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# legacy

# legacy

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### IOA

### ACARS Over AVLC

ACARS over AVLC (AOA) transports ARINC 618 ACARS blocks via the VDL Mode 2 Datalink Layer. The Datalink Layer of VDL Mode 2 is called Aviation VHF Link Control (AVLC). VDL Mode 2 specifies a three (3) layer communications protocol stack. The layers are as follows:

Physical: Differential Encoded 8 Phase Shift Keying (D8PSK)

Datalink: Aviation VHF Link Control (AVLC)

Network: ISO Specification 8208 (ISO 8208) or ACARS (AOA) or ATN/IPS (IOA)

The provisions of this section enable legacy ACARS applications (messages) to be delivered over the VDL Mode 2 air-ground link. Many of the requirements for AOA are made by reference to the ARINC 618 version listed in section 1.1.1.

Some ACARS features described in ARINC 618 as optional for POA ACARS are required for AOA and are specified accordingly in this document. Conversely, some ACARS features described in ARINC 618 as optional for POA ACARS are not allowed for AOA and are specified accordingly in this document.

In ARINC 618, the word “should” means “**shall**”.

AOA **shall** be implemented as described in ARINC 618 version listed in section 1.1.1 with the modifications specified herein, including treating the word “should” in ARINC 618 as a “**shall**”.

This document takes precedence over ARINC 618.

#### ACARS AOA Protocol Identification and Format

The VDL Mode 2 system definition permits ACARS over AVLC (AOA) to coexist with ISO 8208 and/or IOA. All three systems share the same AVLC Frame structure and AVLC resources. The concept of multiple network layer protocols sharing AVLC datalink layer is shown in Figure 3.2.6-1. Figure 3.2.6-1 shows the Information Field of the AVLC INFO Frame containing either an AOA Packet or an ISO 8208 Packet. Another INFO frame payload option is an IOA packet, see section 3.2.5.

In VDL mode 2 MASPS, the range for AVLC frame size allows an AVLC frame size that is too small to accommodate a full size AOA ACARS Message Block (238 octet ACARS Block + 2 octet IPI/EIPI field + 11 octet AVLC Header totals 251 octets or 2008 bits). Therefore, when the ground station supports AOA then the configurable size (N1-Uplink and N1-Downlink) of the AVLC uplink and downlink frames **shall** be set to 251 octets (2008 bits) or greater.

If the ground station sets either N1-Uplink parameter or N1-Downlink parameter too small (less than 2008) then the CMU **shall** terminate AOA with that ground station and, if possible, initiate a VDL Mode 2 handoff to another ground station with acceptable N1 parameter values. The CMU may choose to maintain the connection with that ground station because of the other services (ATN/OSI and/or ATN/IPS) offered by that ground station.

AOA operation can be established if the AOA bit (bit 6 of AVLC specific options parameters) is set to 1 (in both Ground and Airborne XID frames). Figure 3.2.6-1 – AVLC Frame Structure for Multiple Network Layer Protocols

Protocol Identification in the Network Layer. ISO 9577:1990(E) specifies that the first octet of the packet header **shall** be an Initial Protocol Identifier (IPI). The IPI identifies the network layer protocol used in that packet. AOA packets implement a unique IPI value by using an extended IPI (EIPI) field. When the IPI field contains a value of binary 1111 1111, that indicates the presence of Extended IPI (EIPI) field. The Extended IPI (EIPI) field contains a value of binary 1111 1111 to identify an ACARS over AVLC (AOA) network layer protocol.

The Information Field of a VDL mode 2 INFO frame containing an AOA block shall contain an IPI, Extended IPI, and ACARS message block fields as shown in Figure 3.2.6-3.

The IPI value **shall** be binary 1111 1111.

The EIPI value **shall** be binary 1111 1111.

The values for the IPI and Extended IPI fields apply to both uplink and downlink frames.

The fields of ACARS blocks **shall** be as shown in Figure 3.2.6-2 and encoded according to ARINC 618.



Figure 3.2.6-2 AOA IPI, Extended IPI (EIPI), and ACARS Block within AVLC INFO Frame

|  |  |
| --- | --- |
| VDL mode 2 frame INFO fields | First Bit TransmittedBit Number |
|  |
| Description | Octet No. | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Flag | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| DestinationAddressField | 1 | d22 | d23 | d24 | d25 | d26 | d27 | A/G | 0 |
| 2 | d15 |  |  |  |  |  | d21 | 0 |
| 3 | d8 |  |  |  |  |  | d14 | 0 |
| 4 | d22 |  |  |  |  |  | d7 | 0 |
| SourceAddressField | 5 | s22 | s23 | s24 | s25 | s26 | s27 | C/R | 0 |
| 6 | s15 |  |  |  |  |  | s21 | 0 |
| 7 | s8 |  |  |  |  |  | s14 | 0 |
| 8 | s1 |  |  |  |  |  | s7 | 1 |
| Link Control Field | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| InformationField | 10, 112…N-2 | AOA block including IPI and EIPI: 1111 1111, 1111 1111ARINC 618/620 block |
| Frame CheckSequence | N-1 | fcs9 |  |  |  |  |  |  | fcs16 |
| N | fcs9 |  |  |  |  |  |  | fcs8 |
| Flag | N+1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

Figure 3.2.6-3 AOA Packet Structure within VDL Mode 2 Information Frame

##### ACARS AOA Downlink Block Format

AOA downlink blocks **shall** comply with the format specified in ARINC 618 from the SOH character to the 16 bit BCS and BCS Suffix character. The BCS consists of 16 bits of binary data from the CRC calculation defined in ARINC 618, without parity bits. The BCS Suffix character is a DEL character following the BCS.

The text in one AOA downlink block **shall** be limited to 220 characters as described herein and in ARINC 618.

The Supersize blocks defined in ARINC 618 **shall** not be used in AOA.

Longer ACARS downlink messages, up to 16 ACARS blocks, can be sent by using multiple AOA blocks as described in ARINC 618.

The maximum ACARS downlink message size **shall** be limited to 16 ACARS blocks.

ACARS network ground-ground messages, aka Type B messages, are restricted to 3840 characters which includes ground message header. If a message is larger, then the message should be compressed or divided into several messages. An industry standard for this is ARINC 841 (MIAM).

The Mode character field **shall** be set to “2”, 32h, for all AOA downlink blocks as defined in ARINC 618.

The CMU **shall** not transmit any ACARS AOA downlink message unless it has a valid aircraft registration value.

###### Downlink Text Field

The Text field is a field not exceeding 220 characters in length including the mandatory subfields MSN and FI. The Text field in the first block of an ACARS message may contain a Multi-Function Identifier (MFI) subfield as defined in ARINC 618. The Text field in the first block of an ACARS message may contain a Supplementary Address subfield with one or more addresses as defined in ARINC 618.

The MFI and Supplementary Address sub fields, when present**,** **shall** appear in the order shown in ARINC 618.

The MFI and Supplementary Address sub fields, when present**,** **shall** comply with the formatting and order defined in ARINC 618 and 620.

When the ACARS block contains a sublabel and/or MFI and/or supplementary address, see ARINC 620 and 618, then it **shall** reduce the number of characters in the Text field that are available to contain data.

The ACARS sublabel, when present, **shall** comply with the formatting described in ARINC 618 and 620.

The avionics is allowed to continue sending AOA blocks with a maximum text field size of 220 characters even when the VDL Mode 2 parameter N1-Downlink parameter value is greater than 2008.

The downlink text field **shall** exclude the control characters ETB nor ETX (nor STX nor SOH? Others?).

###### Downlink Suffix Character

AOA supports multi-block ACARS messages. When a multi-block message is formatted then all blocks except the last one contain an ETB character instead of an ETX character. Only the last block contains an ETX character, just like plain old ACARS.

Each AOA single block message **shall** be terminated with the control character ETX (03h).

In an AOA multi-block message, all blocks, except the last one, **shall** be terminated with the control character ETB (17h).

The final block of an AOA multi-block message **shall** be terminated with ETX (03h).

###### Downlink Block Check Sequence

A Block Check Sequence (BCS) of 16 bits is transmitted following the ETB or ETX character and is used in the error detection process that controls the generation of the ACARS technical acknowledgment character. The BCS is the result of a Cyclic Redundancy Check (CRC) computation defined in ARINC 618.

The BCS is initiated by, but does not include, the SOH character, and is terminated by, and does include, the End of Block (ETB) or the End of Transmission (ETX) character of the block. The BCS is generated on the entire block, including parity bits.

The avionics **shall** calculate the 16 bit BCS as defined in ARINC 618 and appended it to the AOA block after the Suffix character, ETB or ETX, of each AOA downlink block.

The ground station **shall** verify the 16 bit BCS as defined in ARINC 618 after the Suffix character, ETB or ETX, of each AOA downlink block received in order to determine whether the received block was corrupted. (FYI, Probability of error detection is less than 100%.)

###### Downlink BCS Suffix

The VDL mode 0/A modulation (MSK) for Plain Old ACARS (POA) required the presence of a BCS Suffix character to enable the last bit of the Block Check Sequence (BCS) to be decoded. The BCS Suffix character was retained in AOA even though it’s not needed.

The control character “DEL” (ISO-5 character 7Fh) **shall** be transmitted following the BCS.

##### AOA Uplink Block Format

AOA uplink blocks **shall** comply with the format specified in ARINC 618 from the SOH character to the 16 bit BCS and BCS Suffix character. The BCS consists of 16 bits of binary data from the CRC calculation defined in ARINC 618, without parity bits. The BCS Suffix character is a DEL character following the BCS.

The Text field of an ACARS block is limited to 220 characters. Part of the Text field in an uplink block is used for protocol related subfields such as sublabel or Supplementary Address(es) or MFI. Uplink blocks do not contain MSN nor Flight ID subfields. It is possible to transmit longer messages by using multiple ACARS blocks as defined in ARINC 618. Longer messages are broken up into several blocks as defined in ARINC 618. ACARS AOA messages are limited to 16 blocks, each with at most 220 characters in the text field.

ACARS network ground-ground messages, aka Type B messages, are restricted to 3840 characters which includes ground message header. If a message is larger, then the message should be compressed or divided into several messages. An industry standard for this is MIAM.

The Mode character field **shall** be set to “2”, 32h, in AOA uplinks.

###### Uplink Address Recognition

The CMU should only process an AOA uplink message intended for the aircraft on which it resides. The CMU should compare the ACARS address of each received AOA uplink block with the ACARS addresses of the aircraft to screen out messages destined for other aircraft.

In this document, the phrase “valid ACARS address” refers to the ACARS addresses: Aircraft Registration Mark, Flight Identifier as defined in ARINC 618.

The CMU **shall** recognize the Aircraft Registration and Flight Identifier in AOA uplink blocks as valid ACARS addresses for the aircraft.

Screening of VDL frames is performed by the VDR using the VDL mode 2 addresses provided by the CMU. The address set in the VDR consists of the ICAO 24-Bit Aircraft Address; and VDL mode 2 all station address.

The CMU **shall** validate the ACARS address in an AOA uplink block and if the AOA block does not contain a valid ACARS address for that aircraft then the block is discarded without any further action. An ACARS address mismatch should not occur in normal operation.

The DSP **shall** use the Aircraft Registration address for ATS uplink messages sent via AOA.

###### Uplink Block Identifier

The Uplink Block Identifier (UBI) field is a single character field in an AOA uplink block. Valid values for the Uplink Block Identifier are characters “A” – “Z” (41h – 5Ah) or “a” – “z” (61h – 7Ah) inclusive.

The UBI field **shall** contain a character in the range “A” – “Z” (41h – 5Ah) or “a” – “z” (61h – 7Ah).

Each subsequent uplink block (not duplicate) **shall** have a different UBI value than the previous uplink block.

Uplink AOA blocks transmitted because the ACARS No ACK timer, VGT1, expired **shall** contain the same UBI as the previous transmission of that AOA uplink block.

The CSP **shall** divide the UBI range into two categories, one category of UBI values are only used in ACARS General Response uplink messages and the other category of UBI values are only used in all other ACARS uplink blocks.

Note 1: In the past, some CSPs only used 2 values for UBI which caused problems because the aircraft uses the UBI to detect duplicate uplink blocks. If one uplink block is missed then the next uplink block would have the same UBI as the previous uplink block and it would incorrectly be discarded as a duplicate.

Note 2: The original uplink duplicate detection logic specified in ARINC 618 for AOA would allow an uplink block to be falsely determined to be a duplicate when a certain sequence of uplink blocks occurred. Revisions to the uplink duplicate detection logic were made which are expected to eliminate this problem. The CSP can avoid this problem by dividing the UBI range into two categories, one category of UBI values would only be used in ACARS General Response uplink messages and the other category of UBI values would only be used for all other ACARS uplink blocks.

###### Uplink Text Field

Some uplink blocks may contain additional message routing information in the text field, such as Multi Function Identifier (MFI), sublabel and/or Supplementary/Additional addresses. Refer to Sections 3.2.2.1 and 3.2.3.2 of ARINC Specification 620 for details.

The Uplink Text field in an ACARS block **shall** not exceed 220 characters, including MFI, Sublabel and/or Supplementary Addresses when present.

Messages larger than 220 characters **shall** be uplinked using multiblock messages as defined in ARINC 618.

The uplink text field **shall** not contain the control characters ETB nor ETX (SOH, STX?).

Each single block message **shall** be terminated with an End of Text character, ETX (03h).

In an AOA multi-block uplink message, all blocks, except the last one, **shall** be terminated with the End of Block character ETB (17h).

The final block of an AOA multi-block message **shall** be terminated with ETX character (03h).

###### Uplink BCS Field

A Block Check Sequence (BCS) of 16 bits is transmitted following the ETB or ETX character and is used in the error detection process that controls the generation of the technical acknowledgment character. The BCS is the result of a Cyclic Redundancy Check (CRC) computation defined in ARINC 618.

The BCS is initiated by, but does not include, the SOH character, and is terminated by, and does include, the End of Block (ETB) or the End of Transmission (ETX) character. The BCS is generated on the entire block, including parity bits.

The BCS **shall** be calculated for each uplink AOA block as defined in ARINC 618 and appended to the AOA uplink block after the Suffix character.

The aircraft **shall** form a code polynomial of the uplinked block as described in ARINC 618 and compare it to the received value in order to determine whether the received uplink block is error free.

###### Uplink BCS Suffix

The VDL mode 0/A modulation (MSK) for Plain Old ACARS required the presence of a BCS Suffix character to enable the last bit of the Block Check Sequence (BCS) to be decoded. The BCS Suffix character was retained in AOA even though it’s not needed.

The control character “DEL” (ISO-5 character 7Fh) **shall** be transmitted following the BCS field in each uplink AOA block.

####  ACARS AOA protocol

*Note 1: ACARS POA protocol has some important differences from the ACARS AOA protocol. Refer to ARINC 618. This document has precedence over ARINC 618.*

*Note 2: this document contains some requirements for features that are optional in ARINC 618.*

##### Downlink Block Processing

The ACARS AOA protocol for downlinks **shall** be implemented to behave as described in ARINC 618 with the modifications specified herein.

The AOA DBI reference character in the DSP **shall** be managed as described in ARINC 618 (i.e. the AOA DBI reference character in the DSP is only updated when the downlink AOA block label is not \_DEL, General Response message).

An AOA downlink block **shall** be acknowledged as described in ARINC 618 including downlink retransmission and management of the ACARS timers.

AVLC uses the T2 Timer (delay before VDL Mode 2 acknowledgment timer) with a default value of 500 ms per VDL Mode 2 MASPS. This should be sufficient for acknowledgment of the AVLC INFO frame containing an ACARS Message Block

~~Proposed~~: The ground **shall** create an ACARS acknowledgement and queue it for uplink transmission before AVLC timer T2 expires so that the VDL mode 2 acknowledgement and ACARS acknowledgement can be delivered in one block.

AVLC INFO Frame

(AVLC Frame Ack and contains ACARS Ack)

##### AOA Uplink Block Processing

The ACARS AOA protocol for uplinks **shall** be implemented to behave as described in ARINC 618 with the modifications specified herein.

The AOA UBI reference character in the avionics **shall** be managed as described in ARINC 618 (i.e. the AOA UBI reference character in the avionics is only updated when the uplink AOA block label is not \_DEL, General Response message).

The avionics **shall** set its UBI reference character to NUL after a mode switch (either VDL Mode 0/A POA to Mode 2 AOA or Mode 2 AOA to VDL Mode 0/A POA) to ensure the first uplink block received in the new mode is not processed as a duplicate block.

An AOA uplink block **shall** be acknowledged as described in ARINC 618 including uplink retransmission and management of the ACARS timers.

AVLC uses the T2 Timer (delay before VDL Mode 2 acknowledgment timer) with a default value of 500 ms per VDL Mode 2 MASPS. This should be sufficient for acknowledgment of the AVLC INFO frame containing an ACARS Message Block

~~Proposed~~: The avionics **shall** create an ACARS response, e.g. acknowledgement or other ACARS response (QX, Q5 etc.) and queue it for downlink transmission before AVLC timer T2 expires so that the VDL mode 2 acknowledgement and ACARS acknowledgement can be delivered in one block.

##### ACARS Acknowledgement Protocol

Each downlink block (other than the General Response message and some control messages , see ARINC 620) sent by the avionics should be acknowledged by the ground ACARS network to confirmits receipt. Similarly, the CMU should acknowledge each uplink block (other than the General Response message) to inform the ground ACARS network that delivery to the CMU was accomplished.

Note: Delivery to CMU does not guarantee delivery to FMC or other LRU

Downlink ACARS message nesting **shall** be implemented by avionics as defined in ARINC 618.

The DSP **shall** be able to receive and process nested downlink ACARS messages as defined in ARINC 618.

The avionics **shall** be able to receive and process nested uplink ACARS messages as defined in ARINC 618.

###### Acknowledgment of a Downlink Block

An AOA ACARS downlink block **shall** be acknowledged as described in ARINC 618.

The DSP **shall** reset its DBI reference value when a mode switch (AOA to POA, POA to AOA) occurs in order to ensure that the first downlink received in the new mode is not falsely considered a duplicate.

The DBI character in every AOA downlink received that is not a General Response downlink (label \_DEL) **shall** update the value of the AOA DBI reference character in the DSP. Note the DBI in the General Response does not update the DBI reference.

When the CMU has transmitted an AOA block which requires acknowledgment, the CMU **shall** start VAT7 and initialize VAC1 and wait until the No ACK VAT7 timer expires before retransmitting the AOA block or sending a new AOA block, except for system control message which may be transmitted before VAT7 expires. Reception of an uplink~~, other than a General Response~~, containing a Negative Acknowledgment <NAK> (1/5) character in the Technical Acknowledgment field does not initiate a retransmission nor increment the transmission counter (VAC1) nor restart the NO ACK timer (VAT7).

A downlink retransmission caused by Timer VAT7 expiration **shall** retain the Message Sequence Number (MSN) and retain the DBI of the original downlink block and increment the transmission counter (VAC1) and restart the NO ACK timer (VAT7).

Reception of a General Response uplink, containing a Negative Acknowledgment <NAK> (1/5) character in the Technical Acknowledgment field **shall** initiate a downlink retransmission and increment the transmission counter (VAC1) and restart the NO ACK timer (VAT7).

Failure of the BCS check of a downlinked message may elicit no response from the ground rather than an uplink containing a <NAK>.

When the CMU downlinks an ACARS block that is not acknowledging an uplink block, then the CMU **shall** insert a <NAK> character in the Technical Acknowledgment field.

###### Acknowledgment of an Uplink Block

The UBI character in every AOA uplink received that is not a General Response downlink (label \_DEL) **shall** update the value of the AOA UBI reference character in the avionics. Note the UBI in the General Response does not update the UBI reference.

The avionics **shall** set its UBI reference character to NUL after a mode switch (either VDL Mode 0/A to AOA or AOA to VDL Mode 0/A) to ensure the very first uplink block received in the new mode is not processed as a duplicate block.

Uplink block(s) **shall** be transmitted sequentially to the aircraft through VDL Mode 2 ground stations using the procedure detailed in ARINC 618. Different VDL Mode 2 ground stations may be used, AOA does not care.

The DSP **shall** wait to receive an ACARS ack for the AOA uplink block before it transmits the next AOA uplink block.

When the DSP first transmits an AOA block which requires acknowledgment, the DSP **shall** start VGT1 and initialize VGC1 and wait until the No ACK VGT1 timer expires before retransmitting the AOA block or sending a new AOA block, except for system control message which may be transmitted before VGT1 expires. Reception of a downlink, ~~other than a General Response,~~ containing a Negative Acknowledgment <NAK> (1/5) character in the Technical Acknowledgment field does not initiate a retransmission nor increment the transmission counter (VAC1) nor restart the NO ACK timer (VAT7).

On receipt of an uplink block. the aircraft **shall** perform a BCS error check and, if the block is error free, transmit a downlink block containing a Positive Acknowledgment (Uplink Block Identifier character) in the TAK field to the ground in either:

1. A General Response message, or
2. A new downlink block, if there is one in the downlink queue.

When a downlink block is the vehicle for the Positive Acknowledgment, the DSP **shall** perform a BCS error check on the block and if the block is error-free, transmit an uplink containing a Positive Acknowledgment in the TAK field to the aircraft, in either:

1. A General Response message, or
2. A new uplink block, if it has one for that aircraft.

If the General Response uplink is used, the aircraft returns to the quiescent state upon receiving it. Use of an uplink block for a Positive Acknowledgment should result in another acknowledgment cycle being initiated. When the original Positive Acknowledgment is downlinked in a General Response. message, the aircraft should return to the quiescent state as soon as transmission of the response is complete.

The DSP **shall** manage the UBI to ensure that the next uplink block transmitted has a different value than the block prior to it, unless it is a retransmission.

The CMU **shall** generate a positive response to any uplink requiring acknowledgment based on the criteria below. Acknowledgment criteria:

1. Valid ACARS address for the aircraft and good Block Check Sequence (BCS) **shall** yield a positive response.
2. Valid ACARS address and bad Block Check Sequence (BCS) **shall** be ignored by CMU and discarded.
3. Invalid ACARS address **shall** be ignored by CMU and discarded.
4. An uplink block with a bad BCS check **shall** be ignored by CMU and discarded.

The VDL Mode 2 CRC only protects message over the air/ground link whereas the BCS protects the message all the way from the ACARS DSP.

Uplink block retransmissions **shall** retain the UBI of the original uplink block.

Duplicate uplinks might contain an acknowledgment for a downlink block just received, i.e., embedded ACK and avionics **shall** check for embedded ACK in duplicate uplink blocks.

Duplicate downlinks might contain an acknowledgment for an uplink block just received, i.e., embedded ACK and DSP **shall** check for embedded ACK in duplicate downlink blocks

Reception of a General Response downlink, containing a Negative Acknowledgment <NAK> (1/5) character in the Technical Acknowledgment field **shall** initiate an uplink retransmission and increment the Transmission counter (VGC1) and restart the NO ACK timer (VGT1).

##### Media Switching

Any multi-block ACARS message in progress when the avionics switches between AOA and any other media, including POA, **shall** be re-started.

The multi-block message is re-started when a media switch occurs because

1. The service provider may be different
2. even if it is the same service provider, the ground computers may not have the capability to combine partial messages or,
3. To maintain similarity with existing ACARS media management.

##### AOA Link Management Timers and Counters

The ACARS AOA protocol timers and counters are defined herein. Timer and counter values have been determined to be consistent with the timers/counters and retransmission logic used at the VDL mode 2 layers.

###### Ground-Based AOA Protocol Timers

The ground-based AOA protocol timer definitions and values in the AOA section of ARINC 618 are used by the AOA protocol. ARINC 618 ground timers VGT6 and VG7 are not used by AOA protocol.

The ground **shall** implement VGT1 No ACK Timer as defined in ARINC 618.with the value 35 seconds.

The ground **shall** implement VGT2 Message Reject Timer as defined in herein.with the value 70 seconds. More details in section TBD.

The ground **shall** implement VGT3 Incomplete Uplink Message Interval Timer as defined herein.with the value 20 seconds. More details in section TBD.

The ground **shall** implement VGT4 Incomplete Downlink Message Timer as defined in ARINC 618.with the value 420 seconds.

The ground **shall** implement VGT5 Q5 Timer as defined in ARINC 618 with the value defined by the DSP.

The ground **shall** implement VGT8 Temporary Suspension Timer as defined in ARINC 618.with the value 600 seconds.

###### **Aircraft AOA protocol** Timers

The aircraft AOA protocol timer definitions and values shown in the AOA section of ARINC 618 are used by the AOA protocol. ARINC 618 aircraft timers VAT1, VAT2, VAT3, VAT5 and VAT11 are not used by the AOA protocol.

The aircraft **shall** implement VAT4 Message Assembly Timer as defined in ARINC 618.with the value 80 seconds.

The aircraft **shall** implement VAT6 NO COMM Timer as defined in ARINC 618.with the value 600 seconds.

The aircraft **shall** implement VAT7 No ACK Timer as defined in ARINC 618.with the value 45 seconds.

The aircraft **shall** implement VAT8 UBI Reset Timer as defined in ARINC 618.with the value 600 seconds.

The aircraft **shall** implement VAT9 Voice Timer as defined in ARINC 618.with the value 600 seconds.

The aircraft **shall** implement VAT10 Multiblock Message Timer as defined in ARINC 618.with the value 1200 seconds.

The aircraft **shall** implement VAT12 Inter-Media Switch Timer as defined in ARINC 618.with the value 600 seconds.

The aircraft **shall** implement VAT13 Debounce Message Timer as defined in 3.2.6.2.1.5.2.1. A future update to ARINC 618.will revise ARINC 618 to the VAT13 requirements in the MASPS.

###### **ARINC VAT13 Debounce Timer**

 A CMU that only supports AOA (no ATN/OSI, no ATN/IPS) **shall** use a value of 300 seconds for VAT13 except when an ACARS Autotune Command containing the optional VAT13 value has been received.

If the mode switch was initiated by the CMU receiving an ACARS Autotune Command containing an optional VAT13 value then that value **shall** be used.

A dual stack CMU that supports AOA and either ATN/OSI, or ATN/IPS dynamically selects the VAT13 value, 300 or 30 seconds based on the services offered in the GSIF of the connected ground station except when an ACARS Autotune Command containing the optional VAT13 value has been received.

If a dual stack CMU (AOA and either ATN/OSI or ATN/IPS) is connected to an AOA only ground station then the VAT13 value **shall** be 300 seconds except when an ACARS Autotune Command containing the optional VAT13 value has been received.

If a dual stack CMU (AOA and ATN/OSI) is connected to a ground station that supports ATN/OSI then the VAT13 value **shall** be 30 seconds except when an ACARS Autotune Command containing the optional VAT13 value has been received.

If a dual stack CMU (AOA and ATN/IPS) is connected to a ground station that supports ATN/IPS then the VAT13 value **shall** be 30 seconds except when an ACARS Autotune Command containing the optional VAT13 value has been received.

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###### Ground AOA protocol Counters

The ground **shall** implement AOA protocol counter VGC1 definition and value as defined in ARINC 618.

###### Aircraft AOA protocol Counters

The aircraft **shall** implement AOA protocol counter VAC1 definition and value as defined in ARINC 618.

##### **Switching** Between POA and AOA

The aircraft **shall** switch from POA to AOA as defined in ARINC 618.

The aircraft **shall** switch from AOA to POA as defined in ARINC 618.

If the aircraft switched service providers when it switched from ACARS POA to AOA then the aircraft **shall** downlink an ACARS Media advisory message after establishing VHF comm.

If the aircraft switched service providers when it switched from ACARS AOA to POA then the aircraft **shall** downlink an ACARS Media advisory message after establishing VHF comm.

If the aircraft remained with the same service provider when it switched from ACARS POA to AOA then the aircraft **shall** not downlink an ACARS Media advisory message after establishing VHF comm.

If the aircraft remained with the same service provider when it switched from ACARS AOA to POA then the aircraft **shall** not downlink an ACARS Media advisory message after establishing VHF comm

###### POA to AOA Switch Based on Squitters

If the aircraft is on the ground and POA squitter data indicates that the ground station and aircraft are located at the same airport and signal strength and other user preferences allow AOA use then the CMU **shall** switch from POA to VDL mode 2.

If the aircraft is on the ground and POA squitter data indicates that the ground station and aircraft are located at different airports then the CMU **shall** continue to use POA until airborne.

Whenever the switch from POA to AOA takes place on different Service Providers, then the CMU **shall** send a Media Advisory after receiving an ACARS Ack.

Every time the avionics performs VDL Mode 2 link establishment, then an ACARS Link Test or other AOA downlink message **shall** be sent to establish the AOA connection with the ACARS DSP followed by a Media Advisory after the avionics receives an ACARS ack for the initial downlink.

Having an AVLC link to the Ground Station does not mean the aircraft has a link to the ACARS DSP. The CMU should have non-ambiguous connectivity status information to the ACARS DSP, which is quite different from a link to the Ground Station.

The DSP uses the ACARS Link Test Q0 or other Downlink label to update its Tracking Table and map the 7 character ACARS Aircraft Number with the ICAO 24-bit Aircraft Address

###### **POA** to AOA Switch Based on POA to AOA Retune Command

An POA to AOA Retune (Label :}) is used to command an aircraft to change its operating mode/frequency from POA to AOA. The DSP uses the POA to AOA Retune to offload its POA frequencies in a controlled manner and optimize the transition (i.e., minimize NO COMM condition). The POA to AOA VDL Retune provides a VDL mode 2 frequency and the DSP ID and may also indicate a list of proposed VDL Mode 2 Ground Station addresses. See ARINC Specification 620 for definition of the POA to AOA Retune Label.

There might be situations where the POA to AOA switchover cannot be accepted by the CMU. If the CMU refused the switchover because the POA to AOA Retune is not recognized, then the CMU **shall** send a Label QX downlink to advise that the VDL Retune has not been accepted.

If the CMU recognizes the label but chooses not to comply for other reasons, the CMU **shall** downlink a Label QV Autotune Reject message to advise that the VDL retune has not been accepted.

If the CMU supports the POA to AOA Retune uplink but is temporarily unable to act upon the uplink (multi-block uplink or downlink in progress for example), then the CMU **shall** downlink an ACARS acknowledge for the VDL Retune uplink and when the CMU has completed or quite sending the downlink message, transmit a Label 5V message, and switch to AOA.

If a POA to AOA Retune is received and all conditions to switch to AOA are met, the Debounce Timer (VAT13) **shall** be ignored. In other words, the aircraft should change its operating mode/frequency from POA to AOA when an POA to AOA Retune uplink is received and VAT13 is still running. Note that the Inter-Media Switch Timer (VAT12) should be started as usual (just like on Squitter switchover).

The different steps of the mode switch triggered by the POA to AOA Retune are described in ARINC 618.

###### AOA to POA Switch Based on ACARS Data Transceiver Autotune

An ACARS Data Transceiver Autotune (Label :;) is used to command an aircraft to change its operating frequency/mode from AOA to POA. The DSP can use the ACARS Data Transceiver Autotune to anticipate the loss of VDL mode 2 coverage, and avoid NO COMM situations. The first six characters in the Data Transceiver Autotune are the same as when it’s used to command the CMU to change POA frequencies and contain the target ACARS POA frequency. An optional four-digit field (character positions 7-10) should only be used when attempting to command the CMU to switch from AOA to POA and can specify a one-shot value for the Debounce Timer (VAT13). This optional field can specify a value to be used once for the VAT13 debounce timer. The range is 1 to 9999 seconds.

If an ACARS Data Transceiver Autotune is received and all conditions to switch to POA are met (AOA message complete and no active PM-CPDLC session) and the Inter-Media Switch Timer (VAT12) is running then the CMU **shall** change its operating mode/frequency from AOA to POA using the frequency received in the Autotune uplink.

If the optional characters for VAT13 are present in the ACARS Data Transceiver Autotune, and the CMU executes the mode switch then the VAT13 timer **shall** be started using the value from the uplink.

If the optional characters for VAT13 are present in the ACARS Data Transceiver Autotune and the value is 0000, and the CMU executes the mode switch then the VAT13 timer **shall** be started using the default value for VAT 13.

There might be situations where the AOA to POA switchover cannot be accepted by the CMU. When the CMU chooses not to comply, the CMU **shall** downlink a Label QV Autotune Reject message to advise that the ACARS Data Transceiver Autotune was not accepted.

The different steps of the frequency switch triggered by the ACARS Data Transceiver Autotune are described in ARINC 618.

Note that, unlike the ACARS to ACARS autotune, an AOA to POA autotune **shall** cause an in progress multi-block message (uplink or downlink) to be restarted on the new connection.

When switching from AOA to POA initiated by the ACARS Data Transceiver Autotune, the CMU **shall** not send a Media Advisory.

###### AOA to POA Switch without ACARS Data Transceiver Autotune

At times the avionics will determine that it should switch from AOA to POA such as VDL mode 2 no comm or geographic logic or pilot command etc. When that occurs, then the following steps **shall** be followed:

Step 1 – Avionics decides to switch to ACARS POA frequency without receiving an ACARS Data Transceiver Autotune uplink.

Step 2 - Avionics **shall** transmit an AVLC DISC frame to the VDL Mode 2 link before switching to POA.

##### Exceptions

The following sections describe exceptions and fault handling procedures.

##### Connectivity Loss with ACARS Processor

If a VDL Mode 2 ground station supporting AOA loses its connection to its ACARS processor, then the AOA bit in the AVLC Specific Options parameter of the GSIF **shall** be reset. A connected aircraft using AOA may choose to initiate a VDL Mode 2 handoff as a result.

Subsequent connections requesting AOA service received by the ground station **shall** be refused with XID\_RSP\_LCR containing cause code 0x03 (indicating loss of terrestrial connection).

##### Handoffs to a Ground Station That Does Not Support AOA

Stations that support AOA indicate their capability in the GSIF. When an aircraft conducts a handoff to a new ground station, it searches its PECT for the best station. The aircraft checks the AOA bit to confirm that the station supports AOA. If the CMU that supports AOA initiates a handoff to a ground station that does not support AOA

 If aircraft utilizing AOA attempts to establish a link or handoff to a ground station that does not support AOA or is currently disconnected from the ACARS system, the connection is refused with XID\_RSP\_LCR. The associated cause code (0x07) indicates that the ground station does not have a link to the ACARS system.

##### Switching VDL mode 2 Service Providers

When the aircraft is using AOA and decides to switch VDL mode 2 service providers then a new VDL mode 2 link connection is established in accordance with MASPs using the Link Establishment XID.

After successfully connecting with the new DSP, then the aircraft **shall** downlink an ACARS Link test message or a pending ACARS downlink.

After receiving an AOA acknowledgement, then the aircraft **shall** downlink an ACARS Media Advisory message.

##### Voice/Data Switching

The VDR may be switched to operate in Voice mode at any time. The radio voice/data mode switching on most aircraft equipped with VDL Mode 2 is typically controlled from the Radio Control Panel (RCP) but in some cases in may be controlled by the CMU as in legacy ACARS installations.

When the CMU is using AOA and detects the radio switched from data to voice mode then the CMU **shall** start AEEC 618 timer VAT9.

When the CMU detects the radio switched from voice to data mode before the expiration of AEEC 618 timer VAT9, then the CMU **shall** resume data operation using the same frequency and mode used prior to the switch to voice.

The CMU **shall** maintain the PEC table while in voice mode and delete PECT entries as they time out per MASPS.

When the CMU detects the radio switched from voice to data mode after the expiration of ARINC 618 timer VAT9, then the CMU **shall** enter frequency/mode acquisition per ARINC 618.

If the CMU attempts to restore VDL Mode 2, then the VDL Mode 2 Link Establishment process as specified herein **shall** be followed.

##### AOA Data Transfer Services

VDL Mode 2 link is a separate service provider. This means that the CMU **shall** simultaneously transmit and/or receive ACARS messages via VDL Mode 2 and all other ACARS air/ground networks supported. This also means that if the CMU cannot complete an ACARS downlink on one of the other ACARS air/ground networks, and the CMU re-queues that downlink for transmission over the VDL Mode 2 link then the CMU **shall** do so according to ARINC 618.

 If VDL Mode 2 fails (Label 270 data word from VDR to ACARS CMU, bit 11 set to 1) while a message is in progress, then the message **shall** be treated the same as losing coverage or exhausting retransmission logic.

Upon entering the VDL Mode 2 AOA NO COMM condition, all outstanding AOA uplink/downlink traffic **shall** be considered interrupted and retransmission may be required.

##### AOA NO COMM

Aircraft VDL mode 2 comm can still exist when aircraft AOA is NO COMM.

Aircraft AOA NO COMM **shall** be declared when:

1. The max number of retries at VHF AOA level is exceeded for a given downlink (Transmission counter VAC1 expires and timer VAT7 expires) without acknowledgment. or
2. The VDL Mode 2 service is declared unavailable due to link disconnection (by the AVLC layer or consecutive to a VDL service shutdown request from ACARS-VHF manager). This link disconnection can be accidental or may result from a decision of the ACARS VHF manager to change VDL service provider. or
3. Aircraft VDR is declared as failed. or
4. VHF radio is in Voice mode.

Ground AOA NO COMM shall be declared when:

1. The max number of retries at VHF AOA level is exceeded for a given downlink (Transmission counter VGC1 expires and timer VGT1 expires) without acknowledgment. or
2. The VDL Mode 2 service is declared unavailable due to link disconnection (by the AVLC layer). or
3. Ground station VDR is declared as failed.

If the CMU has knowledge of frequencies broadcast by the ground LME via an uplink XID, these frequencies should be tried (subject to airline policy) prior to returning to ACARS POA operation. If no additional frequency support has been announced, the CMU may attempt to communicate using the CSC prior to returning to Plain old ACARS operation.

If ACARS POA operation is established after loss of VDL Mode 2 operation, ACARS squitters can advertise the availability of VDL Mode 2 services. Return to AOA operation may be delayed until reception of the Label SQ squitter broadcast and expiration of the debounce timer VAT13. Conversely, attempting additional VDL Mode 2 frequencies directly may cause the delay of the TG1 dwell timer on each frequency attempted. Airline policy determines specific implementation preferences.

##### AVLC Requirements

Simultaneous operations in AOA with one service provider and in ATN with another should be possible. Therefore, the AVLC options defined or negotiated for AOA operations should be compatible with ATN operation. See ARINC Specification 631 for more details.

##### AOA NO COMM

A number of events result in AOA declaring to the ACARS router that it is in a NO COMM situation.

Upon NO COMM situation, the ACARS router may decide to route downlink messages to alternate media (HF or satcom).

The AOA is considered to be “IN COMM” when the CMU received an ACARS ack for an AOA downlink.

AOA NO COMM is declared when:

1. The max number of retries at AOA level is exceeded for a given downlink (618 Transmission counter VAC1 expires) without acknowledgment.
2. The VDL mode 2 service is declared unavailable due to link disconnection (by the AVLC layer or consecutive to a VDL service shutdown request from ACARS-VHF manager).
3. VDR is declared as failed.
4. VHF is in Voice mode.
5. VDR Label 270 data word Bits 11 and 14 indicate that the VDR is not in the “Protocol Set” state (as defined in ARINC Characteristic 750).

VDR Label 270 data word Bits 11 and 14 indicate that the VDR is not in the “Protocol Set” state (as defined in ARINC Characteristic 750).

##### Downlink ACARS Message Sequencing

The airborne subsystem and the ground service provider **shall** implement the downlink Message Sequence Number (MSN) field, as defined in ARINC 618, in order to provide a method for

* detecting incomplete multi-block downlinks and
* sending nested downlink messages and
* detecting nested downlink messages

Nesting of downlink multi-block messages to at least one level plus a second level for only single block message **shall** be supported by the avionics as described in ARINC 618.

Nesting of downlink multi-block messages to at least one level plus a second level for only single block message **shall** be supported by the DSP as described in ARINC 618.

##### Uplink Message Sequencing

There are no explicit provisions for AOA uplink block sequencing. Therefore, the aircraft cannot determine with absolute certainty that it is receiving the first block of a new AOA uplink message or the next block of a multiblock message when the labels are the same. ACARS timers VGT2, VGT3 and VAT4 are relied upon to identify when an old message has been aborted and a new message (or the retransmission of the old message) has been started. As a result, errors in the assembly of multi-block uplink messages may occur. The sorts of errors that can occur are:

1. Two messages or multiple instances of the same message may be concatenated or
2. A single message may be incorrectly divided into two partial messages.

#### AOA Retransmissions

Retransmission of AOA message blocks is necessary to provide a reliable communications link between the aircraft and ground. Retransmissions are necessary because messages are not always delivered. On these and other occasions, the associated acknowledgmentis not received at the sending station.

The ground station (uplink) or CMU (downlink) is permitted to make several AOA retransmissions in addition to the VDL mode 2 retransmissions (see MASPS). See the definition of the transmission counters (VAC1 and VGC1) and the description of AOA retransmission timing is provided herein.

AOA messages deemed a duplicate may contain an AOA acknowledgment in the Technical Acknowledgment field, while the original transmission may have contained a <NAK> in this field. The AOA receiver, either ground or aircraft, **shall** check the Technical Acknowledgment field in all received AOA blocks, even duplicates.

##### Uplink AOA Retransmission Detection

Ground stations are programmed to retransmit blocks for which anacknowledgment has not been received within a specified time period (VGT1).

The CMU **should** use the Uplink Block Identifier (UBI) to detect duplicate uplink retransmissions.

The CMU **shall** compare the character found in the UBI position of each uplink block with the UBI reference character (described below) in order to determine whether or not the uplink is a retransmission of the preceding block.

Normally, the reference character should be the character contained in the UBI position of the immediately preceding uplink. However, if the UBI Reset timer (VAT8) expires, the value of the reference UBI character position **shall** be set to the control character <NUL>. See the description of the UBI Reset timer (VAT8). When the aircraft receives a General Response uplink then the it **shall not** update the AOA UBI reference character.

An AOA uplink message identified as a retransmission shall be acknowledged by an AOA downlink response.

When the CMU cannot handle an uplink message, it **shall** downlink a response message.

The DSP **shall** manage UBI characters in uplink message blocks (i.e., uplink blocks which are not General Response uplinks) to ensure that two sequential uplink message blocks do not contain the same UBI character under any circumstances unless the blocks are retransmissions (duplicates).

##### AOA Downlink Retransmission Detection

The aircraft is programmed to retransmit AOA messages for which an AOA acknowledgment has not been received from the ground station within a specified time period (VAT7). See the description of the No ACK timer (VAT7).

Note: The aircraft may have received a VDL mode 2 acknowledgment for the VDL mode 2 INFO frame containing an AOA packet. However, an AOA acknowledgement is also required to complete the message transaction.

The MSN in the AOA downlink is used by the DSP to detect duplicate downlink AOA transmissions. The DSP **shall** compare the MSN of the incoming block with the MSN of the preceding block. If the two MSN values match, then the downlink should be deemed a duplicate and discarded and an AOA acknowledgement uplinked the aircraft.

##### Multi-Block Processing

Multi-block messages are ground-to-air or air-to-ground transmissions in which the text information exceeds the size determined by the VDL mode 2 parameter N1-Uplink or N1-Downlink value. In order to send a message larger than a single ACARS block message requires the use of a multi-block message.

Airline Ground Communication Standards limit ground-ground messages to 3840 characters including all address information.

Multi-block message size is limited to 16 blocks.

The aircraft **shall** limit the size of downlink AOA messages to 3840 characters including all address information (see ARINC 620) and 16 AOA blocks. If the aircraft uses larger downlink AOA blocks when parameter N1-Downlink permits then the aircraft **shall** reduce the number of downlink AOA blocks in order to limit the AOA message size to 3840 characters.

###### Multi-Block Downlinks

The aircraft **shall** limit the size of downlink AOA messages to 3840 characters including all address information (see ARINC 620) and 16 AOA blocks. If the aircraft uses larger downlink AOA blocks when parameter N1-Downlink permits then the aircraft **shall** reduce the number of downlink AOA blocks in order to limit the AOA message size to 3840 characters.

The suffix character in a downlink AOA block allows the ground to determine whether a block is, or is not, the last block of a message. This is accomplished by using the End of Block <ETB> character as the suffix in intermediate blocks and the End of Transmission <ETX> character as the suffix in the last block of a message.

The downlink Message Sequence Number (MSN) allows the DSP to recognize independent messages and the sequence of blocks in a multi-block message. The downlink Message Sequence Number (MSN) allows the DSP to detect when downlink nesting occurs. The DSP procedures for delivering incomplete multi-block downlink messages are described in ARINC Specification 620.

Single block downlink messages are those where the first block is adequate to contain the entire message. The aircraft may prepare a downlink message that has text which is longer than the field provided in a single ACARS downlink block. In this case, the message is partitioned into as many blocks as is required, up to the 16 block maximum.

The final block of any message, either single or multi-block, **shall** contain a Suffix value of <ETX>. The first and intermediate blocks of a multi-block message **shall** contain a Suffix value of <ETB>.

For multi-block messages, all ACARS blocks of the same message are reassembled by the DSP before transmission in a single ground-ground message to the ground user.

A downlink multi-block AOA message reassembly session is closed by one of the following events:

1. The last ACARS block of the message is received, or
2. The Incomplete Downlink Message Delivery timer, VGT4, expires.

###### Incomplete Multi-Block Downlink

The service provider **shall** maintain an Incomplete Downlink Message Delivery timer (VGT4) set to the length of the interval which can elapse between the first block and the last block of a multi-block downlink message before it is declared incomplete. All nested multi-block messages completed before the timer VGT4 expires **shall** be delivered as completed messages by the DSP. Any nested multi-block downlink for which the last block has not been received prior to the expiration of VGT4 **shall** be considered an incomplete message by the service provider.

If the Incomplete Message Delivery timer (VGT4) expires before the last block is received, then the service provider **shall** identify the message as incomplete, including any nested multi-block messages for which the last block has not been received and forward the partial message(s) to the host.

Each block of the downlink message **shall** be retained by the DSP until the final block is received or the Incomplete Downlink Message Delivery timer (VGT4) has expired.

The CMU **shall** recognize that the multi-block downlink has not been delivered because the ACK to the final block was not received before multi-block message timer VAT10 expired.

###### Nesting of Multi-Block Downlinks

The CMU **shall** interrupt a multi-block message downlink in order to downlink a higher priority single block or multi-block message, according to the order of prioritization defined in ARINC 618 and if the number of nesting levels has not been reached yet. ~~The nesting of downlinks is a CMU option.~~

A multi-block downlink message, which was interrupted by a multi-block downlink message, **shall not** be interrupted by yet another multi-block message, but can be interrupted by a single block message or a system control downlink.

If the CMU exceeds the number of levels of multi-block nesting supported by the DSP, then the DSP **shall** abort the first (interrupted) message and forward the partial message to the host as an incomplete (intercept) message.

###### Effect of a Nested Downlink on VAT10 and VGT4

ARINC 618 aircraft timer VAT10 **shall** be managed with respect to nested downlinks as defined in ARINC 618.

ARINC 618 ground timer VGT4 **shal**l be managed with respect to nested downlinks as defined in ARINC 618.

###### Re-blocking a Multi-Block Downlink

The CMU may need to re-block the downlink data. This process should not modify the actual message. Re-blocking has implications in both Message Sequencing and Addressing.

##### AOA Multi-Block ACARS Uplinks

The airborne subsystem **shall** implement a Message Assembly timer (VAT4) which operates in conjunction with equivalent service provider timers (VGT2, VGT3) on the ground, to provide a consistent method for detecting incomplete multi-block uplinks.

The DSP **shall** maintain 618 No ACK timer (VGT1) and a Message Reject timer (VGT2) to minimize inadvertent concatenation of uplink messages.

The ground station **shall** limit the size of uplink AOA messages to 3840 characters including all address information (see ARINC 620) and 16 AOA blocks. If the parameter N1-Uplink value is greater than 2008 and the ground station uses larger uplink AOA blocks when N1-Uplink permits then the ground station **shall** reduce the number of uplink AOA blocks in order to limit the AOA message size to 3840 characters

###### AOA Message Assembly Timer

The airborne subsystem **shall** contain a Message Assembly timer (VAT4) in order to detect when a multi-block uplink is incomplete, regardless of whetherone uplink or two uplink messages are outstanding.

If the Message Assembly timer (VAT4) times out, then the CMU **shall** assume that the next block received is the first block of a new message and process any partial messages as specified by the user.

If two uplink messages are outstanding when the Message Assembly timer (VAT4) expires, then both messages **shall** be deemed incomplete and processed accordingly.

All uplink blocks having the same label/sublabel received prior to expiration of the Message Assembly timer (VAT4) **shall** be considered part of the same message, regardless of the ground site from which they were received.

###### AOA Ground No ACK Timer

If the No ACK timer (VGT1) expires, the service provider checks the retry logic to see if the block should be resent.

when VGT1 expires, the DSP **shall** determine whether to retransmit the block or transmit a higher priority message.

If the AOA retry counter has not been exceeded, then the ground station **shall** retransmit that block. When the retry limit is reached, then the DSP **shall** hold onto the message and wait for either a downlink from the aircraft or the Message Reject timer (VGT2) to time out.

###### AOA Ground Message Reject Timer (VGT2)

The service provider **shall** maintain a Message Reject timer (VGT2) to determine the point at which an attempted uplink should be declared unsuccessful. See ARINC 618 for a description of the Message Reject timer (VGT2).

When the Message Reject timer (VGT2) expires then the ground **shall** start the Incomplete Downlink Message Delivery Timer (VGT3).

When the Incomplete Downlink Message Delivery Timer (timer VGT3) is running then an uplink with the same label/sublabel as the uplink for which VGT2 expired **shall** not be uplinked until VGT3 expires.

When the Incomplete Downlink Message Delivery Timer (timer VGT3) is running then an uplink with a different label/sublabel than the uplink for which VGT2 expired shall be uplinked even though VGT3 is running.

When the Message Reject timer (VGT2) expires while a single uplink message is outstanding, then the service provider **shall** send a message to the originator to report that the message could not be delivered, and indicating the reason for non-delivery in the message.

If multiple uplink messages are outstanding when the Message Reject timer (VGT2) expires, all uplink messages **shall** be deemed unsuccessful.

For each incomplete message, the service provider **shall** send a messageto the originator to report that the message could not be delivered, and indicating the reason for non-delivery.

###### Restart ACARS Multi-Block AOA Uplink

If the DSP receives an VDL Mode 2 Link Establish XID while in the process of uplinking a multi-block AOA message then the DSP **shall** restart the multi-block AOA uplink message.

##### Nesting of ACARS Multi-Block AOA Uplinks

A multi-block uplink in progress may be interrupted for the transmission of a higher priority message with a different label/sublabel.

The DSP **shall** implement nesting of multi-block uplink messages as defined in ARINC 618.

The avionics **shall** implement nesting of multi-block uplink message as defined in ARINC 618.

The downlink response message is a Level 1 priority (system control) message.

##### ACARS Unable to Deliver AOA Uplink Message

The CMU **shall** respond to the receipt of an uplink message which temporarily cannot be delivered to the designated destination and downlink the message Unableto Deliver (Label Q5) and the uplink’s UBI in the Technical Acknowledgment field. The format of Label Q5 message is provided in Section 5.2.5 of ARINC Specification 620.

The CMU **shall** discard the undeliverable uplink block. The CMU **shall** set the UBI reference character to NUL. This procedure enables the CMU to properly process a retransmission of the uplink message if it is received after the “cannot handle” condition has dissipated.

Downlink Label Q5 **shall** be transmitted once and not retransmitted.

When the ground receives a Label Q5 downlink then it **shall** not uplink any response.

When uplink retransmission is caused by the ground receiving a message with the Unable to Deliver (Label Q5), then the retransmitted message **shall** contain a new UBI value.

 The downlink response message is a Level 1 priority (system control) message

##### Unusable ACARS Uplink Message

If the aircraft receives a message that is not supported or has an unrecognizable format and cannot be delivered to the designated aircraft destination then the CMU **shall** send an intercept downlink containing the Unusable (Label QX) and the offending uplink’s UBI in the Technical Acknowledgment field. All blocks received of the message **shall** be discarded. The format of the Label QX message is defined in Section 5.2.7 of ARINC Specification 620.

Possible conditions that could result in an unusable message include:

1. Invalid or unsupported Label and/or Sublabel
2. No onboard connection with destination
3. Unknown message format

The CMU **shall** discard the unusable message.

If the service provider receives an Unusable (Label QX) response from the aircraft then transmission of the uplink **shall** cease and the uplink returned to the message originator with the appropriated error code (see ARINC 620).

Downlink Label QX **shall** be transmitted once and not retransmitted.

When the ground receives a Label QX downlink then the ground **shall** not uplink any response.

The downlink response message is a Level 1 priority (system control) message

##### Undelivered Uplink Messages

When the CMU has acknowledged all the blocks of an uplink message, and is subsequently unsuccessful in its attempts to deliver that message to the airborne subsystem, then the CMU **shall** initiate an Undeliverable Label HX downlink message, indicating that the acknowledged message was not delivered. The format of the Undeliverable (Label HX) message is defined in Section 5.3.46 of ARINC Specification 620.

Note 1: The Label HX message is not a response to the DSP for an uplinked message, as are the other messages defined in this section because the previously downlinked ACARS acks indicated to the DSP that the uplinked message was successfully received by the CMU. The HX message requires an acknowledgment from the DSP; however, the meaning of the DSP response is transparent. Only the airline host system will know how to react to the HX message.

Downlink Label HX **shall** be transmitted with normal retransmission logic.

When the ground receives a Label HX downlink the ground **shall** uplink an ACARS acknowledgement.

if the uplink that triggers a label HX downlink, contained a Supplementary Address then the Supplementary Address **shall** be included in the Label HX downlink as shown in ARINC 620 so that the status of the uplink (undelivered) can be sent to the Supplementary Address. This is particularly important for ATS messages.

The downlink response message is a Level 1 priority (system control) message

##### Message Prioritization

The aircraft **shall** provide the capability to sort downlink AOA messages by priority according to the type of message.

The service provider **shall** provide the capability to sort uplink AOA messages by priority according to the type of message.

###### Priority of System Control Messages

ACARS system control (Level 1) messages **shall** be accorded first priority in the AOA downlink message queue. System Control messages have highest priority because their transmission is used in maintaining the communications link. System Control downlink messages include the following:

Table 3.8.3 – Message Priority

|  |  |  |
| --- | --- | --- |
| **Label** | **Message Title** | **Status** |
| Q5 | Unable to Deliver | required |
| QX | Intercept | required |
| CA-CF | Printer Reject | Optional |

When the Downlink Retry timer VAT7 limit is reached or the current AOA block is acknowledged, the transmission precedence of the messages in the queue **shall** be re‑evaluated. In some cases, this will result in the next message (all blocks of a message must be moved together) in the AOA queue being placed at the back of the line.

###### Regulatory Guidance on Priority

FCC Part 87 (amended by PR Docket No. 85‑292 RM 4993) specifies the rules by which communications are exchanged in aviation service. The amendment provided for the differentiation of message types, relegating airline company administrative messages to a lower priority than airlines operational communications as shown in Table 3.8.3.

Table 3.8.3 – AOA Message Priority

|  |  |
| --- | --- |
| **Type of AOA Message** | **Priority Rank** |
| Distress and Safety | Highest Priority |
| Air Traffic Control (ATC) |  | | |
| Aircraft Operational Control (AOC) |  | | |
| Airline Administrative Communications (AAC) | Lowest Priority |

A more exhaustive list of priorities is provided in Attachment 11 of ARINC Specification 619. The goal of the aircraft and ground **shall** be to expedite delivery of ATS messages within the Required Communications Performance criteria specified by regulatory authorities**.**