ATTACHMENT 19
COMMAND FRAME DATA UNIT (FDU) STRUCTURE AND EXAMPLES

Table 19-4 – Example of Command Frame Data Unit (FDU) Containing a MAC Control Frame Requesting a 5 Pause Quanta (25 millisecond) Delay

BIT	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

V3 Command Frame SOF:

P	0 1 0	X X X X	1 0	0 0	0 1	0 0 0 0 0 0 0 1 0 0	U SAL

V3 Command Frame (Full and Partial) Data Words:

P	0 0 0	0 0 0 0	0 0 0 0 1 0 0 0	1 0 0 0 1 0 0 0	U SAL
P	0 0 1	1 0 1 0	0 0 0 0	0 0 0 0 0 1 0 1	0 0 0 0	U SAL

V3 Command Frame EOF:

P	0 1 1	0 0 0 1	LSB FCS (16-Bit CRC) MSB	U SAL

Where:

GFI Field = X's as placeholder for actual values used over interface (See Table 11-6A of Attachment 11)

Pause Opcode – 16 bit field = 8808 hex

Request Operand – 16 bit field = Pause Time = 5 Pause Quanta = 0005 hex

ATTACHMENT 20
INFORMATION FRAME DATA UNIT (FDU) STRUCTURE AND EXAMPLE

Table 20-1 – Version 3 Information Frame SOF

BIT	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	0 1 0	Reserved	I/C	ARINC 429 Word Count	M/B/U SAL

Where:

P – 32 bit Parity

I/C – Information/Command Frame Identifier Field; 00-Information; 01-Command; 10, 11-Reserved

Word Count Field – 10 bits for an Information Frame – Max Information Frame Size = 2550 bytes

Limit for Bridging = 1500 bytes

M/B/U SAL – Multicast/Bridge/Unique (standard ARINC 429) System Address Label (SAL)

Table 20-2 – Version 3 Information Frame (Full and Partial) Data Words

BIT	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	0 0 0	Destination				LSB	M/B/U SAL
	P	0 0 0	Destination					M/B/U SAL
	P	0 0 0	Source			LSB	MSB Destination	M/B/U SAL
	P	0 0 0	Source					M/B/U SAL
	P	0 0 0	Length/Type LSB	MSB Source				M/B/U SAL
	P	0 0 0	Data		MSB	Length/Type		M/B/U SAL
	P	0 0 0	Data					M/B/U SAL
	P	0 0 0	Data					M/B/U SAL
	P	0 0 0	Data					M/B/U SAL

Where:

P – 32 bit Parity

Destination – 48 Bit MAC Destination Address

Source – 48 Bit MAC Source Address

Length/Type – 16 bit field

Table 20-3 Version 3 Information Frame EOF

BIT	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	0 1 1	0 0 0 0	FCS (32-Bit CRC)			MSB	M/B/U SAL
	P	0 1 1	0 0 0 1	LSB	FCS (32-Bit CRC)			M/B/U SAL

Where:

FCS – Frame Check Sequence, 32-bit CRC for Information Frame

Bit 25 for first half of Information Frame EOF word = 0

Bit 25 for second half of Information Frame EOF word = 1

ATTACHMENT 20
INFORMATION FRAME DATA UNIT (FDU) STRUCTURE AND EXAMPLE

Table 20-4 – Example of Information Frame Data Unit (FDU) Containing a MAC Control Frame Requesting a 5 Pause Quanta (25 millisecond) Delay

BIT	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

V3 Information Frame SOF:

P	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	U SAL

V3 Information Frame (Full and Partial) Data Words:

P	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U SAL
P	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U SAL
P	0	0	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	X	X	X	X	X	X	X	X	U SAL
P	0	0	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	U SAL
P	0	0	0	1	0	0	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	U SAL
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	U SAL
P	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	U SAL

V3 Information Frame EOF:

P	0	1	1	0	0	0	0	FCS (32-Bit CRC) MSB	U SAL
P	0	1	1	0	0	0	1	LSB FCS (32-Bit CRC)	U SAL

Where:

Destination – 48 Bit MAC Destination Address = X's as placeholders (see ARINC Specification 664)

Source – 48 Bit MAC Source Address = Y's as placeholders (see ARINC Specification 664)

Length/Type – 16 bit field = Pause Opcode = 8808 hex

Request Operand – 16 bit field = Pause Time = 5 Pause Quanta = 0005 hex

ARINC Specification 429, Part 1, ARINC Specification 429 and therefore not used in this Part to avoid potential confusion due to duplication. In addition, this approach is used to maintain consistency with previous versions of ARINC Specification 429 when it was published as a whole (through Supplement 14).

APPENDIX F
FORMER AIM AND FILE DATA TRANSFER TECHNIQUES

AEEC Staff Note: See Supplements 4, 5, 6, 7. And 11 of ARINC Specification 429 Part 1 for changes prior to division of ARINC Specification 429 into separate parts.

The information contained in Sections F-2.1.5.2, F-2.1.5.3, F-2.3.1.4 and F-3.2 of this Appendix is no longer applicable to ARINC Specification 429. The contents of Section F-2.3.1.5 provides guidance for character-oriented file transfer protocols reflected in ARINC equipment characteristics. The information is contained herein for reference purposes.

COMMENTARY

Bit-oriented file transfer is the preferred protocol (See Section 2.5 of Part 3 of ARINC Specification 429) for use in new applications. The guidance for character-oriented protocol was removed from the body of the specification to avoid the continuation of its use, but retained herein for those who need to understand the basis for character-oriented protocol already implemented.

F-2.1.5 Sign/Status Matrix

F-2.1.5.2 AIM Data

The order function (first, intermediate, last or control) of AIM or maintenance data should be encoded in bit numbers 30 and 31 of the word as shown in the table below. See Section F-2.3.1.4 of this document for definitions of the terms “Initial Word”, “Control Word”, “Intermediate Word” and “Final Word.”

AIM DATA SIGN/STATUS MATRIX	
BIT 31 30	MEANING
0 0	Intermediate Word
0 1	Initial Word
1 0	Final Word
1 1	Control Word

F-2.1.5.3 Character-Oriented File Transfer

The order and function (first, intermediate, last and control) of text and the sign (Plus/Minus, North/South, etc.) of numeric data transferred by file transfer should be encoded in bits 30 and 31 of each word as shown in the table below.

CHARACTER-ORIENTED FILE TRANSFER STATUS MATRIX		
BIT 31 30	TEXT	DATA
0 0	Intermediate Word	Plus, North, etc.
0 1	Initial Word	Not Defined
1 0	Final Word	Not Defined
1 1	Intermediate Word	Minus, South etc.

Alternatively, the SSM field may be used to describe position in a series of data words (initial, intermediate, final) or word content (control word). Sections F-2.3.1.5.2 through F-2.3.1.5.4 contain the definitions of the terms initial, intermediate and final words.

F-2.3.1 Digital Language

F-2.3.1.4 AIM Data

AIM data (Acknowledgement, ISO Alphabet No. 5 and Maintenance information encoded in dedicated words) should be handled in the manner described in this section.

All three of these applications may involve the transfer of more than 21 bits per “data package”. Source equipment should format such long messages into groups of 32-bit DITS words, each word containing the relevant application label (see ARINC Specification 429, Part 1, Attachment 1) in bits 1 through 8, and a sign/status matrix code in bits 30 and 31.

Bit 32 should be encoded to render word parity odd. The first word of each group should contain the sign/status matrix code defined for “initial word” in F-2.1.5.1. It should also contain, in bits 9 through 16, the binary representation of the number of words in the group, except that when this word is the only word to be transmitted, the total number of information bits to be transmitted is 13 or less) bits 9 through 16 should all be binary “zeros”. See ARINC Specification 429, Part 1, Attachment 6 for word format.

When the word application label is assigned in ARINC Specification 429, Part 1, Attachment 1 for Acknowledgement Data, bits 17 through 29 of this initial word may be used for information transfer. When the word application label is either of those assigned in ARINC Specification 429, Part 1, Attachment 1 Maintenance Data (ISO Alphabet No. 5), bits 17 through 22 should be binary 'zeros” (spares). When the label is for ISO Alphabet No. 5 Messages, bits 17 through 22 are used for unit addressing. Bit usage is given in the table below.

BIT						FUNCTION
22	21	20	19	18	17	
0	0	0	0	0	0	All Call, All Groups
0	0	X	X	X	X	Group 0, Units 1-15
0	1	0	0	0	0	Group 1, All Call
0	1	X	X	X	X	Group 1, Units 1-15
1	0	0	0	0	0	Group 2, All Call
1	0	X	X	X	X	Group 2, Units 1-15
1	1	0	0	0	0	Group 3, All Call
1	1	X	X	X	X	Group 3, Units 1-15

Example:

1	0	1	0	1	0	Group 2, Unit 10

For ISO Alphabet No. 5 Messages and Maintenance Data bits 23 through 29 should take on the pattern of the IOS Alphabet No. 5 control character “STX”.

The second word of the ISO Alphabet No. 5 and Maintenance Data (ISO Alphabet No. 5) application groups is an optional control word containing sign/status matrix code for “control” information for display. When it is used, bits 9 through 13 should contain the binary representation of the line count, bits 14 through 16 should encode the required color, bits 17 and 18 the required intensity, bits 19 and 20 the required

character size and bit 21 should indicate whether or not the display is required to flash. See ARINC Specification 429, Part 1, Attachment 6 for the encoding standards. Bits 22 through 29 of the word should be binary “zeros” (spares).

Intermediate words, containing the sign/matrix code for “intermediate word”, follow the initial word of the group or the control word, when used. Intermediate words are optional in the sense that they are only transmitted if more words than the initial word and the final word (see below) are needed to accommodate the quantity of information to be transferred. When the word application group label that is assigned in ARINC Specification 429, Part 1, Attachment 1 for Acknowledgement is used. Data bits 9 through 29 of that word are available for information transfer. When the word application label is either of those assigned in ARINC Specification 429, Part 1, Attachment 1 for ISO Alphabet No. 5 data transfer or Maintenance Data (ISO Alphabet No. 5), bits 9 through 29 of each word should be divided into three seven-bit bytes (bits 9 through 15, 16 through 22 and 23 through 29), each of which contains one ISO Alphabet No. 5 character.

Each AIM application group transmission other than single-word transmission (see below) should be terminated with a word containing the sign/status matrix code for “final word” defined in F-2.1.5.1. The data field of this word should be structured similarly to that of the intermediate word. Any unused bit positions in ISO Alphabet No. 5 data transfer or Maintenance Data (ISO Alphabet No. 5) final words resulting from the number of ISO Alphabet No. 5 characters in the message being one or two less than a number wholly divisible by three should be filled with binary “zeros.”

F-2.3.1.5 File Data Transfer

F-2.3.1.5.1 Command/Response Protocol

File data will consist of both ARINC 429 BNR numeric words and ISO Alphabet No. 5 characters. A file may contain from 1 to 127 records. Each record may contain from 1 to 126 data words.

A record should contain, at the minimum, one of the eight versions of the “initial word” described in F-2.3.1.5.2. Records in which this initial word contains the “Data Follows” code should also contain from 1 to 126 “intermediate words” (data) and a “final word” (error control). The file data transfer protocol is as follows. A transmitter having the data to send to a receiver transmits, on the bus connecting it to that receiver, the “Request to Send” initial word. The receiver responds, on the separate bus provided for return data flow, with the “Clear to Send” reply. The transmitter then sends the “Data Follows: initial word, the “intermediate words” and the “final word”. The receiver processes the error control information in the ‘final word” and, if no errors are revealed, closes out the transaction by sending the “Data Received OK” word to the transmitter.

If the receiver is not ready to accept data when the transmitter sends its “Request to Send” word, it should so indicate its response (See F-2.3.1.5.2). The transmitter should then wait 200 milliseconds and retransmit the “Request to Send”. The transmitter should also repeat a “Request to Send” transmission 50 milliseconds after the initial transmission if no response is obtained from the receiver. If 2 additional attempts also spaced at 50 milliseconds produce no response from the receiver, the transmitter should send the data. This feature is incorporated to

enable file transfer (under a degraded mode of operation) in the event of a failure in the receiver-to-transmitter bus.

If the receiver detects a parity error during the transmission, it may request an error-correcting retransmission by sending a “Data Received Not OK” word to the transmitter in which is identified the record in which the error occurred. The transmitter should interrupt the data flow and back up to the start of the record so identified. It should then send a “Data Follows” initial word identifying this record as the starting point of the retransmission and recommence its output of data, continuing through the “final word”. The receiver should then close out the transaction as before.

An error detected by processing the error control information in the “final word” should also result in the receiver sending a “Data Received Not OK” word to the transmitter. In the absence of identification of the record in which the error occurred, this word should contain the sequence number of the first record of the file. The transmitter's response should be to retransmit the whole file.

The receiver can signal loss of synchronization to the transmitter at any time bysending the “Synchronization Lost” initial word. On receiving this word, the transmitter should curtail the data flow and back up to the beginning of the file. It should then re-establish that the receiver can accept data by going through the request-to-send routine. Having done this it should send the “Data Follows” initial word, followed by the data and the “final word”.

The protocol also allows a transmitter to send the file size information to a receiver without any commitment to send, or request to the receiver to accept, the file itself. The “Header Information” initial word is used for this purpose. Additionally, a “Poll” initial word is defined for use in the system which continuous “hand-shaking” between two terminals is desired. The response to a “Poll” word will be either a “Request” to Send” initial word when the polled terminal does have data to transmit, or another “Poll” word when it does not. An exchange of “Poll” words may be interpreted as the message, “I have nothing for you, do you have anything for me?”

F-2.3.1.5.2 Initial Word Types

The eight initial types are as follows:

Request to Send

Clear to Send

Data Follows

Data Received OK

Data Received Not OK

Synchronization Lose

Header Information

Poll

Bits 1 through 8 of all of those words except the “Poll” word contain the label code identifying the file to be transferred using the protocol. Bits 1 through 8 of the “Poll” word contains binary zeros. Bits 9 through 29 are divided into three seven-bit fields, the contents of which vary with word type as shown in Table A below. Bits 30 and 31 contain the code identifying them as initial words while bit 32 is encoded to render word parity odd.

NOTES

1. The amount of data the receiver can accept upon receipt of a “Request to Send” signal is determined by the rate at which data delivery can take place and the amount of time the receiver has available before it must turn its attention to some other function. The receiver will set the count code in bits 9-15 of the “Clear to Send” word to indicate the number of maximum length records it can accept when it determines that the “Request to Send signal originates in a high speed data source. It will set this code to indicate the number of 32-bit words it can accept when it determines that the “Request to Send” originates in a low speed data source, e.g., the ACARS ground-to-air link. The receiver will annunciate the contents of this field (record count or word count) by setting Bit 22 as indicated. It will determine the high or low speed nature of the source by port identification of the source of the “Request to Send” signal, the “Request to Send” word label, the SDI code or some combination of these information items.

2. The record sequence number is the number of that record in a multiple-record file being transmitted.

F-2.3.1.5.3 Intermediate Words

Intermediate words contain the data being transmitted by means of the protocol. Bits 1 through 8 contain the file label. Bits 9 through 29 can accommodate three ISO Alphabet No. 5 characters or one ARINC 429 BNR numeric word without its label. Note that this alpha/numeric data interleaving capability without labels necessitates a prior agreement between transmitter and receiver on data format. Bits 30 and 31 contain the word code or the sign information (only) encoded in the sign/status matrix of BNR numeric data words. Bit 32 is encoded to render the word parity odd.

F-2.3.1.5.4 Final Words

The final word of each record contains error control information. Bits 1 through 8 contain the file label. Bits 9 through 29 contain an error control checksum computed from the states of bits 9 through 29 of all intermediate words of the record. The error control checksum should be generated by the arithmetic addition of the binary values of bits 9 through 29 of all intermediate words and discarding the overflow. Bits 30 and 31 of this word contain the code identifying it as a final word. Bit 32 is encoded to render the word parity odd.

F-2.3.1.5.5 Word Type Encoding

Bits 30 and 31 of each word used in data file transfer should be encoded to indicate word type as follows:

BIT 31	BIT 30	WORD TYPE
0	0	Intermediate Word requiring no sign data or having Plus, North, East, Above Right, or To sign
0	1	Initial Word (all types)
1	0	Final Word
1	1	Intermediate Word having Minus, South, West, Below, Left, or From sign

F-2.3.1.5.6 File Data Formats

As noted in F-2.3.1.5.3, the transmission of file data words without labels necessitates the use of pre-arranged data formats. The need to standardize such formats was examined by the working group. The conclusion was reached that a standard format was desirable for flight management computer flight plan updating and for computer cross-talk, but was not necessary for updating the computer's data base. Manufacturers are invited to submit proposals for a standard flight plan update file and cross-talk bus formats.

F-2.3.1.5.7 File Data Labels

Labels define the application of the file data to be transferred. Such application include FMC program load/update, flight plan load/update, the FMC inter-system cross-talk, etc. There may be a need to assign more than one label to some of those applications if priority override capability is desired.

F-3.2 AIM Information Transfer

F-2.3.1.4 describes the techniques to be used for the transfer of Acknowledgement, ISO Alphabet No. 5 and Maintenance (ISO Alphabet No. 5) data by means of the Mark 33 DITS. The motivation for the adoption of this technique was label conservation. Without it, a separate label would have to be assigned to each AIM word application for each source of such data. In it, labels are assigned by word application only, and (where necessary) utilization device input port recognition utilized to identify sources. A special exception to this rule is made for the Airborne Integrated Data System (AIDS), as described in F-2.3.1.4. The technique also accommodates the use of multiple-word DITS messages, as described in Section F-2.3.1.4.

F-3.2.1 Acknowledgement Data

Source equipments responding to requests for acknowledgement of incoming data delivered via a DITS input port should do so in the manner described in F-2.3.1.4. No applications for this system capability have yet been identified and thus no data standards for acknowledgement messages have been established.