title from “VDR” to “VDL

Changes made in paragraphs one, two, three, and the commentary.

Add “analog” before “voice” in text.

5.2.1.2.4.2.2 VDL Mode 2 (AVLC Protocol)

Change in Section title from “VDR” to “VDL”. Changes were made to both paragraphs.

5.2.1.3 VHF Loadable Options

Add “Analog” before “Voice” in text.

5.2.2 SDU ARINC 741 Interface

Separated second paragraph into two parts. Added new fourth paragraph on SDUs output Label 271 Join/Leave messages to indicate their current air/ground connectivity status.

In paragraph three of Section 5.2.2, the first sentence was modified and a second sentence was added.

5.2.4 Gatelink Interface

A note was added at the end of Section 5.2.4.

5.2.6 ARINC 761 SDU Interface

Changed all occurrences of “STU” to “SDU.” Revised first paragraph and added Commentary to clarify that the CMU can support a total of two SDU’s. Added three new paragraphs for the case of SDUs which support more than one type of air/ground bearer system.

The last paragraph of Section 5.2.6 was modified for SATCOM use.

5.2.6.1 SATCOM Data 2

Changed all occurrences of “STU” to “SDU.” Added reference to ARINC Characteristic 741.

5.2.6.2 SATCOM Data 3

Added reference to Section 5.2.2.2.

5.2.6.3 SDU as an End System

Changed tilte from “STU” to “SDU.” Added reference to Section 5.2.2.3.

5.3.2.4 Comm Data Bus #4

Changed input #4A from “SDU/STU #1” to “SDU #1.” Changed input #4B from “HFDR #2 & SDU/STU #2” to “HFDR #2.” Changed input #4C from “HFDR/STU #1” to “HFDR #1.”

5.3.2.5 General Data Bus #5

Changed input #5B from “Spare” to “TAWS.”

5.3.2.6 Comm Data Bus #6

Changed input #6D from “SDU/STU #1” to “SDU #1.”

5.3.2.7 Comm Data Bus #7

Changed input #7C from “SDU/STU #2” to “SDU #2.”

5.3.2.8 Comm Data Bus #8

The table in Section 5.3.2.8 was modified to include Electronic Flight Bags.

Change the table in Section 5.3.2.8 as shown below:

Bus	Source	Spec	Pins
Output #8	CMU Mark 2	758	MP-10J,K
Input #8A	EFB-1 (formerly ELS)	--	MP-10C,D
Input #8B	Cabin	746	MP-08G,H
Input #8C	EFB-2 (formerly Spare)	--	TP-14A,B
Input #8D	Spare	--	TP-14C,D

5.3.3.3 Subsystem Identifier Word Definition (172)

Added new second paragraph and associated commentary concerning the use of bit 17 to indicate in support of the satellite multi-bearer system (MBS) protocol.

After the Commentary of Section 5.3.3.3, the following sentence was added: "On all outputs, setting bit 18 to the 1 state indicates that the CMU supports the new Signal Quality Parameter scale, as defined in ARINC Characteristic 750-4 Attachment 10, Sections A10.4.7 and A10.5.10.

5.3.3.5 ICAO 24-bit Aircraft Address Word Definition

Deleted first sentence in second paragraph and consolidated remainder of paragraph into first paragraph. Added "nor can it have all bits set (i.e., octal 7777 7777)" to sub-paragraph b.

5.3.3.6 Status Output Word #1 (270)

Added reference to ARINC 741, Part 2, Section 4.7.3.3, for the specification of the Join/Leave message for the ARINC 741 SDU, and for the ARINC 761 Inmarsat Aero-I SDU in the first Commentary.

5.3.9 Optional MIL-STD-1553B Interface

Further clarification of the MIL-STD-1553 interface was added. Specifically, to note the dual redundant status of the lines and the use of the third pin for cable shield termination.

5.3.10 CMU/Recorder Inteface

Section title changed (previously "Cockpit Voice Recorder Interface"). Section 5.3.10 was totally revised. "and the discrete output TP12F" was added at the end of the second sentence. The second paragraph was modified.

A commentary and a new sentence were added at the end of the section.

5.3.10.1 CMU Recorder Discrete Output

New section was added.

5.4.6.6 ATC Uplink Discrete Output

New section added.

5.5.3 Simulator ARINC 664 (Ethernet) Interface

The Section title was changed from 646 to 664 to update the reference of the applicable Ethernet network standard.

5.5.3.1 Simulator ARINC 664 Physical Layer

The Section title was changed from 646 to 664 to update the reference of the applicable Ethernet network standard.

5.5.3.2 Simulator ARINC 664 Link Layer

The Section title was changed from 646 to 664 to update the reference of the applicable Ethernet network standard.

The Physical Layer definitions of ARINC 646 are still valid.

ATTACHMENT 1-2 – CMU AS END SYSTEM ARCHITECTURE

Updated diagram.

ATTACHMENT 1-3 – CMU AS ROUTER ARCHITECTURE

Updated diagram.

ATTACHMENT 1-4 – CMU AS REMOTE STACK (GATEWAY) ARCHITECTURE

Eliminated contents of Attachment 1-4 and changed title to Reserved.

ATTACHMENT 1-5 – CMU/FMS AS INTEGRATED ARCHITECTURE

Updated diagram.

ATTACHMENT 1-6 – ARINC 429 BUSES

Changed input 5B from “Spare” to “TAWS.” Changed the “High speed” below 5D to read “High/Low Speed.”

The diagram in ATTACHMENT 1-6 was modified to show the Electronic Flight Bags (EFB #1 and 2) interfacing to Bus #8.

ATTACHMENT 1-8 – DUAL INSTALLATIONS

Add “Analog” before “Voice” in Figures 1-8b and 1-8c titles.

ATTACHMENT 2-1 – REAR CONNECTOR INSERT DIAGRAM

Corrected the polarization positions of the Index Pins.

ATTACHMENT 2-2 – STANDARD INTERWIRING

Terminology within Specifications 741 and 761 has been normalized to use “SDU” universally. Changed all occurrences of “STU” to “SDU.” Changed TP02C and TP02D source/sink from “741 SDU #1 or 761 STU #1” to “Reserved.” Changed TP14H and TP14J from “Spare” to “TAWS.” Changed MP02K from “Spare” to User Defined (Audio Ground).” Changed MP07H Signal Type from “dc Signal Ground” to “Shield.” Changed MP14E through MP14H Signal Type from “ARINC 429 L In” to “ARINC 429 H or L In.” Changed BP13 from “Spare” to User Defined (Coax).”

Assignment on pin TP12F defined.

On pin TP 12F, the Signal Type is "Discrete Data." "Note 4" is added to the NOTES column.

Note 4 is added at the end of Attachment 2-2.

The source of Comm Link Data Bus # 4A was changed to "741/761 SDU-1."

The source of Comm Link Data Bus # 4B was changed to "SDU-2/HFDR-2."

Pin TP12J has been designated "*ATC Uplink Annunciator.*"

Pins TP14A and TP14B have each been designated "EFB-2 Data Input."

Pins MP10C and MP10D have been designated "EFB-1 Data Input."

Pins MP10J and MP10K have been designated "Data Out for EFB(s)."

ATTACHMENT 2-3 – REAR CONNECTOR INSERT LAYOUT

In Table 1 changed all occurrences of "STU" to "SDU." Revised Tables 1, 2 and 3 to be consistent with revisions to Attachment 2-2. In Table 3 Changed the Cable #12 to read "User Defined" vice "Spare." Cable #13 to read "Spare" vice "Coax."

Assignment on pin TP12F defined.

In Table 1, the spacing of row 14 was repaired and the missing spare block was added.

At TP-02C,D "RSVD" was replaced with "SDU #1."

At TP-02E,F "SDU #2" was added.

The rear connector layout was modified to show EFB-2 on pins TP14A and 14B, and EFB-1 on pins MP10C and 10D.

The table in Attachment 2-3 was modified a shown below:

12	Spare	CMU Crosstalk Data Bus Out A B	*SDU #2* CL Data Bus #7C In A B	*CMU to CVR Data Available*	RSVD #1 Disc Out	RSVD #3 Disc Out	~~***RSVD***~~ **ATC Uplink** #4 Disc Out	RSVD Disc Out Common

ATTACHMENT 4 – HF DATA RADIO CONTROL LOGIC TABLES

In Table 4-7, corrections were made to HFDR 1 Fault Bit 24 and HFDR 2 Fault Bit 25 columns.

ATTACHMENT 5 – EXAMPLE OF APM MEMORY MAP

In Table 5-2 add "Analog" before "Voice" in text.

ATTACHMENT 6 - ARINC SPECIFICATION 429 BROADCAST WORD DEFINITIONS

In Table 6-1, "ARINC 429 Input Port Monitoring" changed "SDU #1/STU #1" and "SDU #2/STU #2" to "SDU#1" and "SDU #2" respectively. Deleted "SDU #3/STU #3" and "SDU #4/STU #4."

In Table 6-1, the activity Label was changed from 276 to 275 for the XPDR/ICAO #2 and EFB-1 and EFB-2 were added.

In Table 6-2, a column named "Comm Output Buses 6,7" was added.

In Table 6-3, "Label 030 - DFS AUTO-TUNE Word" corrected the binary coding for Octal Label 030.

In Table 6-8, "Label 270 - Output Status Word #1" corrected bit 17 to be "HDFL or SATCOM Link Not Available" and added "Analog" before "Voice" in Bit 14.

In Table 6-12, "Label 350 - Maintenance Word #1" changed bit 23 from "SDU #1/STU #1 Input" to "SDU #1 Input (Input Port 4A or 6D)" Changed bit 26 from "SDU #2/STU #2 Input" to "SDU #2 Input Port 4B or 7C.).

In Table 6-13, "Label 351 - Maintenance Word #2" changed bit 11 from "SDU #3/STU #3" to "Reserved Changed bit 12 from "SDU #4/STU #4" to "Reserved." Appended "as defined in Attachment 6-1" to Note 1.

New Table 6-14, "Label 352 - Maintenance Word #3" added.

Zeros were added to the Pad section of the word.

Table 6-16, "Label 172 - Subsystem Identifier Word" was formerly Table 6-15. Zeros were added to the pad section of the word for bits 18-29 and an "X" was entered for bit 17.

Added Note 3 to identify support of multi-bearer systems by setting bit 17 to the 1 state.

Added Note 4.

ATTACHMENT 7 – ONBOARD ROUTING LABELS/SUB-LABELS

Rows were added to ATSU, EFB 1 and 2, HFDR1 and 2, Recorder , sent via HF and TAWS. In the Device Column the second "CMU" entry was changed to "CDU". The Comments column was eliminated from the table.

APPENDIX C – REFERENCED DOCUMENTS

Added ARINC Characteristic 761. Eliminated ARINC Specifications 636 and 646. Added ARINC Specification 637.

Added ICAO 9705. Added ten ISO documents as references.

Added the following statement at the end of Ref 61: "Amendment 76 to Annex 10 to the Chicago Convention, Fall 2001".

Ref 62 was deleted. Ref 64, added "Third Edition 2001" at the end of the reference.

APPENDIX D – ACRONYMS

Updated acronym list.

APPENDIX F – MIL-STD 1553B INTERFACES IN THE CMU

Appendix was added.

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SUPPLEMENT 3
TO
ARINC CHARACTERISTIC 758

COMMUNICATIONS MANAGEMENT UNIT (CMU) MARK 2

Published: January 10, 2011

Prepared by the AEEC

Adopted by the AEEC Executive Committee: October 6, 2010

A. PURPOSE OF THIS DOCUMENT

This Supplement was written to support datalink recording. Additionally, several corrections and additions to ARINC Characteristic 758 are included.

B. ORGANIZATION OF THIS SUPPLEMENT

In this document **blue bold** text is used to indicate those areas of text changed by the current Supplement only.

C. CHANGES TO ARINC CHARACTERISTIC 758 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete listing of the changes to the document introduced by this Supplement. Each change is identified by the section number and the title as it will appear in the complete document. Where necessary, a brief description of the change is included.

4.7.6 ATS Event Recording

The paragraph was modified to include “The CMU Mark 2 should be able to send ATS/ATN information to an onboard recorder”.

5.3.2.4 Comm Data Bus # 4

Table 5.3.2.4-1, Pins Assigned in group # 4, Source column, Input # 4D: CVR was replaced by “Spare”; ARINC Characteristic 757 CVR Standard deleted from the Spec Column.

5.3.2.6 Comm Data Bus # 6

Table 5.3.2.6-1, Pins Assigned in group # 6, Source column, Input # 6A: added “/TCAS # 1” to existing “XPDR #1”.

5.3.2.7 Comm Data Bus # 7

Table 5.3.2.7-1, Pins Assigned in group # 7, Source column, Input # 7B: added “/TCAS # 2” to existing “XPDR #2”.

5.3.2.11 Simulator Interface and CVR Data Bus

This section was added including Table 5.3.2.11-1, Pins Assigned in the Simulator/CVR Group.

5.3.3.9 Maintenance Words

Maintenance data word 352 was added.

5.3.10 CMU/Recorder Interface

Addition of CMU/CVR interface pins MP15C,D; changed low-speed ARINC 429 and low-speed Williamsburg to high-speed, and clarified the recorder should not send ARINC 429 data to the CMU Mark 2.

5.3.10.1 CMU/Recorder Discrete Output

This section was deleted by Supplement 3.

ATTACHMENT 1-2 – CMU as End System Architecture

The footnote in this section was deleted.

ATTACHMENT 1-3 – CMU as Router Architecture

The footnote in this section was deleted.

ATTACHMENT 1-5 – CMU as Integrated Architecture

The footnote in this section was deleted.

ATTACHMENT 1-6 – ARINC 429 Buses

In this section “CVR” was replaced with “Spare” for ARINC 429 Input Bus 4D, and added “CVR” to existing ARINC 429 High speed Simulator Interface bus.

ATTACHMENT 2-2 – Standard Interwiring

For Top Plug pin 12F, the existing signal name “CMU to CVR Data Available” was replaced with “RSVD Discrete Out # 1”.

For Top Plug pin 12G the existing signal name “RSVD Discrete # 1” was replaced with “RSVD Discrete Out # 2”.

For Middle Plug pins 08C and 08D, added TCAS #1 to Source/ Sink column.

For Middle Plug pins 10A and 10B, added TCAS # 2 to Source/Sink column.

For Middle Plug pins 10G and 10H, replaced “757 CVR” with “Spare”, in the Source/Sink column.

For Middle Plug pins 15C and 15D, added “CVR” to signal name and source/sink columns.

ATTACHMENT 2-3 – Rear Connector Standard Interwiring

For Top Plug pin 12F, “CMU to CVR Data Available” was replaced with “RSVD #1 Disc Out”.

For Top Plug pin 12G “RSVD #1 Disc Out” was replaced with “RSVD #2 Disc Out”.

For Middle Plug pins 8C and 8D, added TCAS #1.

For Middle Plug pins 10A and 10B, added TCAS #2.

For Middle Plug pins 10G and 10H, replaced “CVR” with “Spare”.

For Middle Plug pins 15C and 15D, added “CVR”.

ATTACHMENT 6 – ARINC Specification 429 Broadcast Word Definition

For Table 6-2, ARINC Specification 429 Broadcast Output Map, added Maintenance Data Word 352 and “Simulator/CVR Output Bus” column.

For Table 6-4, Label 047 – DFS Auto-Tune Word 8.33 kHz, corrected bits.

For Table 6-7, Label 260 – UTC Date Word, corrected bits.

For Table 6-14, Label 352 – Maintenance Word # 3, corrected bits, corrected EFB-1 and EFB-2, and added Notes 1 through 4.

For Table 6-16, Label 172 – Subsystem Identifier Word, corrected bit.

ARINC Standard – Errata Report

1. Document Title

ARINC Characteristic 758: *Communications Management Unit (CMU) Mark 2*
Publication date: January 10, 2011

2. Reference

Page Number: ______ Section Number: ______________ Date of Submission: ______________

3. Error

(Reproduce the material in error, as it appears in the standard.)

4. Recommended Correction

(Reproduce the correction as it would appear in the corrected version of the material.)

5. Reason for Correction *(Optional)*

(State why the correction is necessary.)

6. Submitter (Optional)

(Name, organization, contact information, e.g., phone, email address.)

Please return comments to fax +1 410-266-2047 or standards@arinc.com

Note: Items 2-5 may be repeated for additional errata. All recommendations will be evaluated by the staff. Any substantive changes will require submission to the relevant subcommittee for incorporation into a subsequent Supplement.

[To be completed by IA Staff]

Errata Report Identifier: ______________ **Engineer Assigned:** __________________________

Review Status: ____

ARINC IA Project Initiation/Modification (APIM)

1.0 Name of Proposed Project **APIM #: _____**

(Insert name of proposed project.)

1.1 Name of Originator and/or Organization

(Insert name of individual and their organization that initiated the APIM)

2.0 Subcommittee Assignment and Project Support

2.1 Suggested AEEC Group and Chairman

(Identify an existing or new AEEC group.)

2.2 Support for the activity (as verified)

Airlines: (Identify each company by name.)

Airframe Manufacturers:

Suppliers:

Others:

2.3 Commitment for Drafting and Meeting Participation (as verified)

Airlines:

Airframe Manufacturers:

Suppliers:

Others:

2.4 Recommended Coordination with other groups

(List other AEEC subcommittees or other groups.)

3.0 Project Scope (why and when standard is needed)

3.1 Description

(Insert description of the scope of the project.)

3.2 Planned usage of the envisioned specification

Use the following symbol to check yes or no below. ☒

New aircraft developments planned to use this specification yes ❑ no ❑

Airbus: (aircraft & date)

Boeing: (aircraft & date)

Other: (manufacturer, aircraft & date)

Modification/retrofit requirement yes ❑ no ❑

Specify: (aircraft & date)

Needed for airframe manufacturer or airline project yes ❑ no ❑

Specify: (aircraft & date)

Mandate/regulatory requirement yes ❑ no ❑

Program and date: (program & date)

Is the activity defining/changing an infrastructure standard? yes ❑ no ❑

Specify (e.g., ARINC 429)

When is the ARINC standard required?
______(month/year)__________

What is driving this date? _______(state reason)_____________________

Are 18 months (min) available for standardization work? yes ❑ no ❑

If NO please specify solution: _________________

Are Patent(s) involved? yes ❑

If YES please describe, identify patent holder: _________________

3.3 Issues to be worked

(Describe the major issues to be addressed.)

4.0 Benefits

4.1 Basic benefits

Operational enhancements yes ❑ no ❑

For equipment standards:

a. Is this a hardware characteristic? yes ❑ no ❑

b. Is this a software characteristic? yes ❑ no ❑

c. Interchangeable interface definition? yes ❑ no ❑

d. Interchangeable function definition? yes ❑ no ❑

If not fully interchangeable, please explain: _________________

Is this a software interface and protocol standard? yes ❑ no ❑

Specify: _________________

Product offered by more than one supplier yes ❑ no ❑

Identify: (company name)

4.2 Specific project benefits (Describe overall project benefits.)

4.2.1 Benefits for Airlines

(Describe any benefits unique to the airline point of view.)

4.2.2 Benefits for Airframe Manufacturers

(Describe any benefits unique to the airframe manufacturer's point of view.)

4.2.3 Benefits for Avionics Equipment Suppliers

(Describe any benefit unique to the equipment supplier's point of view.)

5.0 Documents to be Produced and Date of Expected Result

One/Two Project Papers are expected to be completed per the table below.

5.1 Meetings and Expected Document Completion

The following table identifies the number of meetings and proposed meeting days needed to produce the documents described above.

Activity	Mtgs	Mtg-Days (Total)	Expected Start Date	Expected Completion Date
Document a	*# of mtgs*	*# of mtg days*	*mm/yyyy*	*mm/yyyy*
	*# of mtgs **	*# of mtg days **		
Document b	*# of mtgs*	*# of mtg days*	*mm/yyyy*	*mm/yyyy*
	*# of mtgs **	*# of mtg days **		

* Indicate unsupported meetings and meeting days, i.e., technical working group or other ad hoc meetings that do not requiring IA staff support.

6.0 Comments

(Insert any other information deemed useful to the committee for managing this work.)

6.1 Expiration Date for the APIM

April/October 20XX

For IA staff use only

Date Received: Jan 15, 2010 IA staff : ____________

Potential impact: ______

*(**A**. Safety **B**. Regulatory **C**. New aircraft/system **D**. Other)*

Resolution: _______

Authorized, Deferred, Withdrawn, More Detail Needed, Rejected)

Assigned to SC/WG:________________