Protocol Implementation
Conformance Statement ProForma

(This annex **is** part of the Recommendation.)

 Introduction

This annex provides the Protocol Implementation Conformance Statement (PICS) Requirements List (PRL) for implementations of the Proximity-1 Data Link layer standard. The PICS for an implementation is generated by completing the PRL in accordance with the instructions below.

An implementation’s completed PRL is called the PICS. The PICS states which protocol features have been implemented. The following entities can use the PICS:

– the protocol implementer, as a checklist to reduce the risk of failure to conform to the standard through oversight;

– the supplier and acquirer or potential acquirer of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma;

– the user or potential user of the implementation, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICSes);

– a protocol tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

. REFERENCED BASE STANDARDS

 [1] *Proximity-1 Space Link Protocol—Physical Layer*. Recommendation for Space Data System Standards, CCSDS 211.1-B-3. Blue Book. Issue 3. Washington, D.C.: CCSDS, March 2006.

[2] *Proximity-1 Space Link Protocol: Coding and Synchronization Sublayer*. Recommendation for Space Data System Standards, CCSDS 211.2-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, April 2003.

[3] *Proximity-1 Space Link Protocol—Data Link Layer*. Recommendation for Space Data System Standards, CCSDS 211.0-B-4. Blue Book. Issue 4. Washington, D.C.: CCSDS, July 2006.

. GENERAL INFORMATION

.. IDENTIFICATION OF PICS

|  |  |
| --- | --- |
| Ref | Question |
| 1 | Date of Statement (DD/MM/YYYY) |  |
| 2 | CCSDS document number containing the PICS |  |
| 3 | Date of CCSDS Document containing the PICS |  |

.. IDENTIFICATION OF IMPLEMENTATION UNDER TEST (IUT)

|  |  |  |
| --- | --- | --- |
| Ref | Question | Response |
| 1 | Implementation name |  |
| 2 | Implementation version |  |
| 3 | Machine name |  |
| 4 | Machine version |  |
| 5 | Operating System name |  |
| 6 | Operating System version |  |
| 7 | Special Configuration |  |
| 8 | Other Information |  |

.. USER IDENTIFICATION

|  |  |
| --- | --- |
| Supplier |  |
| Contact Point for Queries |  |
| Implementation name(s) and Versions |  |
| Other Information Necessary for full identification - e.g., name(s) and version(s) for machines and/or operating systems;System Name(s) |  |

. INSTRUCTIONS FOR COMPLETING THE PRL

An implementer shows the extent of compliance to the protocol by completing the PRL; the resulting completed PRL is called a PICS.

The referenced document below is document [3] unless otherwise stated.

 **CCSDS PROXIMITY-1 DATA LINK LAYER PICS**

**1.0 GENERAL REQUIREMENTS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| GR-01 |  | Bit and Byte Numbering Convention: The first bit in the field to be transmitted (i.e., the most left justified when drawing a figure) is defined to be ‘Bit 0’; the following bit is defined to be ‘Bit 1’ and so on up to ‘Bit N-1’. When the field is used to express a binary value (such as a counter), the Most Significant Bit (MSB) shall be the first transmitted bit of the field, i.e., ‘Bit 0’, as shown in figure 1. The numbering for octets within a data structure begins with zero. Octet zero is the first octet to be transmitted. By CCSDS convention, all ‘spare’ bits shall be permanently set to value ‘zero’. | 1.5.3 |  |  |

**2. PROTOCOL DATA UNITS**

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| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| PDU-01 |  | A Version-3 Transfer Frame shall encompass the following fields, positioned contiguously, in the following sequence:1. Transfer Frame Header (five octets, mandatory);
2. Transfer Frame Data Field (up to 2043 octets).
 | 3.2.1 |  |  |
| PDU-02 |  | The maximum transfer frame length allowed by a particular spacecraft or ground implementation per Physical Channel may be less than the maximum (2048 octets). Provide the implementation’s maximum size Transfer Frame here. | 3.2.1 |  |  |
| PDU-03 |  | The Transfer Frame Header is mandatory and shall consist of ten mandatory fields, positioned contiguously, in the following sequence:1. Transfer Frame Version Number (2 bits);
2. Quality of Service (QOS) Indicator (1 bit);
3. Protocol Data Unit (PDU) Type ID (1 bit);
4. Data Field Construction Identifier (DFC ID) (2 bits);
5. Spacecraft Identifier (10 bits);
6. Physical Channel Identifier (PCID) (1 bit);
7. Port ID (3 bits);
8. Source-or-Destination Identifier (1 bit);
9. Frame Length (11 bits);
10. Frame Sequence Number (interpretation is QOS dependent) (8 bits).
 | 3.2.2.1 |  |  |
| PDU-04 |  |  Bits 0–1 of the Transfer Frame Header shall contain the Transfer Frame Version Number and it shall contain the binary value ‘10’. | 3.2.2.2 |  |  |
| PDU-05 |  | Bit 2 of the Transfer Frame Header shall contain the QOS Indicator.The QOS Indicator shall indicate the transfer service:1. The QOS Indicator is set to ‘0’ for a frame on the Sequence Controlled service.

The QOS Indicator is set to ‘1’ for a frame on the Expedited service. | 3.2.2.3 |  |  |
| PDU-06 |  | Bit 3 of the Transfer Frame Header shall contain the PDU Type ID.The PDU Type ID shall specify whether the Transfer Frame Data field is conveying protocol supervisory data or user data information.1. The PDU Type ID is set to ‘0’ when the Transfer Frame Data Field contains user data.
2. The PDU Type ID is set to ‘1’ when the Transfer Frame Data Field contains Supervisory Protocol Data Units (SPDUs).
 | 3.2.2.4 |  |  |
| PDU-07 |  | Bits 4–5 of the Transfer Frame Header shall contain the Data Field Construction ID (DFC ID).In a P-frame, the DFC ID is not used, and shall be set to the binary value ‘00’.In a U‑Frame, the DFC ID shall indicate the contents of the Transfer Frame Data Field as defined below:

|  |
| --- |
| DFC ID - ‘00b’ - Packets (integer number of unsegmented packets) |
| DFC ID - ‘01b’ - Segment Data (a complete segmented packet) |
| DFC ID - ‘10b’ - Reserved for future CCSDS definition. |
| DFC ID - ‘11b’ - User-defined Data |

 | 3.2.2.5 |  |  |
| PDU-08 |  | Spacecraft Identifier (SCID): Bits 6–15 of the Transfer Frame Header shall contain the Spacecraft Identifier (SCID).The 10-bit SCID shall provide the identification of the spacecraft that is either the source or the destination of the data contained in the transfer frame. | 3.2.2.6 |  |  |
| PDU-09 |  | Bit 16 of the Transfer Frame Header shall contain the Physical Channel Identifier (PCID).The PCID shall be used to identify the Physical Channel on which the frame is transmitted:a) PCID is set to ‘0’ if the frame is to be received by the Receiver designated by the physical channel whose PCID is 0;b) PCID is set to ‘1’ if the frame is to be received by the Receiver designated by the physical channel whose PCID is 1. | 3.2.2.7 |  |  |
| PDU-10 |  | Bits 17–19 of the Transfer Frame Header shall contain the Port Identifier (Port ID).In a P-frame, the Port ID is not used and shall be set to the value ‘0’.In a U-frame, the Port ID shall identify the output port to which the I/O sublayer delivers the SDUs contained in the frame.Specify the Port IDs used by the implementation and for what purpose here | 3.2.2.8 |  |  |
| PDU-11 |  | Bit 20 of the Transfer Frame Header shall contain the Source-or-Destination Identifier.The sending node shall set the Source-or-Destination Identifier to indicate the contents of the SCID field as shown in Table 3-1b.

|  |  |  |
| --- | --- | --- |
| Source-or-Destination Identifier value | SCID field contents | Transmitted SCID |
| 0 (= source) | SCID of spacecraft that is sending the frame over this link | MIB parameter Local\_Spacecraft\_ID |
| 1 (= destination) | SCID of spacecraft that is intended to receive the frame over this link | MIB parameter Remote\_Spacecraft\_ID |

Table 3-1b: Setting the SCID field and Source-or-Destination Identifier when the frame is created | 3.2.2.9Rewording of this section approved by WG |  |  |
| PDU-12 |  | The behavior of a receiving node with respect to the SCID field and Source-or-Destination Identifier as shown in Table 3-1c:

|  |  |  |  |
| --- | --- | --- | --- |
| Source-or-Destination Identifier value | Test Source value | SCID used to Validate | Section(s) that specify behavior |
| 0 (= source) | true  | MIB parameter Remote Spacecraft\_ID | 6.2.4.2 6.8.3 d |
| 0 (= source) | false | No test is performed | 6.2.4.26.8.3. d |
| 1 (= destination) | True or false | MIB Parameter Local\_Spacecraft\_ID  | 6.8.3 c |

Table 3-1c: SCID field and Source-or-Destination Identifier when the frame is received | 3.2.2.9Rewording of this section approved by WG |  |  |
| PDU-13 |  | Bits 21–31 of the Transfer Frame Header shall contain the Frame Length.This 11-bit field shall contain a length count C, which equals one fewer than the total number of octets in the transfer frame.1. the count shall be measured from the first octet of the Transfer Frame Header to the last octet of the Transfer Frame Data field;
2. the length count C is expressed as: C = (total number of octets in the transfer frame) – 1.

The maximum transfer frame length allowed by a particular spacecraft or ground implementation per Physical Channel may be less than the maximum (2048 octets) (C = 2047). The minimum length is 5 octets (C = 4).Provide the implementation’s maximum and minimum size Transfer Frames here. | 3.2.2.10 |  |  |
| PDU-14 |  | Bits 32–39 of the Transfer Frame Header shall contain the Frame Sequence Number (FSN).The FSN shall increment monotonically and independently for the set of frames within a PC that are associated with the Sequence Controlled service (QOS Indicator set to ‘0’). In this case, the FSN is called the Sequence\_Controlled\_FSN (SEQ\_CTRL\_FSN).The FSN shall increment monotonically for the set of frames for a given PC that are associated with the Expedited Service (QOS Indicator set to ‘1’). In this case, the FSN is called the Expedited\_FSN (EXP\_FSN). | 3.2.2.11 |  |  |
| PDU-15 |  | The Transfer Frame Data field shall:1. follow, without gap, the Transfer Frame Header;
2. be of variable length;
3. contain from zero octets up to 2043 octets (maximum frame length of 2048 less five octets for the frame header);
4. contain either an integer number of octets of data corresponding to one or more SDUs (U-frame), or an integer number of octets of protocol information (P-frame).
 | 3.2.3 |  |  |
| PDU-16 |  | Transfer Frame Data field contents in a U-frame:Packets: When the DFC ID field of a U-frame contains the binary value ‘00’, the Frame Data field shall consist of an integer number of packets each designated to the same Port ID (see figure 3-7)The first bit of the Frame Data field shall be the first bit of a packet header.Segments: When the DFC ID field of a U-frame contains the binary value ‘01’, the Frame Data field contains a Segment data unit consisting of an eight-bit segment header followed by a segment of a packet (see figure 3‑4).CCSDS Reserved Field: In a U-frame, the binary value ‘10’ for the DFC ID field is reserved by CCSDS and shall not be used.User Defined Data: When the DFC ID field of a U-frame contains the binary value ‘11’, the Frame Data field shall consist of User Defined Data (see figure 3‑4). | 3.2.4 (Packets)3.2.5(Segments)3.2.6 (Reserved)3.2.7(User defined data) |  |  |
| PDU-17 |  | SEGMENTATION FORMAT: The contents of the segment header and segment data field shall be as follows:1. bits 0 and 1 of the segment header compose the sequence flags, which shall identify the position of the segment relative to the packet of which the segment is a part as specified in table 3-2;
2. the remaining six bits of the segment header compose an identifier field, the pseudo packet identifier, which shall adaptively be used to associate all the segments of a packet data unit;
3. segments must be placed into the data link in the proper order:
4. segments of the same packet must be sent in frames of the same PCID and Port ID,
5. segments from another packet may be interspersed but only in frames containing a different PCID or Port ID.
 | 3.2.5 |  |  |
| PDU-18 |  | Segment Header Sequence Flags (Table 3-2):A sequence flag value of ‘01’ shall be interpreted as the first segment.A sequence flag value of ‘00’ shall be interpreted as a continuing segment.A sequence flag value of ‘10’ shall be interpreted as the last segment.A sequence flag value of ‘11’ shall be interpreted as no segmentation (i.e., contains the entire packet). | 3.2.5.2 |  |  |
| PDU-19 |  | PACKET REASSEMBLY: Prior to delivery to the user, the Data Link layer shall re-assemble all the segments using the same Routing ID, i.e., using the same PCID, Port ID, and pseudo packet ID, into a packet. Only complete packets shall be delivered to the user.The accumulated packet shall be discarded and this event shall be logged into the session accountability report whenever any of the following errors occur:1. the packet length field does not agree with the number of bytes received and aggregated from the segments;
2. the first segment received for a Routing ID is not the start segment of the data unit;
3. the last segment for a Routing ID is not received before the starting segment of a new packet is received.
 | 3.2.5.33.2.5.43.2.5.5 |  |  |
| PDU-20 |  | In a P-frame, the Transfer Frame Data field shall consist of supervisory PDUs (SPDUs). | 3.2.8Clarification approved by the WG |  |  |
| PDU-21 |  | SPDUs may be transmitted using only the expedited QOS (QOS = ‘1’) | 3.2.8.1.2 |  |  |
| PDU-22 |  | Table 3-3 defines the format for Fixed-Length Supervisory Protocol Data Units (of which there are two types: Fixed length PLCW and one reserved for CCSDS) | 3.2.8.3 |  |  |
| PDU-23 |  | Table 3-4 defines the format for Variable-Length Supervisory Protocol Data Units (of which there are three types currently defiined: 1) Directives/Reports/PLCWs, 2) Time Distribution PDU, 3) Status Reports  | 3.2.8.4 |  |  |

**3. FRAME SUBLAYER FUNCTIONS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| FSF-01 |  | At the sending end, the Frame sublayer shall accept frames supplied by the Data Services and MAC sublayers and modify field values as necessary | 4.1.1.1 |  |  |
| FSF-02 |  | At the sending end, the Frame sublayer shall formulate PLCWs and status reports and incorporate them into a P-frame as required. | 4.1.1.1 |  |  |
| FSF-03 |  | At the sending end, the Frame sublayer shall determine the order of frame transmission | 4.1.1.1 |  |  |
| FSF-04 |  | At the sending end, the Frame sublayer shall transfer the frames to the C&S sublayer. | 4.1.1.1 |  |  |
| FSF-05 |  | At the receiving end, the Frame sublayer shall receive a frame from the C&S sublayer. | 4.1.1.2 |  |  |
| FSF-06 |  | At the receiving end, the Frame sublayer shall validate that the received frame is a Version-3 Transfer Frame. | 4.1.1.2 |  |  |
| FSF-07 |  | At the receiving end, the Frame sublayer shall validate that the frame should be accepted by the local transceiver based on the Spacecraft ID field and the Source-or-Destination ID of the transfer frame. | 4.1.1.2 |  |  |
| FSF-08 |  | At the receiving end, if the frame is a valid U-Frame, the Frame sublayer shall route it to the data services sublayer | 4.1.1.2 |  |  |
| FSF-09 |  | At the receiving end, if the frame is a valid P-Frame, the Frame sublayer shall route the contents of the frame (SPDUs) to the MAC sublayer | 4.1.1.2 |  |  |
| FSF-10 |  | At the receiving end, if the frame is a valid P-Frame and contains a PLCW, the Frame sublayer shall route the PLCW to the data services sublayer | 4.1.1.2 |  |  |

**4. FRAME MULTIPLEX PROCESS CONTROL**

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| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| FMPC-01 |  | Frames shall be generated and sent as required when the TRANSMIT parameter is set to on. When the PLTU contents are ready for transmission and while TRANSMIT is on, the data shall be transferred to the C&S sublayer for processing. | 4.1.2.1.1 |  |  |
| FMPC-02 |  | When either NEED\_PLCW or NEED\_STATUS\_REPORT is set to true, the required status and/or PLCW data shall be generated and inserted into a P-frame for delivery. | 4.1.2.1.2 |  |  |
| FMPC-03 |  | Each time a transfer frame is to be dispatched to the C&S sublayer, its selection from a series of sources shall be based on the following priority schemes:a) 1st priority shall be given to a frame from the MAC queue in the MAC sublayer;b) 2nd priority shall be given to a PLCW or status report, if U-frame\_last\_sent is true;c) 3rd priority shall be given to an Expedited frame from the Expedited Frame queue in the I/O sublayer;d) 4th priority shall be given to a Sequence Controlled frame, first from the Sent queue if required, and then from the Sequence Controlled Frame queue in the I/O sublayer;e) 5th priority shall be given to a PLCW or status report , if U-frame\_last\_sent is False.See notes – Section 4.1.2.2 | 4.1.2.2 |  |  |

**5. MAC SUBLAYER: PERSISTENT ACTIVITY PROCESS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| PAP-01 |  | Upon initiation of a persistent activity, a hold (PERSISTENCE signal is set to true) shall be placed upon the Frame sublayer to inhibit the selection of any frame other than a frame from the MAC queue | 4.2.2.2.2 |  |  |
| PAP-02 |  | The success or failure of the activity shall be determined by the detection of the expected RESPONSE within the activity’s LIFETIME:a) no response within the activity’s LIFETIME period shall be deemed a failure;b) in either case, a NOTIFICATION of the activity’s success or failure shall be communicated back to the vehicle controller, and the PERSISTENCE signal shall be set to false. | 4.2.2.2.3 |  |  |

**6. MAC CONTROL MECHANISMS**

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| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| MCM-01 |  | PERSISTENCE: when true shall set a hold on the frame selection process in the Frame sublayer, allowing only frames from the MAC queue to be selected for output. When false, no restriction applies.  | 4.2.3.1 |  |  |
| MCM-02 |  | MAC\_FRAME\_PENDING: set to true when a complete frame is loaded into the MAC queue. Set to false when the last bit of the frame is extracted from the MAC queue. | 4.2.3.2 |  |  |
| MCM-03 |  | TIME\_COLLECTION: used to indicate the status of collecting time correlation data (time, frame sequence numbers, direction) during Timing Services. It has 3 states: inactive, collecting data, collection complete (but not yet read out) | 4.2.3.3 |  |  |
| MCM-04 |  | Implementations shall include a Directive Decoder function for processing the supervisory protocol directives defined in Section 3.2.8 and Annex A | 4.2.4 |  |  |
| MCM-05 |  | SENT\_TIME\_BUFFER: shall store all of the egress clock times, and associated frame sequence numbers when TIME\_COLLECTION is in either the ‘collecting data’ or ‘collection complete’ state. | 4.2.5.1 |  |  |
| MCM-06 |  | RECEIVE\_TIME\_BUFFER: shall store all of the ingress clock times, and associated frame sequence numbers when TIME\_COLLECTION is in either the ‘collecting data’ or ‘collection complete’ state. | 4.2.5.2 |  |  |

**7. DATA SERVICES SUBLAYER**

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| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| DSS-01 |  | Data Services sublayer on the sending side shall : a) run the FOP-P process, b) process received PLCWs, c) acknowledge delivery of complete SDUs to the I/O sublayer, d) provide frame accountability to the I/O sublayer, e) accept either an Expedited or a Sequence Controlled frame from the I/O sublayer.  | 4.3.1.1 |  |  |
| DSS-02 |  | Data Services sublayer on the receive side shall: a) run the FARM-P process, b) accept U-frames from the frame sublayer. | 4.3.1.2 |  |  |
| DSS-03 |  | Data Services sublayer shall control the order of transfer of the user data (including user-supplied directives) that are to be transmitted within the session | 4.3.2.1 |  |  |
| DSS-04 |  | Data Services sublayer shall provide the following two grades of service:a) Expedited service shall ensure transmission without errors of Expedited frame data in the order received;b) Sequence Controlled service shall guarantee that data within a communication session are delivered in order without errors, gaps, or duplications. | 4.3.2.2 |  |  |

**8. I/O INTERFACE SUBLAYER**

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| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| IOI-01 |  | Upon input, I/O sublayer shall:1. accept for transfer the data for which the user specifies: 1) the required QOS, 2) the output port ID, 3) PDU type, 4) frame data field construction rules, 5) Remote\_Spacecraft\_ID, 6) PDIC, 7) Source-or-Destination ID
2. using the value of the MIB parameter, Maximum\_Packet\_Size, organize the received data to form the Frame Data Unit and the Transfer Frame Header
3. notify the user when an Expedited SDU is radiated
4. notify the user when a Sequence Controlled SDU has been successfully transferred across the communications channel.
 | 4.4.1.1 |  |  |
| IOI-02 |  | I/O sublayer shall output received and accepted SDUs: a) receive U-frames accepted via the lower layers, b) assemble received segments into packets and verify that each packet is complete, c) deliver only complete packets to the user(length of the rebuild packet must match packet length field), and discard incomplete packets, d) deliver the packets/user-defined data via the specified output port ID in the U-frame header. | 4.4.1.2 |  |  |
| IOI-03 |  | I/O sublayer i/f sublayer shall pass the service data units that require the Sequence Controlled service via the the Sequence Controlled queue, and shall pass those for the Expedited queue. | 4.4.2.1 |  |  |
| IOI-04 |  | I/O sublayer i/f sublayer shall provide 2 queues (Expedited and Sequence Controlled) for the received U-frames capable of supporting the maximum data rate expected using the communications channel with that transceiver. | 4.4.2.2 |  |  |
| IOI-05 |  | For Sequence controlled service, the I/O sublayer maintains an association between each SDU provided to the Data Services sublayer and the frame sequence number of the frame which contains the last octet of the SDU. | 4.4.2.3 |  |  |
| IOI-06 |  | For Sequence Controlled service, the I/O sublayer evaluates NN(R), to validate that a complete SDU was received from the Data Services sublayer, and notifies the user when acknowledged transfer of the SDU has been accomplished.  | 4.4.2.4 |  |  |
| IOI-07 |  | While any data units are stored within the Sequence Controlled Frame queue, SEQUENCE\_CONTROLLED\_FRAME\_AVAILABLE shall be true; otherwise it shall be false. | 4.4.3.1 |  |  |
| IOI-08 |  | While any data units are stored within the Expedited Frame queue, EXPEDITED\_FRAME\_AVAILABLE shall be true; otherwise, it shall be false. | 4.4.3.2 |  |  |
| IOI-09 |  | When the Data Services sublayer extracts a frame from either queue, that frame is permanently removed from the queue, and the appropriate frame available parameter is reevaluated.  | 4.4.3.3 |  |  |

**9. TIMING SERVICES**

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| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| TS-01 |  | The time tag capture method shall be composed of the following steps:1. The vehicle controller shall issue a SET CONTROL PARAMETERS (local time tag) directive to the initiating transceiver, instructing it to capture its local time reference and associated frame sequence numbers over a commanded interval of frames. Upon receipt of this directive, the MAC sublayer shall set the Time\_Collection variable from inactive to collecting data, indicating that time collection has started.
2. The initiating transceiver shall build and transmit the SET CONTROL PARAMETERS (Time Sample) directive. Upon egress of each frame during the commanded interval (based upon the value of Time Sample), the initiating transceiver shall capture the time and frame sequence number of every Proximity frame being radiated. The application processes, which use the collected data, will also require information about any internal signal path delays associated with the radiation process. Once the commanded interval has been reached (the prescribed number of frame time tags have been captured), the MAC sublayer shall set the Time\_Collection variable to collection complete, indicating that those times and sequence numbers are available for transfer. Coincidently upon receipt of the SET CONTROL PARAMETERS directive, the recipient transceiver shall identify and decode the directive and capture the subsequent time and frame sequence number of every Proximity frame received over the commanded interval. The recipient transceiver shall also keep track of any internal signal path delays in the process. Upon readout of the collected data set, Time\_Collection shall be set to inactive.
3. When the time collection process is completed, both the initiating and remote transceivers shall transfer their captured times, associated frame sequence numbers, and direction (indication of whether time tagging was performed upon frame egress or ingress) of every transmitted and received Proximity-1 frame over the commanded interval to their respective vehicle controllers.
4. The vehicle controller (CDS) shall create a Proximity time correlation packet consisting of the series of points (time tag, frame sequence number, time tag direction) it received from its local transceiver collected over the commanded interval. In addition, the internal signal path delays in the transmission and reception chains of the transceiver are required to be known a priori.

See Figure 5-1 | 5.2.2 |  |  |
| TS-02 |  | The method for transferring time to a remote asset shall consist of the following steps:1. As soon as possible after a Proximity time correlation between the initiator and recipient is completed, the initiator shall build and transmit the Time Distribution (Time Transfer) directive over the Proximity link. This directive contains the correlation between the Enterprise’s master clock and the recipient’s clock.
2. The recipient transceiver shall decode the directive and transfer the contents of the directive (the Enterprise’s master clock to local Proximity clock correlation) to its vehicle controller.
3. The recipient vehicle controller shall apply the correlation in order either to project the Enterprise’s master clock values into the future, or to correct past clock values.

See Figure 5-2 | 5.2.3 |  |  |

**10. STATE TABLE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| ST-01 |  | Table 6-2 States Independent of the DUPLEX Variable | 6.2.1 |  |  |
| ST-02 |  | Table 6-3 States when DUPLEX = FullNOTE: In State S33, the new description to this State is: In this state the HAIL directives: (if present) SET\_PL EXTENSIONS , SET\_TRANSMITTER\_PARAMETERS, (if present) SET PL EXTENSIONS, SET\_RECEIVER\_PARAMETERS) in that order are radiated in one Proximity-1 transfer frame to initiate a session with the hailed remote unit, i.e., the responder. | 6.2.1(Needed by those missions to support data rates above 256 Kbps) |  |  |
| ST-03 |  | Table 6-4 States when DUPLEX = HalfNOTE: In State S13, the new description to this State is: In this state the HAIL directives: (if present) SET\_PL EXTENSIONS , SET\_TRANSMITTER\_PARAMETERS, (if present) SET PL EXTENSIONS, SET\_RECEIVER\_PARAMETERS) in that order are radiated in one Proximity-1 transfer frame to initiate a session with the hailed remote unit, i.e., the responder.(Needed to support data rates above 256 Kbps) | 6.2.1(Needed to support data rates above 256 Kbps) |  |  |
| ST-04 |  | Table 6-5 States when DUPLEX = Simplex | 6.2.1 |  |  |

**11. STATE CONTROL VARIABLES**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| SCV-01 |  | State Control Variable: MODE | 6.2.2.1 |  |  |
| SCV-02 |  | State Control Variable: DUPLEX | 6.2.2.2 |  |  |
| SCV-03 |  |  State Control Variable: TRANSMIT | 6.2.2.3 |  |  |
| SCV-04 |  |  State Control Variable: SUB-STATE | 6.2.2.4 |  |  |

**12. OPERATIONAL CONTROL VARIABLES**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| OCV-01 |  | Operational Control Variable: X | 6.2.3.1 |  |  |
| OCV-02 |  | Operational Control Variable: Y | 6.2.3.2 |  |  |
| OCV-03 |  | Operational Control Variable: Z | 6.2.3.3 |  |  |
| OCV-04 |  | Operational Control Variable: MODULATION | 6.2.3.4 |  |  |
| OCV-05 |  | Operational Control Variable:PERSISTENCE | 6.2.3.5 |  |  |
| OCV-06 |  | Operational Control Variable:NEED\_PLCW AND NEED\_STATUS\_REPORT | 6.2.3.6 |  |  |
| OCV-07 |  | Operational Control Variable: REMOTE\_SCID\_BUFFER | 6.2.3.7 |  |  |
| OCV-08 |  | Operational Control Variable: COMMUNICATION\_VALUE\_BUFFER | 6.2.3.8 |  |  |
| OCV-09 |  | Operational Control Variable: Receiving\_SCID\_Buffer | 6.2.3.9 |  |  |
| OCV-10 |  | Operational Control Variable: Receiving\_PCID\_Buffer | 6.2.3.10 |  |  |

**13. DATA LINK LAYER MIB PARAMETERS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| DMP-01 |  | Local\_Spacecraft\_ID | 6.2.4.1 |  |  |
| DMP-02 |  | Test\_Source | 6.2.4.2 |  |  |
| DMP-03 |  | Carrier\_Only\_Duration – Updated definition below: Carrier\_Only\_Duration represents the time that shall be used to radiate an unmodulated carrier at the beginning of a transmission. Separate MIB settings for this timer may be needed depending upon the function (hailing vs comm. change). | 6.2.4.3Updated definition |  |  |
| DMP-04 |  | Acquisition\_Idle\_Duration – Updated definition: Acquisition\_Idle\_Duration represents the time that shall be used to radiate the idle sequence pattern after carrier only to enable the receiving transceiver to achieve bit synchronization and decoder lock. Separate MIB settings for this timer may be needed depending upon the function (hailing vs comm. change). | 6.2.4.4Updated definition |  |  |
| DMP-05 |  | Tail\_Idle\_Duration - Updated definition:Tail\_Idle\_Duration represents the time that shall be used to radiate the idle sequence pattern at the end of a transmission to enable the receiving transceiver to process the last transmitted frame (i.e., push the data through the decoders). The time value for the Tail\_Idle\_Duration parameter can be calculated from the number of idle bits that need to be sent. Separate MIB settings for this timer may be needed depending upon the function (hailing vs comm. change). | 6.2.4.5Updated definition |  |  |
| DMP-06 |  | Carrier\_Loss\_Timer\_Duration | 6.2.4.6 |  |  |
| DMP-07 |  | Comm\_Change\_Waiting\_Period | 6.2.4.7 |  |  |
| DMP-08 |  | Comm\_Change\_Response | 6.2.4.8 |  |  |
| DMP-09 |  | Comm\_Change\_Notification | 6.2.4.9 |  |  |
| DMP-10 |  | Comm\_Change\_Lifetime | 6.2.4.10 |  |  |
| DMP-11 |  | Hail\_Wait\_Duration - Updated definition:Hail\_Wait\_Duration represents the time that the initiating transceiver (Hailer) will wait for a response to the HAIL. This value must exceed the partnered transceiver’s Carrier\_Loss\_Timer\_Duration. This is required for the partnered transceiver to lose carrier lock between rehailing attempts. | 6.2.4.11Updated definition |  |  |
| DMP-12 |  | Hail\_Response | 6.2.4.12 |  |  |
| DMP-13 |  | Hail\_Notification | 6.2.4.13 |  |  |
| DMP-14 |  | Hail\_Lifetime | 6.2.4.14 |  |  |
| DMP-15 |  | Hailing\_Channel | 6.2.4.15 |  |  |
| DMP-16 |  | Hailing\_Data\_Rate | 6.2.4.16 |  |  |
| DMP-17 |  | Send\_Duration | 6.2.4.17 |  |  |
| DMP-18 |  | Receive\_Duration | 6.2.4.18 |  |  |
| DMP-19 |  | PLCW\_Repeat\_Interval | 6.2.4.19 |  |  |

**14. PROX-1 TIMERS and EVENTS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| PT-01 |  | Carrier\_Loss\_Timer | 6.3.2 |  |  |
| PT-02 |  | PLCW Timer | 6.3.3 |  |  |
| PT-03 |  | Output FIFO | 6.3.4 |  |  |
| PT-04 |  | No\_Frames\_Pending | 6.3.5 |  |  |

**15. DIRECTIVES**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| D-01 |  | SET MODE | 6.3.6.1.1 |  |  |
| D-02 |  | SET INITIALIZE MODE | 6.3.6.1.2 |  |  |
| D-03 |  | LOCAL COMM\_CHANGE (LCCD) | 6.3.6.1.3 |  |  |
| D-04 |  | LOAD COMMUNICATIONS VALUE BUFFER | 6.3.6.1.4 |  |  |
| D-05 |  | LOCAL\_NO\_MORE\_DATA (LNMD) | 6.3.6.1.5 |  |  |
| D-06 |  | SET DUPLEX | 6.3.6.1.6 |  |  |
| D-07 |  | SET RECEIVING SCID BUFFER | 6.3.6.1.7 |  |  |
| D-08 |  | READ STATUS | 6.3.6.1.8 |  |  |
| D-09 |  | SET TRANSMITTER PARAMETERS | 6.3.6.2.1 |  |  |
| D-10 |  | SET RECEIVER PARAMETERS | 6.3.6.2.2 |  |  |
| D-11 |  | SET PL EXTENSIONS:SET PL EXTENSIONS directive is the mechanism by which additionalPhysical layer parameters defined outside of the Proximity-1 Physical layer canbe enabled or disabled. This directive is transferred across the Proximity linkfrom the local transceiver to the remote transceiver. This directive is provided for compatibility between transceivers with physical layer extensions in addition to those discussed in this Proximity-1 Recommendation.Note: This directive is the same one already defined in Annex A. | NEWSubsection |  |  |
| D-12 |  | SET CONTROL PARAMETERS | 6.3.6.2.3 |  |  |
| D-13 |  | Initialized Prox-1 Control Variables | 6.3.7 |  |  |

**16. FULL DUPLEX STATE TABLE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| FDST-01 |  | Table 6-7 Full Duplex Session Establishment/Data Services State Transition Table – see updated entries below:Event E3 - HAIL Directives ReceivedReceive (if present) SET PL EXTENSIONS, Set\_Transmitter\_PARAMETERS,(if present) SET PL EXTENSIONS, SET\_RECEIVER\_PARAMETERS DirectivesEvent E9 - Valid Transfer Frame Received Actions (new action in RED):- Set Transmitter values from Comm Value Buffer- WT=Carrier\_Only\_Duration- Set Modulation=off- Set Transmit = on- Set PERSISTENCE=false- Send Hail\_Notification to C&DH | 6.4.2Needed to support data rates above 256 Kbps)Changed Set TRANSMIT to ON (previous value was true) |  |  |
| FDST-02 |  | Table 6-8: Full Duplex Comm Change State Table  | 6.4.2 |  |  |
| FDST-03 |  | Table 6-9: Full Duplex Session Termination State TableUpdates to this table include:Event E28 description:SET MODE Inactive- Notify vehicle controller: End of Session (# octets received)NOTES1. Not Shown on Full Duplex Transition Diagram.
2. E28 initializes Prox-1 control variables See table 6‑6.
 | 6.4.2explicitly now states SET MOD inactive, and notifies vehicle controller |  |  |
| FDST-04 |  | Table 6-10: Half Duplex Session Establishment and Data Services State TableUpdates to this table include:E30 Hail Received:Receive (if present) SET PL EXTENSIONS, Set\_Transmitter\_PARAMETERS,(if present) SET PL EXTENSIONS, SET\_RECEIVER\_PARAMETERS Directives | 6.4.3Needed to support data rates above 256 Kbps) |  |  |
| FDST-05 |  | Table 6-11: Half Duplex Communication\_ Change State Table | 6.4.3 |  |  |
| FDST-06 |  | Table 6-12: Half Duplex Session Termination State Table | 6.4.3 |  |  |
| FDST-07 |  | Table 6-13 Simplex State Transition Table | 6.5 |  |  |

**17. INTERFACES WITH THE PHYSICAL LAYER**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| IPL-01 |  | Output InterfacesUpdate: When on, the Modulation Signal requires the transceiver to modulate the carrier with the data provided on the Output Bitstream. | 6.6.1MODULATION value set to ON |  |  |
| IPL-02 |  | Input Interfaces | 6.6.2 |  |  |

**18. SENDING OPERATIONS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| SO-01 |  | Table 6-14: Data Source Selection for Output Bit Stream with TRANSMIT = on and MODULATION = on | 6.7.2 |  |  |
| SO-2 |  | Events related to data handling activities | 6.7.4 |  |  |

**19. RECEVING OPERATIONS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| RO-01 |  | All of the Receiving operations in 6.8In addition there is an update to the following sub-requirements:1. 6.8.3 c The Spacecraft ID (SCID) field in the transfer frame header shall contain the value of the Local\_Spacecraft\_ID (MIB parameter) when the Source-or-Destination Identifier value equals ‘1’, i.e., destination; otherwise the frame shall be rejected as invalid.
2. 6.8.3 d The Spacecraft ID (SCID) field in the transfer frame header shall contain the value equal to the Receiving\_SCID\_Buffer for all frames received (i.e., Remote\_Spacecraft\_ID, MIB parameter) when the Source-or-Destination Identifier value equals ‘0’, i.e., source, and Test\_Source is true; otherwise, a session violation has occurred and the vehicle controller shall be notified. See annex D.
 | 6.8Flag value fixed per new section 3.2.2.9 |  |  |

**20. COP-P**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| COPP-01 |  | .Sending Procedures COP-POutput Queue | 7.1.1 |  |  |
| COPP-02 |  | FOP-P Variables | 7.1.2 |  |  |
| COPP-03 |  | FOP-P State Table EventsThe following changes have been made to 7.1.3.3 FOP-P State Table:Event Number/Name: SE0At Session Startup (see note 1), Resulting Action in State S1 Active – Initialize Note 1: At each session startup, enter state S1 and trigger event SE0 before allowing any other events to occur. If subsequent reconnection is desired without starting a new session, the FOP-P can continue data services by maintaining and using the current state of the FOP-P variables.  | 7.1.3changed from “at Startup” to “at Session Startup” |  |  |
| COPP-4 |  | FARM-P State TableChanges to FARM-P State tableEvent RE0: Entered this state at each Session startup | 7.2.1changed from “at Startup” to “at Session Startup” |  |  |
| COPP-5 |  | Internal FARM-P Variables | 7.2.2 |  |  |
| COPP-6 |  | Interface to the I/O Layer | 7.2.3 |  |  |

**21. I/O SUBLAYER**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| IOS-01 |  | Sending Operations | 8.1 |  |  |
| IOS-2 |  | Receiving Operations | 8.2 |  |  |

**22. ANNEX A: VARIABLE-LENGTH SUPERVISORY PROTOCOL DATA FIELD FORMATS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| AA-01 |  | All of ANNEX A | Annex A |  |  |
| AA-02 |  | Proximity Link Control Word (PLCW)A setting of ‘1’ in the PLCW Retransmit Flag shall indicate that a received frame failed a frame acceptance check and that a retransmission of the expected frame is required. | A1.7.4 |  |  |
| AA-04 |  | SET PL EXTENSIONSThe data rate portion of this direction is required for cross-support for data rates above 256,000 bps. | A1.8 |  |  |
| AA-05 |  | ScramblerNone of these Scrambler options are specified by CCSDS in other Recommendations and therefore they are not required for cross-support. | A1.8.5 |  |  |

**23. ANNEX B – MANAGEMENT INFORMATION BASE PARAMETERS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| MIBB-01 |  | All of the entries in ANNEX B including the changes below:Acquisition\_Idle\_DurationChanges in RED below:Use: Mandatory. Used in Full, Half Duplex, and Simplex session establishment and Comm Change. Session static. See 6.2.4.4.Sub-layers: P,M | Annex BUpdated definition |  |  |
| MIBB-2 |  | Carrier\_Only\_DurationChanges in RED below:Use: Mandatory. Used in Full, Half Duplex, and Simplex session establishment and Comm Change. Session static. See 6.2.4.3.Sub-layers: P,M | Annex BUpdated definition |  |  |
| MIBB-3 |  | Changes in RED below:Maximum\_Frame\_LengthMandatory. Defines the maximum size Proximity-1 transfer frame transferred between nodes. Link efficiency at various data rates may require varying frame lengths. Session dynamic. See 3.2.3.1Sub-layer: F | Annex BUpdated definition |  |  |
| MIBB-4 |  | PCIDChanges in RED below:The Physical Channel ID (PCID) is carried in Transfer Frames and in PLCWs. It can support two independently-multiplexed logical channels within a Physical Channel.Sub-layer: D | Annex BUpdated definition |  |  |
| MIBB-5 |  | Update to this MIB parameter:Source\_Destination\_IDMandatory. ‘0’= Source SCID; ‘1’=Destination SCID. Session Static. See 3.2.2.9Sub-layer: M | Annex BUpdated definition |  |  |
| MIBB-6 |  | Update to this MIB parameter:Tail\_Idle\_DurationMandatory. Used in Full, Half Duplex, and Simplex session establishment and Comm Change. Session static. See 6.2.4.5.Sub-layers: P,M | Annex BUpdated definition |  |  |

**24. ANNEX C:** **NASA MARS SURVEYOR PROJECT 2001 ODYSSEY ORBITER
PROXIMITY SPACE LINK CAPABILITIES**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| AC-01 |  | All of Annex CPlus update below in RED:A setting of ‘1’ in the PLCW Retransmit Flag shall indicate that a received frame failed a frame acceptance check and that a retransmission of the expected frame is required. | Annex C4.3.6.3Updated definition |  |  |

**25. ANNEX D: NOTIFICATIONS TO VEHICLE CONTROLLER**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item  | Verification Method | Protocol Feature  | Reference  | Implementation Compliance | Implementation Comment |
| AD-01 |  | All of Annex D | Annex D |  |  |