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Standard for Compressed-Distributed Interactive Simulation (C-DIS)

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1 Overview (informational)

This document describes a compression scheme for Distributed Interactive Simulation Version 7 (DIS V7) Protocol Data Units (PDUs) that may be implemented by any user to achieve between 2:1 and 4:1 compression ratios of DIS data for typical applications with some data sets exceeding 6:1. Exact performance depends on the mix of DIS PDU data and the choice of Compressed DIS (C-DIS) mode of operation. Users will need to access the DIS standard; only the C-DIS modifications are described in this document.

1.1 Scope

This document applies to all users of the C-DIS Protocol.

1.2 Purpose

This document describes the format of the PDUs used by C-DIS. This document serves as the required standard format and transmission rules of C-DIS data, to allow interoperability among different users that implement and use this standard.

1.3 Objectives

The goal of C-DIS is to represent standard DIS V7 PDUs with fewer bits in order to preserve bandwidth and thus allow more data to be sent than would be possible using standard DIS. The goal is to reach at least 50% or better reduction (2:1 compression ratio) on average of the DIS data but much higher compression ratios are possible. Compression ratios from 2.25:1 to 4:1 are typical but 6:1 has been observed for some data sets. This document describes a bit oriented data format for DIS V7 data. This document also describes an approach to partial updates that may be used to further reduce bandwidth. This document does not specify the actual transmission medium (bus, Ethernet, Wi-Fi, Radio Frequency (RF) network, etc.). This standard is intended to be used to compress the transmission of DIS data using an encoder/decoder to compress and decompress data passed over a low bandwidth connection as illustrated in Figure 1. C-DIS is not generally intended to be used by simulation application(s) internally. C-DIS may be implemented as a separate encoder/decoder, as middleware, or as a simulation application interface. C-DIS encoders/decoders may receive one version of DIS messages and transmit them onto the other DIS network as a different DIS version.

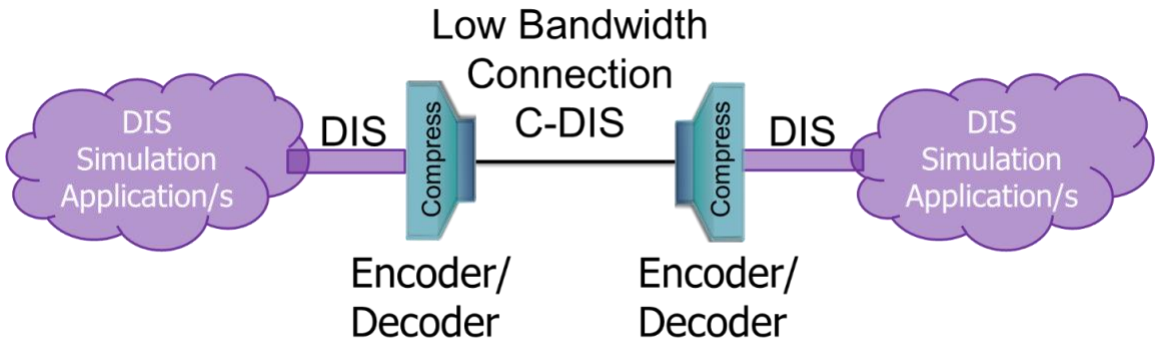

Figure 1—C-DIS connects one or more DIS simulation applications over a low bandwidth connection.

1.4 Intended Audience

The audience for this standard are users of the DIS standard that desire to reduce their transmitted bandwidth over a network or bus. These have historically been military simulation applications, but may be any DIS user.

2 References (informational)

2.1 Simulation Interoperability Standards Organization (SISO) Documents

The following SISO documents were used in generating the policies and procedures defined herein. When the following documents are superseded by an approved revision and that causes a conflict with this document, the revision of the below-referenced documents shall supersede this document. These documents are available through the SISO web site at https://sisostandards.org.

Document Number	Title
SISO-REF-010	Reference for Enumerations for Simulation Interoperability
SISO-ADM-003	SISO Balloted Products Development and Support Process
SISO-ADM-005	Policy for the Style and Format of SISO Documents

2.2 Other Documents

These documents were also used in the development of the C-DIS Standard.

Document Number	Title
Institute of Electrical and Electronics Engineers (IEEE) Std 1278.1™-2012	IEEE Standard for Distributed Interactive Simulation - Application Protocols https://www.ieee.org/standards/buy-standards.html
Combat Air Force (CAF) Distributed Mission Operations (DMO) Mission Package	Combat Air Force Distributed Mission Operations, Operations and Integration (CAF DMO O&I). Dayton: Northrop Grumman Information Systems
IEEE Transactions on Aerospace and Electronic Systems Vol. 32, No. 1 pp 473-476 Jan 1996	Olson, D.K., "Converting Earth-Centered, Earth-Fixed Coordinates to Geodetic Coordinates"

3 Definitions (normative)

Term	Definition
CDIS_FULL_UPDATE_PERIOD	The period of real-world time after which the C-DIS encoder must provide a Full Update PDU to the C-DIS network.
Decoder	A process that converts C-DIS information into standard DIS formatted messages.
DIS Heartbeat Timer	A variable parameter associated with object PDUs or supplemental PDUs to indicate when a heartbeat PDU is required to be issued. This allows all simulations to receive a full set of data for an entity or other object within a certain period of real-world time. Entity heartbeat timer parameters are based on entity kinds and platform entity domains and whether they are moving or stationary.
DIS Heartbeat Update	A Protocol Data Unit (PDU) that is issued when a predetermined length of real-world time has elapsed since the last PDU was issued for a given entity, environmental process, or supplemental data [e.g.,Electromagnetic Emission (EE) PDU and Identification Friend or Foe (IFF) PDU.

Term	Definition
DIS Timeout	The period of real-world time after which the data associated with a PDU type for a specific object is cleared from a receiving simulation's database if no new PDU is received.
Encoder	A process that converts standard DIS data into C-DIS formatted messages.
Full Update	A PDU that provides data for every used field in the PDU. Some fields such as acceleration or rotation rates may not be used if the dead reckoning algorithm does not require these fields. This is still considered a full update because these fields are not used.
Full Update Mode	Only Full Update C-DIS messages are allowed.
HBT_CDIS_FULL_UPDATE_MPLIER	A multiplier used to multiply times the DIS Heartbeat Timer to determine the CDIS_FULL_UPDATE_PERIOD.
MTU	The maximum size of a PDU that can be communicated in a single network layer transaction.
Partial Update	A PDU that does not provide data for every field that is required for a Full Update. For example: an Entity State PDU that provides position, velocities, accelerations and rotation rates but does not provide the Force ID, Entity Type, Marking or Capabilities.
Partial Update Mode	Both Full Update and Partial Update C-DIS messages are allowed.
UVINT/SVINT	Unsigned/Signed version of Variable Integer.
VARINT	A variable integer that uses one or two initial bits as a flag to indicate the number of data bits that will follow.

4 Acronyms and Abbreviations (normative)

Acronym/Abbr	Definition
Alt	Altitude
App	Application
ASCII	American Standard Code for Information Interchange
AZ	Azimuth angle
CAF	Combat Air Force
C-DIS	Compressed-Distributed Interactive Simulation
cm	Centimeters (meters / 100)
dam	Dekameters (meters * 10)
dBm	Decibel relative to a milliwatt of power

Acronym/Abbr	Definition
Deg	Degrees
DIS	Distributed Interactive Simulation
DIS V6	DIS Version 6 (IEEE Std 1278.1a™-1998) (amendment to IEEE Std 1278.1™-1995)
DIS V7	DIS Version 7 (IEEE Std 1278.1™-2012)
DMO	Distributed Mission Operations
DR	Dead Reckoning
DRA	Dead Reckoning Algorithm
ECEF	Earth Centered Earth Fixed coordinate reference system
EE	Electromagnetic Emission
EL	Elevation Angle
Ent	Entity
EX	Magnitude of the X-component of the Electrical field
EZ	Magnitude of the Z-component of the Electrical field
ENUM	Enumerated Value
ERP	Effective Radiated Power
FPB	Fixed orientation, Position extrapolated with velocity, Body coordinates (DRA=6)
FVB	Fixed orientation, Velocity and position extrapolated using velocity and acceleration, Body coordinates (DRA=9)
FPW	Fixed orientation, Position extrapolated with velocity, World coordinates (DRA=2)
FVW	Fixed orientation, Velocity and position extrapolated using velocity and acceleration, World coordinates (DRA=5)
G	Units of acceleration. 1 g = Gravity (9.81 meters / sec / sec)
GPS	Global Positioning System
Hz	Hertz
ID	Identifier
IEEE	Institute of Electrical and Electronics Engineers
IFF	Identification Friend or Foe

Acronym/Abbr	Definition
Lat	Latitude
Lon	Longitude
LSB	Least Significant Bit
MSB	Most Significant Bit
MSL	Mean Sea Level
MTU	Maximum Transmission Unit
NN	Used to indicate an unknown/variable numeric value usually in a range (e.g. 1 to NN)
NTP	Network Time Protocol
Param/s	Parameter/s
PDU	Protocol Data Unit
PGRF	Pulse Group Repetition Frequency
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
RF	Radio Frequency
RPB	Rotating, Position extrapolated with velocity, Body coordinates (DRA=7)
RVB	Rotating, Velocity and position extrapolated using velocity and acceleration, Body coordinates (DRA=8)
RPW	Rotating, Position extrapolated with velocity, World coordinates (DRA=3)
RVW	Rotating, Velocity and position extrapolated using velocity and acceleration, World coordinates (DRA=4)
SAE	Site, Application, Entity ID triplet identification number used in DIS
SIMAN	Simulation Management
SISO	Simulation Interoperability Standards Organization
STD	Standard
SVINT	Signed Variable Integer
TDL	Tactical Data Link

Acronym/Abbr	Definition
UID	Universal Identifier (Used in SISO-REF-010 as the table ID and model ID)
UVINT	Unsigned Variable Integer
VARINT	Variable Integer
VINT	Variable Integer
VP	Variable Parameter
WGS	World Geodetic System

5 C-DIS Overview (informational)

5.1 Summary

The C-DIS standard was created in order to exchange DIS V7 Protocol Data Unit (PDU) information in limited bandwidth situations. By applying these real-time compression techniques to standard DIS PDUs it is typical to achieve 2.25:1 to 4:1 compression ratios with some data sets achieving 6:1 or more. This can be used to increase the amount of information sent over an existing link, or it could be used to enable DIS simulations to operate over links that would previously have had insufficient bandwidth.

As with any compression scheme there is an increase in the complexity of packing and unpacking C-DIS PDUs when compared to standard DIS PDUs. When bandwidth usage is critical, the C-DIS standard offers an excellent alternative to standard DIS PDUs.

This standard defines the compressed format of standard DIS PDUs and how to use these compressed messages to decrease bandwidth usage.

Users will require access to the DIS V7 standard, and SISO-REF-010 for complete details of the DIS protocol.

5.2 Introduction

The C-DIS standard packs DIS V7 PDUs into smaller compressed versions of the same DIS PDUs. It does not define any new PDUs. It does add some fields and flags to the standard DIS PDUs. The communications mechanism (Ethernet, 1553 data bus, Fibre Channel, etc.) is not specified by this standard. Only the compressed formats and rules of exchange of the PDUs are described by this document. The SISO-REF-010 document provides appropriate enumeration values that are used in DIS and should be referenced for enumerated values. C-DIS currently supports only a subset of the standard DIS PDU types but could be expanded to include additional PDU types in the future.

The C-DIS standard supports the DIS PDU types shown in Table 1.

Table 1—Supported DIS PDUs

PDU Type	PDU Name
1	Entity State
2	Fire
3	Detonation

PDU Type	PDU Name
4	Collision
11	Create Entity
12	Remove Entity
13	Start/Resume
14	Stop/Freeze
15	Acknowledge
16	Action Request
17	Action Response
18	Data Query
19	Set Data
20	Data
21	Event Report
22	Comment
23	Electromagnetic Emission
24	Designator
25	Transmitter
26	Signal
27	Receiver
28	IFF (Layers 1, 2, 3, 4, and 5)

The C-DIS IFF PDU supports Layers one through five. These PDU types are commonly used by real time simulations and were therefore considered a good starting point for creating a C-DIS standard. It would be possible to apply the same compression techniques to the remaining PDU types.

6 Compression (informational)

6.1 Packet Size

C-DIS strives to create the smallest packets possible while still preserving all of the information contained in each DIS PDU. The most efficient maximum size for a PDU is the smallest Maximum Transmission Unit (MTU) of all the networks being used. An Ethernet network, which is the most commonly used network, has an MTU of 1500 bytes. Messages that are less than 1500 bytes (including the IP, UDP header, and encryption overhead) are able to be passed as a single unit over the network. Messages that are larger than this must be fragmented into multiple packets and then reassembled at the receiver. Messages that are fragmented use more bandwidth, more processing, are less reliable, and may arrive out of order due to potentially different routing over the network. It is therefore desirable to avoid fragmentation by ensuring that packets including overhead (1452 user bytes unencrypted) are less than the Ethernet MTU of 1500 bytes (see also DIS V7 6.3.4). DIS V7 defines an MTU size of 1400 bytes. C-DIS is designed to support messages that are less than the 1500 byte Ethernet MTU to avoid fragmentation when using an Ethernet network.

6.2 Compression Techniques and Principles

DIS consists of primarily fixed message formats that C-DIS is able to compress because the data types are fully defined. DIS also allows for user Datums that consist of a Datum ID and Length followed by user defined items. Because Datums contain user defined data that are not defined in DIS V7 it is not possible for the C-DIS standard to define how to compress user Datums; however, users may apply the C-DIS principles in order to create compressed versions of their Datums, but that is outside the scope of the C-DIS standard.

The following is an informational summary of the techniques and principles used by C-DIS to compress DIS data that may also be applied to user Datums:

a) Eliminate all padding fields, including those required for byte alignments.

b) Reduce enumeration fields to just the number of bits required to support the current enumerations, while leaving some room for future growth. For example if there are 16 enumerations, you might define the field with five bits which would support 32 enumerations (Values 0-31). This supports all current enumerations while allowing room to double the required enumerations in the future. Consider using Variable Integers (VARINTs).

c) Use VARINTs for both signed and unsigned data to encode data in the smallest number of bits possible when values are more likely to be small than large. This allows supporting larger data values if necessary while allowing smaller values to achieve more compression, at the expense of one or two additional flag bits that indicate the size of data that will follow. The largest VARINT values will therefore be larger than the original data size by the number of flag bits, but will allow compression of small values. A knowledge of the likely data values is necessary when deciding to use VARINTs.

d) Use U/SVINTs rather than basic scaled integers when most likely values are significantly smaller than the bit size allows. Do not use U/SVINT if all possible values are equally likely.

e) Reduce integer value fields to only support the required values. For example, the number of fixed Datum Records is Unsigned Variable Integer 8 (UVINT8) which allows up to 255 Fixed Datums. Fixed Datums each require 64 bits so 64 bits * 255 / 8 = 2040 bytes which exceeds the 1500 byte packet payload. Supporting larger numbers of Fixed Datums is therefore not required, so allocating UVINT8 bits is appropriate rather than using UVINT16 or VINT16.

1) Change all floating point fields to signed(S) or unsigned(U) scaled integers, variable unsigned or signed Integers (UVINT/SVINT) or custom floating point values. Use Table 2 that defines the desired precisions and maximum values in C-DIS to guide how many bits a particular field requires. If a field requires a large range of values consider coding the value using a custom floating point by using a separate Mantissa and Exponent like Frequency in the Electromagnetic Emission (EE) PDU rather than scaled integer or UVINT/SVINT. Remember to account for sign bits if values are signed. You can use the C-DIS standard as a guide. For example, if you are encoding an angle you can refer to locations in the C-DIS standard that encode angles and see that angles require 13 bits to encode a +-180 degree angle while achieving a 0.04395 degree precision. You can copy the approach C-DIS uses for fields with the same types of values including angles, position, velocity, acceleration, relative positions, frequency, power, etc.

f) If PDUs or Datums contain variable records or optional fields consider creating “Field Present” bit flags at the beginning to indicate the presence or absence of those fields. Sometimes treating groups of fields that are typically provided together with a single flag rather than individual flags may be appropriate. For example the Beam Field Present Flags-Fundamental Parameters flag represents, Frequency, Frequency Range, Effective Radiated Power (ERP), Pulse Repetition Interval (PRI), and Pulse Width fields with a single Field Present flag rather than individual bit flags. These bit flags can significantly reduce bandwidth if many of the fields are optional.

g) Consider adding a “Units” flag/enum if values require a large span of values rather than adding additional bits to support the large span of values. This reduces the precision, but can allow a large increase in range when appropriate. A units bit flag could indicate centimeters or dekameters, providing a 1000x factor range increase while only using one bit.

h) If enumerations are not consecutive, such as 0, 100, 101, 5000 which would require a bit field of 12 bits, while only actually defining four unique enumerations, consider changing the enumerations to be consecutive 0, 1, 2, 3 which would require only two bits to send. Note this is really a change to the enumerations rather than to the C-DIS representation.

i) For American Standard Code for Information Interchange (ASCII) text consider using the 5/6bit scheme used for Marking in the Entity State PDU to reduce the required size. Add a length field to indicate the number of provided characters so that only used characters are sent rather than sending a fixed length ASCII text field which is not fully used. If upper and lower case text is required, the 5/6 bit character scheme will not work.

j) Make any length refer to bits rather than bytes. Limit length fields to allow for defining a packet up to 1500 bytes. There is no need to have a bit length field of 24 bits that could define a packet that would be $(2^{24}-1) / 8 = 2\ 097\ 151$ bytes because the packet MTU is 1500 bytes. A length of 14 bits would provide $(2^{14} - 1) / 8 = 2047$ bytes. If 13 bits was used it would only support 1023 bytes so 14 bits would be required to support up to the desired 1500 bytes. Reaching exactly 1500 bytes is typically not possible, but should be supportable in the number of bits that are allocated.

k) Do not send easily recreated values. For example, the PDU Family in the DIS header can be recreated at the receiver using a lookup table.

l) Use the C-DIS shortened Entity Type rather than the full DIS version.

m) Use the C-DIS Latitude (Lat), Longitude (Lon), Altitude (Alt) approach for world Earth Centered Earth Fixed (ECEF) coordinates.

n) Rely on DIS providers to properly apply DIS heartbeat, timeout, thresholds and Dead Reckoning (DR) Algorithms (DRAs) in order to limit PDU rates.

o) Only require “Full Update” data information be sent on the first and last update, and once during the PDU CDIS_FULL_UPDATE_PERIOD. In between only send “Partial Update” state data that are missing type, marking, appearance, and other fields that have not changed, using the bit flags to indicate what is provided in a particular PDU. Set the "Full Update Flag" = 1 for full updates.

These techniques and principles are applied to all C-DIS supported PDUs and are detailed in this document. Because Datums are not universal the C-DIS standard does not provide specific C-DIS Datum formats, however C-DIS principles may be used to create compressed versions of Datums that could substantially impact bandwidth requirements if Datums are sent frequently. Datums that are only sent once or very sporadically do not impact bandwidth and therefore are not strong candidates for compression. Federations or groups of users that heavily use common Datums should create and maintain a compressed standard version of those Datums.

6.3 Compression Technique Example

The C-DIS Entity State PDU:

a) Reduced the number of Protocol Versions supported from 256 to four.

b) Used UVINT8 for DIS Exercise. Values of 0-15 will provide compression, which is more than typically required. All values are supported.

c) Removed PDU Family in the DIS header, which may be looked up based on PDU type.

d) Reduced the accuracy of the timestamp from 1.67 µsec to 107 µsec.

e) Reduced the Length from 16 bits to 14 bits, which is large enough to represent a PDU of 16 383 bits = 2045 bytes.

f) Added single bit flags to indicate if lesser used fields and fields that do not change each update are present in this particular update, such as Alternate Entity Type, Articulated Parts, Entity Marking, Capabilities, Appearance, DR flags and parameters.

g) Added a 4-bit Length to Entity Marking to indicate the actual number of characters being used by the Entity Marking field. Unused characters are not sent. Coded the character as five or six bits rather than 8-bit ASCII.

h) Used UVINT8 for Force Identifier (ID) to represent Force that will commonly use five bits instead of eight.

i) Changed ECEF location to latitude, longitude, and altitude. Reduced field sizes and used SVINT24 for the altitude based on historical usage. This requires a coordinate conversion be applied to the ECEF XYZ coordinates.

j) Represented floating point entity latitude, entity longitude, and entity orientation as scaled signed integers with limited bit lengths with appropriate scales.

k) Changed floating point altitude, velocity, acceleration, and angular velocity to Signed VARINTs with limited bit lengths with appropriate scales.

l) Defined bit flags so that entities that are static or that are not using accelerations or rotation rates do not send velocities, accelerations, and rotation rates that will not be used.

m) Added bit flags to indicate if the variable parameter records are present rather than using the 8-bit number of variable parameter records equal to zero to indicate that the variable parameters are not being used.

n) Used UVINT8 to minimize the size of the number of variable parameter records when present.

o) Reduced the size of the Entity Type enumeration from 64 bits while still supporting all current enumerations and likely future enumerations by using UVINT8 values for Category, Subcategory, Specific and Extra fields. Reduced the Kind and Domain fields to four bits and Country to 9 bits which supports all current kind, domain and country definitions while still allowing some space for future growth.

p) Used UVINT32 to encode capabilities because all enumerations are currently less than eight, which allows encoding with 2-bit flag + 8 data bits = 10 bits total typically while supporting all possible values if something is added in the future.

q) Bit packed all data rather than observing traditional computer data byte boundary alignments and eliminated all padding.

r) Used Partial Updates to reduce the size of updates that do not require information such as the Force ID, Entity Type, Alternate Entity Type, Appearance, Entity Marking, and Capabilities.

6.4 Compression Summary

By applying these compression techniques to the standard DIS Entity State PDU it can be compressed significantly. The overall compression ratio will depend on the ratio of the full and partial updates as well as actual data values. Compression ratios of between 2:1 and 6:1 have been observed with 2.25:1 - 4:1 being common. Other DIS PDUs can be reduced by similar amounts using the same techniques. Signal PDU voice and datalink contents will not be modified and therefore will result in nearly zero compression of those PDUs. This approach requires more processing to pack and unpack the data, requires the look up of some data, limits some values, and trades some loss in accuracy for the ability to pass more DIS data over a limited bandwidth connection.

The compressed data, however, does have an exact one-to-one field mapping to DIS maintaining all of the same DIS concepts and approaches, such as dead reckoning, enumerations, etc.. This makes it easy to expand the messages back into a full DIS protocol without doing any translations of types or concepts. Enumerations are largely the same as defined in the SISO-REF-010. Most existing enumeration values are supported. Exceptions are noted in the limitations.

7 C-DIS Limitations (informational)

7.1 Limitations and Precision

C-DIS has limitations in supported enumerations and data values. Each field that limits data values is indicated in the specific PDU tables but a summary of the limitations that C-DIS users should be aware of are listed below:

a) Floating-point numbers encoded as C-DIS scaled integer values have minimum and maximum values as well as precision that are smaller than the corresponding standard IEEE floating-point values. For details of minimum and maximum values and precision, refer to each field in the PDU definitions. General limitations are listed in Table 2.

b) The maximum altitude is 83 886 070 meters above Mean Sea Level (MSL).

c) Special Case location. An altitude of -8 388 608 indicates ECEF center of the earth (x = 0, y = 0, z = 0) location. In this special case, Latitude and Longitude values are ignored.

d) In EE PDUs the Emitter Systems number of unique fundamental parameters within a PDU is limited to 31, beam parameters 31, and up to 63 Site/Application (App) pairs. There is no direct equivalent limitation in DIS. Systems with a high number of Site/App pairs could have issues if sensors are tracking entities from many different Site/App pairs simultaneously.

Table 2—C-DIS Approximate Precision Limitations and Maximum Values

Item	Approximate Precision	Maximum Value
Latitude/Longitude	0.93 centimeters(cm)	+-90/+-180 deg
Altitude	1 cm/dekameter	+8 388 607, -8 388 608 (-8 388 608 special case to indicate ECEF x = 0, y = 0, z = 0)
Velocity	0.1 m/sec	6369 knots
Acceleration	0.1m/sec/sec	83.5Gs
Angle	0.0439 deg	+-180 deg
Angular Velocity	0.35 deg/sec	720 deg/sec
Emission Frequency/ Emission Frequency Range/ Transmit Frequency Bandwidth	5 significant decimal digits	131 071x10^{15}Hertz (Hz)
Transmitter Frequency	7 significant decimal digits	16 777 215x10^{15}Hz
Pulse Repetition Frequency (PRF)	100Hz	6553.5 KHz
Pulse Width	4 significant decimal digits	16383x10^{3}µsec
Power	1 decibel relative to a milliwatt (dBm)	255 dBm
Time	107 µsec	1 hour (timestamp) - 107µsec

To estimate the amount of positional error due to time precision limitations a calculation was done for an entity traveling at 1000 knots for evaluation. An entity traveling at 1000 knots moves 0.055 meters in 107 µsec (5.5 cm). An average sampling error would be half of the time interval and therefore an average error of 5.5 / 2 = 2.75 cm. Slower entities would have proportionally lower errors due to time. Global Positioning System (GPS) synchronization using Network Time Protocol (NTP) is in the one to five milliseconds range which would be an effect at least 10X this precision error. GPS synchronization with hardware could be much lower (50 nano seconds) which would make this precision a more prominent factor. There are other factors that contribute to practical precision that were deemed to be more likely including latency and jitter in the network, accuracy of live vehicle location (GPS or Navigation), frame time limitations in simulation applications, dropouts and error thresholds. Error threshold by default is one meter which is much larger than the .055 m potential error due to time precision limitations assuming an entity traveling at 1000 knots. After considering all of these factors a time precision of 107 µsec was deemed sufficient.

7.2 Late Joiners

When operating in Partial Update Mode if a system connects to the network and a simulation is already in progress the decoder must wait to receive a Full Update (indicated by the Full Update Flag = 1) for stateful objects before it can create a local state and begin passing data to its DIS network. The maximum time before a Full Update is received is the CDIS_FULL_UPDATE_PERIOD = HBT_CDIS_FULL_UPDATE_MPLIER * DIS Heartbeat value. Many updates will occur before the CDIS_FULL_UPDATE_PERIOD is reached. The worst case may be calculated by rounding up the value of HBT_CDIS_FULL_UPDATE_MPLIER to the next full integer and then multiplying that number times the DIS Heartbeat. For example, by default the HBT_CDIS_FULL_UPDATE_MPLIER = 2.4 so rounding up to the next full integer = 3. Assuming a static entity with a DIS Heartbeat of 60 seconds the worst case before a full update = 3 * 60 = 180 seconds. For an entity with a DIS Heartbeat of five seconds the worst case before a full update = 3 * 5 = 15 seconds. Federations must determine how long it is acceptable for a late joiner to go before having an opportunity to receive full updates for objects. Increasing HBT_CDIS_FULL_UPDATE_MPLIER value will increase compression, but will also have the effect of causing late joiners to wait longer before receiving updates for all stateful objects. Federations can choose smaller or larger values of HBT_CDIS_FULL_UPDATE_MPLIER to meet their requirements. Consideration should be given to the reliability of the transport in the network when determining values for HBT_CDIS_FULL_UPDATE_MPLIER. HBT_CDIS_FULL_UPDATE_MPLIER should not be set to exact integer values to avoid race conditions.

In Full Update Mode the maximum time to wait for a full update is the DIS Heartbeat time.

8 Document Conventions (informative)

This document defines each field in the DIS PDU and indicates the original size of the DIS PDU field, as well as the new bit size in the C-DIS standard. The changes to the DIS standard have been highlighted in the tables using colors as described in Table 3.

Table 3—Meaning of Text Colors

Meaning of Text Colors
Red text indicates new items that have been added to the DIS Standard PDUs or indicates that field sizes have been altered.
Blue text Indicates items that are optional for most updates but are required as part of a "Full" update. "Full" updates are required for the first PDU update, at least once during the CDIS_FULL_UPDATE_PERIOD, and for the final PDU update.
Green text indicates items that are completely optional and may not be required as part of a "Full" PDU update. These items may not be applicable for a particular entity or system being modeled and may never be provided. Decoders set default values for these items, typically zero.
Black Text indicates items that are the same as the DIS V7 standard.
Grayed out Text indicates items that are not used in C-DIS such as padding fields.

Tables that describe the records and PDUs have a column for comments that are meant to be informational and helpful in understanding a field's value. The comments provide general precision, minimum values, and maximum values. The precisions specified as decimal numbers are approximate and are not used to scale values. Comments may show equivalent values in commonly used units (not the actual units of the encoded value) for reference such as degrees, knots, Gs, etc.. These should help users verify that the precision and min/max values are appropriate for their application. The precise scales and units that are used to encode data values are contained in the text descriptions of the field or record description. Comments provide the Universal Identification number (UID) to look up enumeration values for a field in SISO-REF-010. Required Flag value definitions (0 = None, 1 = Present, etc.) and some short enumeration values are provided in the comment field for convenience.

9 C-DIS Interface Requirements (normative)

C-DIS encoders and decoders shall follow these rules and meet these requirements in order to ensure proper operation and interoperability between different implementations.

a) Relative Locations shall be initialized to zero by receivers until relative location information is received, that shall override this initial value. Relative location data need not be sent by senders if the intended relative location is (x = 0, y = 0, z = 0).

b) The precise scales and units that shall be used to encode data values are contained in the text descriptions of the field or record description. The precisions specified as decimal numbers in section 6.1 and in the comments column in the tables are approximate and shall not be used to scale values.

c) Velocities, Accelerations, and Rotation Rates shall be initialized to zero by receivers.

d) Velocities, Accelerations, Rotations, and Rotation Rates shall follow the DIS Geocentric Reference system referred to as ECEF or body coordinates as appropriate for the Dead Reckoning Algorithm.

e) World position shall be encoded as Latitude and Longitude defined by the World Geodetic System 84 (WGS84) ellipsoid and Altitude MSL. This requires a coordinate conversion be applied to the ECEF XYZ coordinates. An altitude of -8 388 608 shall indicate ECEF center of the earth (x = 0, y = 0, z = 0) location. In this special case Latitude and Longitude values shall be ignored.

f) World position altitude may be in units of centimeters (cm) or dekameters (dam). The units shall be indicated by the Units-Entity Location Altitude flag. Centimeters shall be used for all altitudes less than the maximum value possible using centimeters. The dekameters units are provided in order to support satellites or other such entities that must have very large altitudes. The units flag applies only to a single update. It may change as needed over time if an entity starts at a low altitude but then exceeds the maximum altitude able to be represented in centimeters or starts at a high altitude and falls below the centimeter maximum value.

g) The Standard DIS Entity Identifier (ID) record consists of three elements: a Site Number, an Application Number, and an Entity Number. In standard DIS the size of all three fields is 16 bits (16:16:16 bits). Typically, Site, Application, and Entity Numbers are much less than 65 535. In addition, many scenarios have only a few entities which will commonly be assigned from 1 to NN. C-DIS shall compress the DIS data stream by using UVINT16 for the Site, Application and Entity numbers. This is especially helpful for compression in the EE PDU track/jam list where many IDs may be used.

h) Entities that are not making use of entity linear velocity (DR Algorithm 1=Static) shall set the Fields Present Flags Entity Linear Velocity to indicate that velocity is not used and shall not provide velocity values in addition to setting the proper DR Algorithm.

i) Entities that are not making use of entity linear acceleration (DR Algorithms 1 = Static, 2 = FPW, 3 = RPW, 6 = FPB, 7 = RPB) shall set the Fields Present Flags DR Params-Entity Linear Acceleration = 0 to indicate that acceleration is not used and shall not provide acceleration values in addition to setting the proper DR Algorithm.

j) Entities that are not making use of entity angular velocity (DR Algorithms 1 = Static, 2 = FPW, 5 = FVW, 6 = FPB, 9 = FVB) shall set the Fields Present Flags DR Params-Entity Angular Velocity = 0 to indicate that entity angular velocity is not used and shall not provide entity angular velocities in addition to setting the proper DR Algorithm.

k) All numbers shall use 2’s complement representations which will result in the Most Significant Bit (MSB) = 1 for negative numbers and MSB = 0 for positive numbers.

l) All angles in DIS are in units of radians. The radian values shall be normalized to fit within the range of values specified for the C-DIS field before applying the specified C-DIS encoding scale. All C-DIS scales are specified relative to radians. For example: Assuming a field specifies +-π (+-180 degrees) as the range then 13π / 6 (390 degrees) is first reduced to π / 6 (+30 degrees) before applying the appropriate scale to encode the value in C-DIS.

m) All counters (event counters etc.) shall roll over from maximum to zero and then continue to increment if the size of a C-DIS field is exceeded.

n) If a floating-point value represents a linear value (not time or angles that roll over) is exceeded then the C-DIS value shall be set to the maximum possible positive or negative value for that field.

o) Variable Datums in Simulation Management (SIMAN) PDUs shall not be padded to any bit offset. The datum length shall be set to the number of bits actually used.

p) The PDU length shall be filled with the number of bits used by the PDU, not the number of bytes as in the DIS standard.

q) In Full Update Mode encoders/decoders are not required to maintain any state information because they compress the message and pass it on without reference to any previously received message. All used fields must be present in a single message to be a Full Update. The encoder shall indicate a Full Update by setting the Full Update Flag = 1.

r) Encoders must provide at least one Full Update during each CDIS_FULL_UPDATE_PERIOD. CDIS_FULL_ UPDATE_PERIOD = HBT_CDIS_FULL_UPDATE_MPLIER * DIS Heartbeat Timer. If operating in Partial Update mode, all other updates may be Partial Updates. If operating in Full Update mode CDIS_FULL_UPDATE_PERIOD is not used.

s) In Partial Update Mode all encoders/decoders shall maintain the state of stateful objects including Entity State, Emissions, Transmitters, Designators and IFF. Encoders shall maintain a state to determine if the CDIS_FULL_UPDATE_PERIOD since the last full update has been exceeded, or if data has changed. Decoders shall maintain a state so that they can send a full DIS PDU when any partial or full update is received over C-DIS. Decoders shall initialize fields for which no data has yet been received to zero unless explicitly directed to use a different value in the field description. Decoders shall wait to receive a Full Update (Full Update Flag = 1) for an object to ensure the full object state is correct before sending out a corresponding first DIS PDU for an object. The encoder shall indicate a Partial Update by setting the Full Update Flag = 0.

t) In Partial Update Mode full updates shall be sent for the first and last updates and at least once every CDIS_FULL_UPDATE_PERIOD = HBT_CDIS_FULL_UPDATE_MPLIER X DIS HEARTBEAT timer. Default value for HBT_CDIS_FULL_UPDATE_MPLIER shall be 2.4, but may be modified by federation agreement. Encoders shall mark all Full Updates by setting the Full Update Flag = 1.

u) The HBT_CDIS_FULL_UPDATE_MPLIER multiplier shall equal 2.4 by default, but shall be configurable to allow federations to change the default value. This multiplier shall be used in conjunction with the DIS Heartbeat timer to determine the CDIS_FULL_UPDATE_PERIOD.

v) The DIS simulation applications shall be responsible to meet DIS Heartbeat update rules. Encoders only send data to the C-DIS network when they receive data on the standard DIS network input.

w) C-DIS encoder/decoders shall honor federation agreements for heartbeats and timeouts. Heartbeat and timeout values shall be configurable in the C-DIS encoder and decoder to allow federations to change the default DIS values.

x) All encoder/decoders must support partial updates for proper operation in Partial Update Mode. Using this mode is a federation agreement. Federations may agree not to allow Partial Update Mode.

y) Decoders operating in Partial Update Mode shall timeout object states if the DIS Timeout period is reached without receiving any full or partial update messages on the C-DIS network for that object.

z) Decoders operating in Partial Update Mode shall remove Entity State objects if requested by Entity State Appearance Bit 23 (Object State = 1 Deactivate). Emissions and IFF that are associated with removed entities may be immediately deleted or allowed to timeout.

10 Bit order and Basic Data Types (normative)

10.1 Bit Order Definition

Bit zero shall be the Most Significant Bit (MSB), while Bit seven shall be the Least Significant Bit (LSB) as shown in Table 4. Bit values are packed from MSB to LSB. The first value in the stream shall start with bit zero (the MSB). Subsequent values may start at any bit. A value that crosses a byte boundary shall continue with the MSB in the following byte. Note that this is the opposite convention used in DIS V7 PDUs for numbering bits, for specifying bit field records, and for packing bit streams.

In the example in Table 4, the MSB of the 13-bit value starts with byte one bit two for illustration. After six bits are consumed in the first byte, bit packing continues with byte two bit zero and ends with the value's LSB at byte two bit six. The following value would then start at byte two bit seven.

Table 4—Bit Order Definition Example

	Byte 1								**Byte 2**							
Bit Number	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	MSB							**LSB**	**MSB**							**LSB**
Example 13 bit value that spans two bytes			0	1	2	3	4	5	6	7	8	9	10	11	12	
			MSB												LSB	

10.2 VARINTs

A Variable Integer is made up of initial flag bits that indicate the number of data bits that will follow. Table 5 shows the layout of a generic VARINT. C-DIS uses a fixed flag length of one or two bits. UVINT8 uses a one bit flag, all other C-DIS VARINTs use a two bit flag. Unsigned VARINTs have no sign in the data and shall be treated as unsigned integers with a minimum value of zero and a maximum value of $(2^{\text{ndata bits}} - 1)$. For example, a UVINT with four data bits would have a maximum value of $2^4 - 1 = 15$.

Table 5—Generic VARINT/VINT Definition

VARINT/VINT	1 to N Flag Bits	1 to N Data Bits

C-DIS uses unsigned VARINTs (UVINT8/16/32) and signed VARINTs (SVINT12/13/14/16/24) where the number indicates the maximum number of data bits used not including the flag bits. UVINTs are used for many different types of unsigned values within C-DIS. SVINTs are generally limited to a single type of data except SVINT16 which is used to encode velocities, relative locations and pulse repetition frequency. SVINT usage is summarized in Table 6.

Table 6—SVINT Table of Usages

SVINT Variable Sizes	Values that use SVINT
SVINT24	MSL Altitudes
SVINT16	Velocities, Entity Relative Locations, Pulse Repetition Frequency (PRF)
SVINT14	Accelerations
SVINT13	Emitter Beam Angles
SVINT12	Angular Rates

Encoding values into VARINTs shall follow this three-step process:

a) Scale the original value using the scale for that field which is typically (($2^{\text{ndata bits}}$ - 1) / MaxValue for unsigned or ($2^{\text{ndata bits-1}}$ - 1) / MaxValue for signed values. Some fields however use other scales or are not scaled at all. Scales are specified in the field definitions. Angles shall be first normalized (reduced to a value within the possible range, e.g. 750 degrees shall be normalized to 30 degrees but in radians units) before applying scaling in order to get the correct values. Values shall be rounded to the nearest integer.

b) Encode the magnitude of the value (and sign if SVINT) into the smallest number of data bits possible, using 2's compliment for all numbers which maintains the MSB as the sign bit for SVINT fields. MSB = 1 for negative numbers.

c) Set the VARINT bit flag to indicate the number of data bits used to encode the data in the VARINT.

VARINT encoding example using a Signed Variable Integer with 2 bit flag and up to 12 data bits (SVINT12) that will be used to encode an Angular Rate value = OriginalAngularRateRadiansPerSec:

a) Scale the angular rate value to a 12-bit signed value and round it to the nearest integer. Rounding may be accomplished in several ways. A language function may round the number or the number may be rounded by adding or subtracting 0.5 before truncating to the integer value as shown below.

   1) For positive values

   2) integer value = (int) (((OriginalAngularRateRadiansPerSec * (2^{12-1} - 1) / (4π)) + 0.5)) to get a rounded integer value that represents the angular rate.

   3) For negative values

   4) integer value = (int) (((OriginalAngularRateRadiansPerSec * (2^{12-1} - 1) / (4π)) - 0.5)) to get a rounded integer value that represents the angular rate.

b) Encode in the smallest number of bits possible in the SVINT12. Check to see if the value is less than what will fit in the defined data sizes for the SVINT. SVINT12 uses 3, 6, 9 or 12 data bits including the sign so the magnitudes are $2^{3-1} = 4$, $2^{6-1} = 32$, and $2^{9-1} = 256$. All values will use 2's compliment format and will result in the MSB sign bit equal to one for negative numbers.

   1) For positive values and zero

      i. if (value < 4) use 3 bits

      ii. else if (value < 32) use 6 bits

iii. else if (value < 256) use 9 bits

iv. else use 12 bits

2) For negative values

i. if (value >= - 4) use 3 bits

ii. else if (value >= -32) use 6 bits

iii. else if (value >= -256) use 9 bits

iv. else use 12 bits

c) Set the bit flag to indicate the size of the data bits. For SVINT12 set the bit flag to zero if three bits were used, one if six bits were used, two if nine bits were used or three if twelve bits were used.

To decode VARINTs:

a) Read the bit flag to see how many data bits follow.

b) Read the number of data bits specified in the bit flag.

c) In SVINTs if the MSB is set to one then the value is negative. Extend the sign bit to a full 32-bit integer size before scaling back to the original value. This can be done by explicitly extending the sign bits with a mask, or by negating the magnitude of the value i.e., signed_int32_value = -magnitude of VARINT without sign bit.

d) Divide the value using floating-point division by the scaling factor to get back to the closest representation of the original value supported by the precision of C-DIS.

10.2.1 UVINT8

UVINT8 shall use one flag bit and up to eight data bits. Zero shall indicate a data size of four bits. One shall indicate a data size of eight bits as shown in Table 7. Values shall be encoded with the smallest number of data bits possible. Data values shall represent an unsigned integer value.

Table 7—UVINT8 Definition

UVINT8 1-Bit Flag	Value Bit Sizes	Max Value
0	4	15
1	8	255

10.2.2 UVINT16

UVINT16 shall use two flag bits and up to 16 data bits. Flag Values and data sizes shall be as shown in Table 8. Values shall be encoded with the smallest number of data bits possible. Data values shall represent an unsigned integer value.

Table 8—UVINT16 Definition

UVINT16 2-Bit Flag	Value Bit Sizes	Max Value
0	8	255
1	11	2047
2	14	16 383
3	16	65 535

10.2.3 UVINT32

UVINT32 shall use two flag bits and up to 32 data bits. Flag Values and data sizes shall be as shown in Table 9. Values shall be encoded with the smallest number of data bits possible. Data values shall represent an unsigned integer value.

Table 9—UVINT32 Definition

UVINT32 2-Bit Flag	Value Bit Sizes	Max Value
0	8	255
1	15	32 767
2	18	262 143
3	32	4 294 967 295

10.2.4 SVINT12

SVINT12 shall use two flag bits and up to 12 data bits. The data shall represent a positive number if the MSB data bit = 0 or a negative number if the MSB data bit = 1. All numbers shall be represented in 2's complement format. Flag Values and data sizes shall be as shown in Table 10. Values shall be encoded with the smallest number of data bits possible.

Table 10—SVINT12 Definition

SVINT12 2-Bit Flag	Value Bit Sizes	Max Value
0	3	+3, -4
1	6	+31, -32
2	9	+255, -256
3	12	+2047, -2048

10.2.5 SVINT13

SVINT13 shall use two flag bits and up to 13 data bits. The data shall represent a positive number if the MSB data bit = 0 or a negative number if the MSB data bit = 1. All numbers shall be represented in 2's complement format. Flag Values and data sizes shall be as shown in Table 11. Values shall be encoded with the smallest number of data bits possible.

Table 11—SVINT13 Definition

SVINT13 2-Bit Flag	Value Bit Sizes	Max Value
0	5	+15, -16
1	7	+63, -64
2	10	+511, -512
3	13	+4095, -4096

10.2.6 SVINT14

SVINT14 shall use two flag bits and up to 14 data bits. The data shall represent a positive number if the MSB data bit = 0 or a negative number if the MSB data bit = 1. All numbers shall be represented in 2's complement format. Flag Values and data sizes shall be as shown in Table 12. Values shall be encoded with the smallest number of data bits possible.

Table 12—SVINT14 Definition

SVINT14 2-Bit Flag	Value Bit Sizes	Max Value
0	4	+7, -8
1	7	+63, -64
2	9	+255, -256
3	14	+8191, -8192

10.2.7 SVINT16

SVINT16 shall use two flag bits and up to 16 data bits. The data shall represent a positive number if the MSB data bit = 0 or a negative number if the MSB data bit = 1. All numbers shall be represented in 2's complement format. Flag Values and data sizes shall be as shown in Table 13. Values shall be encoded with the smallest number of data bits possible.

Table 13—SVINT16 Definition

SVINT16 2-Bit Flag	Value Bit Sizes	Max Value
0	8	+127, -128
1	12	+2047, -2048
2	13	+4095, -4096
3	16	+32 767, -32 768

10.2.8 SVINT24

SVINT24 shall use two flag bits and up to 24 data bits. The data shall represent a positive number if the MSB data bit = 0 or a negative number if the MSB data bit = 1. All numbers shall be represented in 2's complement format. Flag Values and data sizes shall be as shown in Table 14. Values shall be encoded with the smallest number of data bits possible.

Table 14—SVINT24 Definition

SVINT24 2-Bit Flag	Value Bit Sizes	Max Value
0	16	+32 767, -32 768
1	19	+262 143, -262 144
2	21	+1 048 575, -1 048 576
3	24	+8 388 607, -8 388 608

10.3 Custom Floating Point Numbers

Scaled integers and VARINTs cannot represent extremely large ranges of values efficiently. In these cases, C-DIS defines custom floating-point numbers using an integer value (Mantissa) multiplied by a base 10 exponent (Exponent) (value = Mantissa x $10^{Exponent}$). The exponent may be signed in order to represent very small and very large numbers, or may be unsigned when the required numbers are always positive. The mantissa may be signed if negative numbers are required or unsigned if negative numbers are not required. An example of an unsigned exponent is a frequency in Hz that will never be less than 1 Hz in DIS. The mantissa of a custom floating-point number should be as large as possible, and the exponent should be as small as possible to represent the floating-point number. This preserves the largest number of significant digits to preserve accuracy. For example: the EE PDU Fundamental Parameter Pulse Width uses a 14-bit unsigned mantissa and 3-bit signed exponent. It represents a number of microseconds (µsec). The maximum value that can be represented in 14 bits = 2^{14} - 1 = 16 383 µsec. The mantissa therefore must be less than or equal to 16 383. If a floating-point value of 1 234 567 µsec is to be encoded then it may be represented in at least three ways mathematically with exponents of one to three:

a) Option 1: 1 234 x 10^3

b) Option 2: 12 345 x 10^2

c) Option 3: 123 456 x 10^1

Option 3 would require a mantissa larger than 16 383 and therefore cannot be used. Option 2 is the correct option because it maximizes the value of the mantissa while minimizing the exponent. Option 1 is not used because it reduces the number of significant digits and therefore degrades the accuracy of the floating-point representation. The mantissa and exponent both use standard 2's complement values where the MSB will represent the sign. The exponent is a 10-based exponent.

One way to get the maximum mantissa and minimum exponent is to see if the value will fit within the maximum value of the mantissa (e.g. 14 bits = 2^{14} - 1 = 16 383 is value <= 16 383). If it does then no exponent is needed therefore the exponent = zero. If the value does not fit then continue to divide the value by ten until it does fit. Each division represents an increase in the exponent by one.

11 Record Definitions (normative)

11.1 Angular Velocity

This field shall specify the rotation rate using entity body axis angles as specified in DIS (see DIS V7 6.2.7). The values shall be encoded as SVINT12 with values up to +-4π (720 degrees) / sec. Scale = (2^{11} - 1) / (4π).

Table 15—Angular Velocity Record

Field Name	DIS Size (Bits)	C-DIS Size (Bits)	Comments
Entity Angular Velocity X	32	SVINT12	+-720 degrees per second max 0.35 degrees resolution
Entity Angular Velocity Y	32	SVINT12	+-720 degrees per second max 0.35 degrees resolution
Entity Angular Velocity Z	32	SVINT12	+-720 degrees per second max 0.35 degrees resolution

11.2 Beam Antenna Pattern Record

This record specifies the direction, pattern, and polarization of radiation from a radio transmitter's antenna. See DIS V7 6.2.8.2 for a detailed definition of fields. All angles shall be scaled signed 13-bit integer with a maximum value of +-π. Scale = (2^{12} - 1) / π. EZ and EX shall be 16-bit signed integer values.

Table 16—Beam Antenna Pattern Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Beam Direction	Psi	32	13	Max +-π 0.0439 degree resolution
	Theta	32	13	Max +-π 0.0439 degree resolution
	Phi	32	13	Max +-π 0.0439 degree resolution
Azimuth (AZ) Beamwidth		32	13	Max +-π 0.0439 degree resolution
Elevation (EL) Beamwidth		32	13	Max +-π 0.0439 degree resolution

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Reference System		8	2	[UID 168]
Padding		8	0	
Padding		16	0	
EZ		32	16	+32767, -32768
EX		32	16	+32767, -32768
Phase		32	13	Max +-π 0.0439 degree resolution
Padding		32	0	

11.3 Beam Data Record

The specification of beam-specific data necessary to describe the scan volume of an emitter beam shall be communicated in a Beam Data record. Significant details and diagrams that clarify the definitions of these values may be found in DIS V7 6.2.11 Beam Data Record.

a) ***Beam Azimuth Center.*** See DIS V7 6.2.11. Value shall be scaled to SVINT13 with a scale of $(2^{12} - 1) / \pi$ (Maximum Value = +-π, Approximate Resolution 0.00076 radians = 0.0439 degrees).

b) ***Beam Azimuth Sweep.*** See DIS V7 6.2.11. Value shall be scaled to SVINT13 with a scale of $(2^{12} - 1) / \pi$ (Maximum Value = +-π, Approximate Resolution 0.00076 radians = 0. 0439 degrees).

c) ***Beam Elevation Center.*** See DIS V7 6.2.11. Value shall be scaled to SVINT13 with a scale of $(2^{12} - 1) / \pi$ (Maximum Value = +-π, Approximate Resolution 0.00076 radians = 0. 0439 degrees) (Maximum valid value is +-π / 2).

d) ***Beam Elevation Sweep.*** See DIS V7 6.2.11. Value shall be scaled to SVINT13 with a scale of $(2^{12} - 1) / \pi$ (Maximum Value = +-π, Approximate Resolution 0.00076 radians=0. 0439 degrees). (Maximum valid value is +-π / 2).

e) ***Beam Sweep Sync.*** See DIS V7 6.2.11. Value shall be scaled to an unsigned 10-bit integer with a scale of $(2^{10} - 1) / 100$ (Maximum Value = 100.0 (100%), Approximate Resolution = 0.097 percent).

Table 17—Beam Data Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Beam Data	Beam Az Center	32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam Az Sweep	32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam El Center	32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam El Sweep	32	SVINT13	0.00076 radian = 0.0439 degrees resolution

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
	Beam Sweep Sync	32	SVINT13	Percent of the scan (0.097 percent max accuracy)

11.4 Clock Time Record

This record is used to send clock time. It is the same as DIS V7. (see DIS V7 6.2.14)

Table 18—Clock Time Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Time	Hour	32		
	Time Past Hour	32		

11.5 Crypto Key ID Record

This field sets the current crypto Key using a 15-bit key and a 1-bit crypto mode flag. It is formatted the same as DIS V7. Detailed requirements for setting this field are specified in DIS V7 item b9) in 5.8.3.3.

Table 19—Crypto Key ID Record

Field Name	DIS Size (Bits)	C-DIS Size (Bits)	Comments
Crypto Mode	1	1	
Pseudo Crypto Key	15	15	

11.6 Datum Specification Record

A Variable Datum record shall be used for all data values in a Datum Specification record that are over 32 bits in length or require more than one numeric value. All data transmitted by character strings in a Datum Specification record shall be variable datums. Only one variable datum is allowed per Variable Datum field. The fields of this record are as follows:

a) ***Number of Fixed Datum Records.*** This field shall specify the number of Fixed Datum records and shall be represented by a UVINT8.

b) ***Number of Variable Datum Records.*** This field shall specify the number of Variable Datum records and shall be represented by a UVINT8.

c) ***Fixed Datum records.*** These fields shall contain zero or more Fixed Datum records (see DIS V7 6.2.37). Fixed Datums are not compressed, since the appropriate possible range of values is not known.

d) Variable Datum records. These fields shall contain zero or more Variable Datum records (see DIS V7 6.2.93). Variable Datum Length is specified by a 14-bit unsigned integer. Variable Datum Values are not compressed, since the appropriate possible range of values is not known. Variable datums are NOT padded to reach 128 bits or to reach any byte boundary. The length shall specify the number of bits only in the datum value. The length shall not include the 32 bits of the variable Datum ID or 14 bits of the Variable Datum Length.

The format of the Datum Specification record shall be as shown in Table 20.

Table 20—Datum Specification Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	Up to 16 383 bits (2 047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value - K1 bits	32	NN	Only the number of bits actually used for real data with no padding so actual size is unknown
	Padding to 64-bit boundry	32	0	No padding on Variable datums to make up padding

11.7 Electromagnetic Emission (EE) Fundamental Parameter Data Record

The EE Fundamental Parameter Data record contains electromagnetic emission regeneration parameters that are variable throughout a scenario dependent on the actions of the participants in the simulation. This record also provides basic parametric data that may be used to support low-fidelity simulation applications that do not have the processing capability to model a high-fidelity regeneration of emission beams. Detailed information not included here for these fields is available in DIS V7 6.2.22.

Frequency, Frequency Range, Effective Radiated Power, PRI, and Pulse Width are treated as a group in C-DIS and shall all be provided together if any one of these items must be updated. The Beam Field Present Flags-Fundamental Parameters flag shall be used to indicate if the Fundamental Params Index that indexes into the list of fundamental parameter data will be provided.

The EE Fundamental Parameter Data record shall consist of five fields as follows:

a) Frequency.

1) ***Mantissa.*** See DIS V7 6.2.22. Value shall be scaled to an unsigned 17-bit integer with a scale = 1 / $10^{Exponent}$ Hz (Maximum Value = 131 071 x 10^{15} Hz). Units of Hz.

2) ***Exponent.*** - unsigned power of ten for Frequency

b) Frequency Range.

1) ***Mantissa.*** See DIS V7 6.2.22. Value shall be scaled to an unsigned 17-bit integer with a scale = 1 / $10^{Exponent}$ Hz (Maximum Value = 131 071 x 10^{15} Hz). Units of Hz.

2) ***Exponent.*** - unsigned power of ten for Frequency Range

c) ***Effective Radiated Power.*** See DIS V7 6.2.22. Value shall be scaled to an unsigned 8-bit integer from 0-255dBm. (Maximum Value = 255 dBm, Resolution 1 dBm).

d) ***Pulse Repetition Frequency.*** See DIS V7 6.2.22. Value shall be Frequency in HZ / 100 and encoded as UVINT16. (Maximum Value = 6 535.5 KHz). Units hundreds of Hz.

e) Pulse Width.

1) ***Mantissa.*** See DIS V7 6.2.22. Value shall be scaled to an unsigned 14-bit integer with a scale = 1 / $10^{Exponent}$ Hz (Maximum Value = 16 383 x 10^{3} µsec). Units of µsec.

2) ***Exponent.*** - signed power of ten for Pulse Width (+3, -4 max)

NOTE: Beam AZ, Beam El, and Beam Sweep Fields are not part of the EE Fundamental Parameter Data Structure in C-DIS. See Record Definitions-Beam Data Record for definitions of these items.

Table 21—EE Fundamental Parameters

Field Name			DIS Size (Bits)	C-DIS Size (Bits)	Comments
Fundamental Params	Frequency	Mantissa	32	17	Frequency = Unsigned Mantissa x $10^{Exponent}$
		Exponent		4	Unsigned Exponent
	Frequency Range	Mantissa	32	17	Frequency Range = Unsigned Mantissa x $10^{Exponent}$
		Exponent		4	Unsigned Exponent
	ERP		32	8	0 to 255 dBm
	PRF		32	UVINT16	Hundreds of Hz
	Pulse Width	Mantissa	32	14	Pulse Width = Unsigned Mantissa x $10^{Exponent}$
		Exponent		3	Signed Exponent +3, -4

11.8 Emitter System Record

Information about a particular emitter shall be represented using an emitter system record. Use of the Emitter System record in the EE PDU is described in DIS V7 5.7.3.3. This record shall consist of three fields as follows:

a) ***Emitter Name.*** This field shall specify the nomenclature for a particular emitter and shall be represented by a 16-bit enumeration (see [UID 75]). This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

b) ***Emitter Function.*** This field shall specify the general function associated with a particular emitter. Typical functions include airborne fire control, ground surveillance radar, and so on. This field is intended to help receiving entities determine whether the EE PDU is of interest to the systems simulated by that entity. This field shall be represented by an 8-bit enumeration (see [UID 76]). This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

c) ***Emitter Number.*** This field shall specify the specific emitter system associated with an entity. This field allows the differentiation of multiple emitter systems on an entity even if in some instances two or more of the emitters are of identical emitter types. This field shall be represented by a UVINT8. This field shall be provided in every EE PDU.

Table 22—Emitter System Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Emitter System	Emitter Name	16	16	[UID 75]
	Emitter Function	8	8	[UID 76]
	Emitter Number	8	UVINT8	

11.9 Encoding Scheme

The encoding scheme defines the type of data that is contained in the Signal PDU and is made up of the Encoding Type/Number of Tactical Data Link (TDL) Messages, and Encoding Class. It contains two fields which are:

a) ***Encoding Class.*** This is a 2-bit enumeration. 0 = Encoded Audio, 1 = Raw Binary Data, 2 = Application Specific, 3 = Database index [UID 270].

b) ***Encoding Type or Number of TDL Messages.*** The definition of this UVINT8 depends on the value of the Encoding Class field and can be either an encoding type or the number of TDL messages in this Signal PDU. Encoding Type enumeration (see [UID 271]).

Table 23—Encoding Scheme

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Encoding Scheme	Class	2	2	[UID 270]
	Type	14	UVINT8	[UID 271]

11.10 Entity Coordinate Vector

This field shall be represented by an Entity Coordinate Vector [see DIS V7 item c) in 6.2.96]. C-DIS shortens these 32-bit floating-point values to SVINT16. The units may be in centimeters or meters as indicated by the Units flag in the PDU. Centimeter units shall be used unless the location is larger than the maximum +32 767, -32 768 cm value that can be encoded in an entity coordinates SVINT16 XYZ field.

Table 24—Entity Coordinate Vector

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Entity Coordinate Vector	X	32	SVINT16	+32767, -32768 cm or meters as indicated by bit flag
	Y	32	SVINT16	
	Z	32	SVINT16	

11.11 Entity Identifier Record

The unique designation of each entity in an event or exercise shall be specified by an Entity Identifier Record. The Entity Identifier (Entity ID) record shall consist of a Simulation Address (Site and Application) and an Entity/Event Number encoded with UVINT16.

Table 25—Entity Identifier Record (ID)

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	

11.12 Entity Type

This field shall be represented by an Entity Type record (see DIS V7 6.2.30). C-DIS shortens the Kind, Domain, and Country fields that are larger than required by current DIS enumerations, while still allowing for some growth. C-DIS uses 4:4:9:UVINT8:UVINT8:UVINT8:UVINT8 sizes versus standard DIS 8:8:16:8:8:8:8 sizes.

Table 26—Entity Type Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Entity Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]

11.13 Field Present Flags

This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Each PDU will have a unique list of Field Present flags. Fixed fields (Not variable parameter fields) that do not have a flag in the Field Present Flags section must be provided in every PDU.

11.14 IFF Data Specification Record

The IFF Data Specification record shall be used when variable records are required to be included in a layer format for Layers three through seven. The IFF Data Specification record shall contain the following fields:

Number of IFF Data Records. This field shall specify the number of IFF Data records and shall be represented by a 5-bit unsigned integer. If no records are present for an issuance of the PDU as indicated by the Field Present Flags-IFF Data Records = 0 then this field and following data shall not be provided.

The IFF data record shall contain the following fields:

a) ***Record Type.*** This field shall indicate the unique record number assigned to this IFF Data record. It shall be represented by a 16-bit enumeration (see [UID 66]).

b) ***Record Length.*** This field shall indicate the record length expressed as the total number of octets in the record. The value of the Record Length shall be the sum of the sizes of the Record Type field, the Record Length field, and all Record-Specific fields (3 + K1 Octets). The Record Length shall be represented by an 8-bit unsigned integer.

c) ***Record-Specific fields.*** These are the data fields of the record. Any number of types of data fields may be included.

d) ***Padding.*** Padding shall not be used in C-DIS.

Table 27—IFF Data Specification Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Number of IFF Data Records (N)		16	5	Max 31 IFF Data Records (Present if IFF Data Records = 1)
IFF Data Record (1 to NN)				
IFF Data Record	Record Type	32	16	[UID 66]
	Record Length	16	8	(3 + K1 octets)
	Record Specific Fields	8	8	K1 octets
	Padding to 32-bit Boundary		0	P1 octets (No Padding)

11.15 IFF Fundamental Parameter Data Record

The specification of the fundamental energy radiation characteristics of a transponder or interrogator system emission shall be communicated by an IFF Fundamental Parameter Data record. The fields of this

record shall be common to all systems except for the System-Specific Data field. The System-Specific Data field shall be used to convey unique data applicable to a specific system type. The fields of this record are as follows:

a) ***ERP.*** This field shall specify the average peak radiated power for the emission in dBm. This field shall be represented by an unsigned 8-bit number in units of decibel milliwatts.

b) ***Frequency.*** This field shall specify the center frequency of the emission in Hz. Frequency modulation for a particular emitter and mode shall be derived from database parameters stored in the receiving entity.
   1) ***Mantissa.*** Value shall be scaled to an unsigned 17-bit integer with a scale = 1 / $10^{Exponent}$ Hz (Maximum Value = 131 071 x 10^{15} Hz). Units of Hz
   2) ***Exponent.*** - unsigned power of ten for Frequency

c) ***PgRF.*** When applied to originators, this field shall specify the number of interrogations per second emitted. This field shall contain zero when applied to responder (i.e., transponder) systems. This field shall be represented by a 10-bit unsigned integer.

d) ***Pulse Width.*** This field shall specify the duration in tenths of µsec of the fundamental pulse of which the interrogation or reply is composed and shall be represented as an unsigned 10-bit integer. (102.3 µsec max)

e) ***Burst Length.*** This field shall specify the number of emissions generated in a single burst. This field shall contain zero for continuously emitting systems and shall contain the value one for responders. This field shall be represented as a 10-bit unsigned integer.

f) ***Applicable Modes.*** This field shall specify the modes to which the fundamental parameter data apply. This field shall be represented by a 3-bit enumeration (see [UID 339]).

g) ***System Specific Data.*** This field shall be used for system specific data associated with the system type. This field shall be represented by 24 bits as defined for a specific system type. The System-Specific Data formats for applicable system types are contained in DIS V7 Annex B.

The format of the IFF Fundamental Parameter Data record shall be as shown in Table 28.

Table 28—IFF Fundamental Parameter Data

Field Name			DIS Size (Bits)	C-DIS Size (Bits)	Comments
IFF Fundamental Parameter Data Record	ERP		32	8	0 to 255 dBm
	Frequency	Mantissa	32	17	Frequency = Unsigned Mantissa x $10^{Exponent}$
		Exponent	0	4	Unsigned Frequency Exponent
	PgRF		32	10	Interrogations/sec (Max 1023)
	Pulse Width		32	10	Tenths of µsec (102.3 µsec max)
	Burst Length		32	10	Number of Bursts (Max 1023)
	Applicable Modes		8	3	[UID 339]
	System Specific Data		24	24	

11.16 Jamming Technique

The methods used to conduct electronic warfare shall be specified by a Jamming Technique record (see see DIS V7 5.7.3.8). This record shall consist of a Kind, Category, Subcategory, and Specific indication of the technique (see [UID 284]). The fields of this record are as follows:

a) ***Kind.*** This field shall be represented by an enumeration encoded as a UVINT8 and indicates the broadest category of jamming.

b) ***Category.*** This field shall be represented by an enumeration encoded as a UVINT8 and permits more detailed definition of techniques defined by the Kind.

c) ***Subcategory.*** This field shall be represented by an enumeration encoded as a UVINT8 and permits more detailed definition of techniques defined by the Kind and Category.

d) ***Specific.*** This field shall be represented by an enumeration encoded as a UVINT8 and provides a means for high fidelity electronic warfare emitters to indicate the most detailed definition of techniques.

The format of the Jamming Technique record shall be as shown in Table 29.

Table 29—Jamming Technique

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Jamming Technique	Kind	8	UVINT8	[UID 284]
	Category	8	UVINT8	[UID 284]
	Sub Category	8	UVINT8	[UID 284]
	Specific	8	UVINT8	[UID 284]

11.17 Layer Header Record

The identification of the additional information layer number, layer-specific information, and length of the layer shall be specified by a Layer Header record. The fields of this record are as follows:

a) ***Layer Number.*** This field shall identify the layer number. The field shall be represented as a 4-bit unsigned integer.

b) ***Layer-Specific Information.*** This field shall specify the layer-specific information that varies by System Type (see 6.2.87) and Layer Number. This field shall be represented by an 8-bit enumeration.

c) ***Length.*** This field shall specify the length in bits of the layer, including the Layer Header record and shall be represented by a 14-bit unsigned integer.

The format of the Layer Header record shall be as shown in Table 30. This record is used by the IFF PDU Layers to identify each layer and specify the length of the layer.

Table 30—Layer Header Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Layer Header	Layer Number	8	4	DIS V7 5 Layers defined - Allow 16
	Layer-Specific Information	8	8	
	Length	16	14	Length In Bits of the Layer including header 16 383 = max 2047 bytes

11.18 Linear Acceleration

This field shall specify a linear acceleration. The coordinate system for a linear acceleration depends on the dead reckoning algorithm used. This field shall be represented by a Linear Acceleration Vector record

[see DIS V7 item c) in 6.2.96]. Acceleration shall always be in a world based geocentric or body frame of reference, even though in C-DIS the location is provided as Latitude, Longitude, and Altitude. C-DIS uses SVINT14 to represent acceleration values rather than floating-point numbers. Units are in decimeters/sec/sec = meters/10/sec/sec. Values +8191, -8192 decimeters/sec/sec = 819.1 meters/sec/sec.

Table 31—Linear Acceleration

Field Name	DIS Size (Bits)	C-DIS Size (Bits)	Comments
Entity Linear Acceleration X	32	SVINT14	+8191, -8192 decimeters/sec/sec (Aprox 83.5 g)
Entity Linear Acceleration Y	32	SVINT14	+8191, -8192 decimeters/sec/sec (Aprox 83.5 g)
Entity Linear Acceleration Z	32	SVINT14	+8191, -8192 decimeters/sec/sec (Aprox 83.5 g)

11.19 Linear Velocity

This field shall specify a linear velocity. The coordinate system for a linear velocity depends on the dead reckoning algorithm used. This field shall be represented by a Linear Velocity Vector record [see DIS V7 item b) in 6.2.96]. Velocities shall always be in a world based geocentric or body frame of reference, even though in C-DIS the location is provided as Latitude, Longitude, and Altitude. C-DIS uses SVINT16 to represent velocity values rather than floating-point numbers. Units are in decimeters/sec = meters/10/sec. Values +32 767, -32 768 decimeters/sec = 3276.7 meters/sec.

Table 32—Linear Velocity

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Entity Linear Velocity	X	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Y	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Z	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)

11.20 Modulation Type Record

Information about the type of modulation used for radio transmission shall be represented by a Modulation Type record. (see DIS V7 6.2.59 for details).

Spread Spectrum. This field shall indicate the spread spectrum technique or combination of spread Spectrum techniques in use. The Spread Spectrum field shall consist of a 4-bit record. DIS V7 defines values 0-2.

a) ***Major Modulation.*** This field shall specify the major classification of the modulation type. This field shall be represented by a 4-bit enumeration (see [UID 155]).
b) ***Detail.*** This field shall provide certain detailed information depending on the major modulation type. This field shall be represented by a 4-bit enumeration (see [UID 156-162]).

c) ***Radio System.*** This field shall specify the radio system associated with this Transmitter PDU and shall be used as the basis to interpret other fields whose values depend on a specific radio system. This field shall be represented by a 4-bit enumeration (see [UID 163]).

Table 33—Modulation Type Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Modulation Type	Spread Spectrum	16	4	DIS V7 defines 0-2
	Major Modulation	16	4	[UID 155]
	Detail	16	4	[UID 156-162]
	Radio System	16	4	[UID 163]

11.21 Munition Descriptor

This field shall be represented by a Compressed Munitions descriptor record (see DIS V7 6.2.30). C-DIS shortens the Kind, Domain, and Country fields that are larger than required by current DIS enumerations, while still allowing for some growth. C-DIS uses 4:4:9:UVINT8:UVINT8:UVINT8:UVINT8 sizes versus standard DIS 8:8:16:8:8:8:8 sizes (see Record Definitions-Entity Type). The warhead and fuse are 16 bits the same as DIS but the quantity and rate are only eight bits versus 16 bits. Expendables shall set the Field Present Flags Descriptor-Warhead Fuse and Field Present Flags Descriptor Quantity and Rate = 0 to indicate that these fields are not used for expendables and shall not be provided in the PDU. Other items that do not use these fields shall set these flags to zero to indicate these fields are unused. If Warhead and Fuse = 0 or Quantity and Rate = 0 the Field Present flags shall be used to not send these fields.

Table 34—Munition Descriptor

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Descriptor-Entity Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]
Descriptor	Warhead	16	16	[UID 60]
	Fuse	16	16	[UID 61]
	Quantity	16	8	Max 255
	Rate	16	8	Max 255/per burst

11.22 Orientation

This field shall specify a geocentric orientation using Euler angles as specified in DIS. The values shall be scaled signed integer units up to +-π (180 degrees). Scale = $(2^{12} - 1) / \pi$. Angles shall be reduced to within the +-π (180 degrees) range before scaling to get accurate values.

Table 35—Orientation

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Orientation	Psi	32	13	0.0439 degree resolution
	Theta	32	13	0.0439 degree resolution
	Phi	32	13	0.0439 degree resolution

11.23 System Identifier (IFF)

The identification of the IFF emitting system shall be specified by a System Identifier record. This record shall specify the change status of this PDU, the system type, name, and mode. The fields of this record are as follows:

a) ***System Type.*** This field shall specify the general type of emitting system and shall be represented by a 4-bit enumeration (see [UID 82]).

b) ***System Name.*** This field shall specify a particular named type of system and shall be represented by a 5-bit enumeration (see [UID 83]).

c) ***System Mode.*** This field shall specify a mode of operation for the named system and shall be represented by a 3-bit enumeration (see [UID 84]).

d) ***Change/Options.*** This field shall specify the status of this PDU (existence of changes from previous, indicators for alternate fields, etc.). This field shall be represented by the Change/Options record (see DIS V7 6.2.13) and shall be represented by an 8-bit unsigned integer field.

The format of the System Identifier record shall be as shown in Table 36.

Table 36—System Identifier Record (IFF)

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
System ID	System Type	16	4	[UID 82]
	System Name	16	5	[UID 83]
	System Mode	8	3	[UID 84]
	Change/Options	8	8	

11.24 Track/Jam Data

The Track/Jam Data record identifies a tracked/illuminated entity or an emitter beam targeted with jamming. Use of the Track/Jam Data record in the EE PDU is described in DIS V7 5.7.3 and 7.6.2. The Emitter Beam-Beam Function shall be used to determine if a beam is a jammer. Enumeration values may be added in the future to SISO-REF-010 and therefore specific Emitter Beam - Beam Function Enumeration values that indicate jamming are not explicitly listed in C-DIS (see SISO-REF-010 [UID 78]). This record consists of a Site App Pair Index, Entity ID, Emitter Number, and a Beam Number:

a) ***Site App Pair Index*.** This field shall specify an index into the Site App Pairs List that matches the values desired for this track. Index shall range from 0 to 63.

b) ***Entity ID.*** Actual Entity ID of this track that completes the Site App Entity (SAE) triplet. This field shall be represented by UVINT16.

c) ***Emitter Number.*** This field shall specify an emitter system associated with the entity. This field shall be represented by UVINT8. This shall only be provided for jammers.

d) ***Beam Number.*** This field shall specify a beam associated with the emitter system. This field shall be represented by UVINT8. This shall only be provided for jammers.

The format of the Track/Jam Data record shall be as shown in Table 37.

Table 37—Track/Jam Data

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Track/Jam	Site App Pair Index		6	Index into Site App Pairs List
	Entity ID	16	UVINT16	
	Emitter number	8	UVINT8	Based on Jammer Track Flag
	Beam number	8	UVINT8	Based on Jammer Track Flag

11.25 Units

This field shall contain flags to indicate the units to be used by particular fields in a particular PDU. Common units are cm and meters.

11.26 Valid Entity State Marking Characters

Table 38 lists the characters that are valid in C-DIS. C-DIS does not support lower case characters. Lower case characters shall be translated to upper case letters. The 5-bit characters are the most commonly occurring letters based on Morse code. These are used to compress character strings to the maximum extent possible. Unsupported characters shall be translated as 63 = "*" asterisk.

Table 38—Valid Entity State Marking Characters

Value	6-bit Characters	5-bit Characters
0	Null Char	Null Char
1	A	A
2	B	B
3	C	C
4	D	D
5	E	E
6	F	F
7	G	G
8	H	H
9	I	I
10	J	L

Value	6-bit Characters	5-bit Characters
11	K	M
12	L	N
13	M	O
14	N	P
15	O	R
16	P	S
17	Q	T
18	R	U
19	S	V
20	T	W
21	U	Y
22	V	0
23	W	1
24	X	2
25	Y	3
26	Z	4
27	.	5
28	?	6
29	!	7
30	0	8
31	1	9
32	2	
33	3	
34	4	
35	5	
36	6	
37	7	
38	8	
39	9	
40	Space	
41	[	
42	]	
43	(	

Value	6-bit Characters	5-bit Characters
44	)	
45	{	
46	}	
47	+	
48	-	
49	_	
50	@	
51	&	
52	"	
53	'	
54	:	
55	;	
56	,	
57	~	
58	\	
59	/	
60	%	
61	#	
62	$	
63	*	

11.27 World Coordinates Record

This field shall specify an entity's physical location in the simulated world and shall be represented by a compressed World Coordinates record. C-DIS uses Latitude, Longitude, and Altitude MSL using the WGS84 ellipsoid to encode the world position rather than standard DIS geocentric coordinates because it can be represented by a much smaller data structure. Unlike other C-DIS items that are directly scaled by the C-DIS encoder this requires DIS geocentric ECEF XYZ coordinates be converted to geodetic Latitude, Longitude, and Altitude MSL coordinates in order for the C-DIS encoder to fill in the C-DIS world coordinates record. C-DIS decoders must convert the C-DIS Lat/Lon/Alt values back into ECEF to fill in the DIS messages. The algorithms described by Olsen are recommended as accurate and fast conversions between ECEF and Geodetic Lat/Lon/Alt coordinates (see IEEE Transactions on Aerospace and Electronic Systems Vol. 32, No. 1 pp 473-476 Jan 1996).

a) **Latitude** is represented using a 31-bit signed integer scaled up to $+-\pi / 2$ (90 degrees) Scale = $(2^{30} - 1) / (\pi / 2)$. Units are radians.

b) **Longitude** is represented using a 32-bit signed integer scaled up to $+-\pi$ (180 degrees). Scale = $(2^{31} - 1) / \pi$. Units are radians.

c) **Altitude Mean Sea Level (MSL)** is represented using SVINT24 in units of centimeters (cm) = meters / 100, or dekameters (dam) = meters * 10 as indicated by the units flag. (Special Case -8 388 608 shall indicate center of the earth Geocentric x = 0, y = 0, z = 0 regardless of units). Latitude and Longitude shall be ignored if the altitude is the special case value. Geocentric x = 0, y = 0, z = 0 may be used by transmitters to indicate that no power calculations should be performed for communications. This is sometimes used by white force radios that require communications with all participants. Units of cm shall be used if the altitude value is less than 8 388 608 cm in order to preserve maximum precision.

Table 39—World Coordinates Record

Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Entity Location	Latitude	64	31	+-π/2 (90 degrees) Lat (approx 0.93 cm accuracy)
	Longitude	64	32	+-π (180 degrees) Lon (approx 0.93 cm accuracy)
	Altitude MSL	64	SVINT24	+8 388 607, -8 388 608 cm or dekameter as indicated by Entity Location Altitude Units Flag

12 Variable Parameter Records (normative)

This section describes each of the defined Variable Parameter Records in the DIS V7 specification and how they are compressed.

12.1 Articulated Part Variable Parameter (VP) Record

The specification of articulated parts for movable parts and a combination of moveable/attached parts of an entity shall be represented by an Articulated Part VP record. This record shall specify whether or not a change has occurred, the part identification of the articulated part to which it is attached, and the type and value of each parameter (see DIS V7 Annex I for further explanation, figures, and examples). The Articulated Part VP record is a type of Variable Parameter record. It shall contain the following fields:

a) ***Compressed Flag.*** This field shall indicate if this Variable Record is compressed. 0 = Normal 128-bit standard DIS record, 1 = Compressed.

b) ***Record Type.*** This field shall designate the identification of an Articulated Part VP record. This field shall be represented by a 3-bit enumeration (see [UID 56]).

c) ***Change Indicator***. This field shall indicate the change of any parameter for any articulated part. This field shall be specified by an 8-bit unsigned integer. This field shall be set to zero for each exercise and sequentially incremented by one for each change in articulation parameters. In the case where all possible values are exhausted, the numbers shall be reused beginning at zero.

d) ***ID—Part Attached To***. This field shall specify the identification of the articulated part to which this articulation parameter is attached. This field shall be specified by a 10-bit unsigned integer. This field shall contain the value zero if the articulated part is attached directly to the entity. See DIS V7 Annex I.2.2.2.

e) ***Parameter Type***. This field shall specify the type of parameter represented and shall be specified by a 14-bit enumeration (see [UID 58-59]). Parameter types are defined in DIS V7 Annex I.

f) ***Parameter Value***. This field shall specify the parameter value and shall be specified by a 15-bit mantissa and 3-bit signed exponent. The definition of this field shall be determined based on the type of parameter specified in the Parameter Type field (see item 5) above).

The format of the Articulated Part VP Record shall be as shown in Table 40.

Table 40—Articulated Part VP Record

C-DIS MESSAGE Format -Articulated Part VP Record				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Notes**
Compressed Flag			1	Indicate if Variable Record is compressed 0 = Normal DIS 128 bits, 1 = Compressed
Type	Record Type = 0	8	3	[UID 56]
Change Indicator		8	8	Increments all values
ID Part Attached to		16	10	Allow up to 1023 subparts
Parameter Type		32	14	Type Class [UID 59] + Type Metric [UID 58]
Parameter Value	Mantissa	32	15	Signed Value +-16383 x $10^{Exponent}$ (Approx Four Decimal Place accuracy 9999) Smallest = $1x10^{-4}$ Largest 16 $383x10^{3}$
	Exponent		3	Signed Exponent +3, -4
Padding		32	0	

12.2 Attached Part VP Record

The specification of removable parts that may be attached to an entity shall be represented by an Attached Part VP record. This record shall specify whether or not the part is currently attached, the part identification, and the type and value of each parameter (see DIS V7 Annex I for further explanation, figures, and examples). The Attached Part VP record is a type of Variable Parameter record. It shall contain the following fields:

a) ***Compressed Flag.*** This field shall indicate if this Variable Record is compressed. 0 = Normal 128-bit standard format DIS record, 1 = Compressed.

b) ***Record Type.*** This field shall designate the identification of an Attached Part VP record. This field shall be represented by a 3-bit enumeration (see [UID 56]).

c) ***Detached Indicator.*** This field shall indicate whether an attached part is attached or detached. This field shall be specified by a 1-bit enumeration (see [UID 415]). This field shall be set to Attached = 0 to indicate the part is attached and to Detached = 1 if the part becomes detached. (See DIS V7 I.2.3.1 for transitions between the attached and detached states.)

d) ***ID—Part Attached To***. This field shall specify the identification of the articulated or attached part to which this attached part is attached. This field shall contain the value zero if the attached part is attached directly to the entity. This field shall be specified by a 10-bit unsigned integer. See DIS V7 I.2.2.2.

e) ***Parameter Type.*** This field shall specify the location (or station) to which the part is attached and shall be specified by an 11-bit enumeration (see [UID 57]). Parameter types are defined in DIS V7 Annex I.

f) ***Attached Part Type.*** This field shall specify the Entity Type record enumeration of the attached part (see Record Definitions-Entity Type).

The format of the Attached Part VP record shall be as shown in Table 41.

Table 41—Attached Part VP Record

C-DIS MESSAGE Format -Attached Part VP Record				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Notes**
Compressed Flag			1	Indicate if Variable Record is compressed 0 = Normal DIS 128 bits, 1 = Compressed
Type	Record Type = 1	8	3	[UID 56]
Detached Indicator		8	1	[UID 415]
ID Part Attached to		16	10	Allow up to 1023 Subparts
Parameter Type		32	11	[UID 57]
Attached Part Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] - Allow 511 Max
	Cat	8	UVINT8	[UID 9-15, 22-28]
	Subcat	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]

12.3 Entity Separation VP Record

The physical separation of an entity from another entity shall be communicated using the Separation VP Record. The Separation VP Record also provides the capability to specifically identify the station location on the parent entity that the entity separated from. Examples include the launch of an air-to-surface missile from the wing station of a fighter aircraft, the separation of a stage of a multistage missile, and the separation of a component of a smart weapon.

The Separation VP record shall contain the following fields:

a) ***Compressed Flag.*** This field shall indicate if this Variable Record is compressed. 0 = Normal 128-bit standard format DIS record, 1 = Compressed.

b) ***Record Type.*** This field shall identify the record as a Separation VP record. It shall be represented by a 3-bit enumeration (see [UID 56]).

c) ***Reason for Separation.*** This field shall indicate the reason for the separation. It shall be represented by a 3-bit enumeration (see [UID 282]).

d) ***Pre-Entity Indicator.*** This field shall indicate whether the entity existed prior to the separation and, if so, in what manner. It shall be represented by a 3-bit enumeration (see [UID 283]).

e) ***Parent Entity ID.*** This field shall indicate the Entity ID of the parent entity. It shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

f) ***Station Location.*** This field shall indicate the station that this entity was attached to prior to separation if known. It shall be represented by the Named Location Identification record (see DIS V7 6.2.62).

1) Station Name shall use an unsigned 6-bit integer enumeration.
2) Station Number shall use an unsigned 12-bit integer value.

The format of the Separation VP record shall be as shown in Table 42.

Table 42—Entity Separation VP Record

C-DIS MESSAGE Format-Entity Separation VP Record				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Notes**
Compressed Flag			1	Indicate if Variable Record is compressed 0 = Normal DIS 128 bits, 1 = Compressed
Type	Record Type = 2	8	3	[UID 56]
Reason for Separation		8	3	[UID 282]
Pre-Entity Indicator		8	3	[UID 283]
Padding		8	0	
Parent Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Padding		16	0	
Station Location	Station Name	16	6	[UID 212]
	Station Number	16	12	Allow up to 4096 Stations

12.4 Entity Type VP Record

The Entity Type for an entity when it is different than the entity type value contained in the Entity Type field of the Entity State PDU shall be communicated using the Entity Type VP record.

The Entity Type VP record shall contain the following fields:

a) ***Compressed Flag.*** This field shall indicate if this Variable Record is compressed. 0 = Normal 128-bit standard format DIS record, 1 = Compressed.

b) ***Record Type.*** This field shall identify the record as an Entity Type VP record. It shall be represented by a 3-bit enumeration (see [UID 56]).

c) ***Change Indicator.*** This field shall indicate whether this VP record has changed since the last issuance. It shall be represented by a 1-bit enumeration (see [UID 320]).

d) ***Entity Type.*** This field shall contain an Entity Type record for the Entity Type associated with an entity (see Record Definitions-Entity Type and DIS V7 6.2.30).

The format of the Entity Type VP record shall be as shown in Table 43.

Table 43—Entity Type VP Record

C-DIS MESSAGE Format -Entity Type VP Record				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Notes**
Compressed Flag			1	Indicate if Variable Record is compressed 0 = Normal DIS 128 bits, 1 = Compressed
Type	Record Type = 3	8	3	[UID 56]
Change Indicator		8	1	[UID 320]
Attached Part Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] - Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]
Padding		16	0	
Padding		32	0	

12.5 Entity Association VP Record

For details on the purpose and general rules for various types of entity associations refer to DIS V7 6.2.94.4.1.

The Entity Association VP record shall contain the following fields:

a) ***Compressed Flag.*** This field shall indicate if this Variable Record is compressed. 0 = Normal 128-bit standard format DIS record, 1 = Compressed.

b) ***Record Type.*** This field shall identify the record as an Entity Type VP record. It shall be represented by a 3-bit enumeration (see [UID 56]).

c) ***Change Indicator.*** This field shall indicate whether this VP record has changed since the last issuance. It shall be represented by a 1-bit enumeration (see [UID 320]).

d) ***Association Status.*** This field shall indicate the association status between two entities, or an entity with another object. It shall be represented by a 4-bit enumeration (see [UID 319]).

e) ***Association Type.*** This field shall indicate the type of association that exists between two entities, or an entity with another object. It shall be represented by an 8-bit enumeration (see [UID 323]).

f) ***Entity/Object ID.*** This field shall indicate the Object ID of the entity or other object associated with this entity. It shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28) or Object Identifier record (see DIS V7 6.2.63).

g) ***Own Station Location.*** This field shall indicate the station location on one's own entity where a physical connection is attached, if known. If there is more than one physical connection, then each connection that is described shall be included in a separate Entity Association VP record. This field shall be represented by a 6-bit enumeration (see [UID 212]).

h) ***Physical Connection Type.*** This field shall indicate the type of physical connection, if any, between this entity and another entity or object. If the association does not involve a physical connection, this field shall be set to Not Specified (0). It shall be represented by a 5-bit enumeration (see [UID 324]).

i) ***Group Member Type.*** This field shall indicate the type of member the entity is within the group. If this entity is not part of a group, this field shall be set to zero. It shall be represented by a 4-bit enumeration (see [UID 321]).

j) ***Group Number.*** This field shall indicate the group, if any, to which an entity belongs. If this entity is not part of a group, this field shall be set to zero. The manner in which group numbers are assigned is outside the scope of this standard. It shall be represented by a 16-bit unsigned integer.

The format of the Entity Association VP Record shall be as shown in Table 44.

Table 44—Entity Association VP Record

C-DIS MESSAGE Format-Entity Association VP Record				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Notes**
Compressed Flag			1	Indicate if Variable Record is compressed 0 = Normal DIS 128 bits, 1 = Compressed
Type	Record Type = 4	8	3	[UID 56]
Change Indicator		8	1	[UID 320]
Association Status		8	4	[UID 319]
Association Type		8	8	[UID 323]
Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Own Station Location		16	6	[UID 212]
Physical Connection Type		8	5	[UID 324]
Group Member Type		8	4	[UID 321]
Group Number		16	16	Assigned group

13 C-DIS PDU Format Details (normative)

13.1 C-DIS PDU Header

The Header for each C-DIS message will be composed of the same items; therefore, the details are described here once to make the document shorter and easier to read.

The C-DIS header shall be used at the beginning of every C-DIS PDU. The header shall contain the following fields:***Protocol Version.*** This field indicates which C-DIS version is being used. Zero is illegal for C-DIS (Reserved for DIS so that processes can check for non-zero to identify C-DIS versus 0 = DIS data stream) 1=SISO-STD-023-2023, two and three are reserved for future use if new C-DIS versions are created. The version of DIS PDU received by an encoder is not passed to the decoder. The decoder will reconstruct the DIS PDU using the DIS version that it supports, which may differ from the DIS version received by the C-DIS encoder. This means that the C-DIS encoder may receive a DIS Version 6 (DIS V6) PDU from a simulation application, send data to a C-DIS decoder, and then that decoder may create a DIS V7 PDU on its DIS network.

a) ***Exercise ID.*** This field shall specify the exercise to which the PDU pertains. C-DIS users should use 0-15 whenever possible for compression efficiency. Other IDs will increase the message size four bits for all PDUs. This shall be represented as a UVINT8.

b) ***PDU Type.*** This field shall indicate the type of PDU that follows. This field shall be represented by an 8-bit enumeration (see [UID 4]).

c) ***Protocol Family.*** This field is not used in C-DIS because it is redundant with PDU Type. The C-DIS decoder shall recreate Protocol Family based on PDU type.

d) ***Timestamp.*** This field shall specify the time that the data in the PDU was generated. The LSB of the timestamp indicates if the timestamp is relative time or absolute time. Bits 2-26 are coded with the actual time. The scale of the time value contained in the most significant 25 bits of the timestamp shall be determined by letting zero represent the start of the hour and letting 2^{25} - 1 represent one time unit before the start of the next hour. The next hour then starts back at zero. This results in each time unit representing exactly 3600 / (2^{25}) seconds (approximately 107.288361 µsec). Scale = (2^{25}) / 3600.

e) ***Length.*** This field shall specify the length of the PDU, including the PDU Header in bits not in bytes like standard DIS. This is necessary because C-DIS is a bit oriented standard and will not be aligned to byte boundaries, and therefore a byte count is not applicable.

f) ***PDU Status.*** This field shall specify the PDU status related to one or more PDU Types (see DIS V7 6.2.67).

g) ***Padding.*** No Padding fields are used in C-DIS.

The format of the C-DIS Header shall be as shown in Table 45.

Table 45—C-DIS Message Header

C-DIS MESSAGE Format-DIS Header				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	Protocol Version	8	2	0 Reserved for Standard DIS, 1 = SISO-023-2023, 2 & 3 reserved for future use
	Exercise ID	8	UVINT8	0-15 recommended for efficiency
	PDU Type	8	8	
	Protocol Family	8	0	Not necessary
	Time Stamp	32	26	107 µsec smallest time unit (LSB = Absolute Time Flag just like DIS, Original DIS 31 bits = 1.67 µsec)
	Length	16	14	Length in bits 16 383 max (not Bytes like Standard DIS)
	PDU Status	8	8	
	Padding	8	0	Not applicable

13.2 Entity State PDU

Information about a particular entity shall be communicated by issuing an Entity State PDU. See DIS V7 5.3.2 for specific requirements on the use of the Entity State PDU. The Entity State PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received. Fields required as part of a full update must be provided on the first and last PDU updates, and at least once during the CDIS_FULL_UPDATE_PERIOD.

1) ***Force ID.*** Flag = 0 indicates the Force ID field shall not be provided. Flag = 1 indicates that the Force ID field shall be provided in this PDU.

2) ***Variable Parameter.*** This flag is used to indicate that variable parameters are going to be used or not. If variable parameters are not used (flag = 0) then the Number of variable parameter records field shall not be present in the PDU, and no variable parameter data shall be added to the PDU.

3) ***Entity Type.*** Flag = 0 indicates the Entity Type record shall not be provided. Flag = 1 indicates that the Entity Type record shall be provided in this PDU.

4) ***Alternate Entity Type.*** Flag = 0 indicates the Alternate Entity Type record shall not be provided. Flag = 1 indicates that the Alternate Entity Type record shall be provided in this PDU.

5) ***Entity Linear Velocity.*** Flag = 0 indicates the Entity Linear Velocity record shall not be provided. Flag = 1 indicates that the Entity Linear Velocity record shall be provided in this PDU.

6) ***Entity Location.*** Flag = 0 indicates the Entity Location record shall not be provided. Flag = 1 indicates that the Entity Location record shall be provided in this PDU.

7) ***Entity Orientation.*** Flag = 0 indicates the Entity Orientation record shall not be provided. Flag = 1 indicates that the Entity Orientation record shall be provided in this PDU.

8) ***Entity Appearance.*** Flag = 0 indicates the Entity Appearance record shall not be provided. Flag = 1 indicates that the Entity Appearance record shall be provided in this PDU.

9) ***Dead Reckoning Params – Other.*** Flag = 0 indicates this Dead Reckoning Params-Other 120-bit optional params field shall not be provided in the PDU. Flag = 1 indicates the Dead Reckoning Params-Other 120-bit optional params field shall be provided in the PDU.

10) ***Dead Reckoning Params – Entity Linear Acceleration.*** Flag = 0 indicates the Entity Linear Acceleration record shall not be provided. Flag = 1 indicates that the Entity Linear Acceleration record shall be provided in this PDU.

11) ***Dead Reckoning Params – Entity Angular Velocity.*** Flag = 0 indicates the Entity Angular Velocity record shall not be provided. Flag = 1 indicates that the Entity Angular Velocity record shall be provided in this PDU.

12) ***Entity Marking.*** Flag = 0 indicates the Entity Marking record (Marking Length, CharBitSize and Marking) shall not be provided. Flag = 1 indicates that the Entity Marking record (Marking Length, CharBitSize, and Marking) shall be provided in this PDU.

13) ***Capabilities.*** Flag = 0 indicates the Capabilities record shall not be provided. Flag = 1 indicates that the Capabilities record shall be provided in this PDU.

c) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this particular PDU.

1) ***Entity Location Altitude.*** Flag = 0 indicates that the Entity Location Altitude Mean Sea Level shall be in units of centimeters (cm) = meters / 100. Flag = 1 indicates units of dekameters (dam) = meters * 10.

d) ***Full Update Flag.*** This field shall contain a bit flag to indicate if this PDU represents a Full Update or Partial Update. C-DIS decoders shall only create a new object when a Full Update is received in order to have a complete and accurate initial object state. Flag = 0 shall indicate a Partial Update. Flag = 1 shall indicate a Full Update.

e) ***Entity ID.*** This field shall identify the entity issuing the PDU and shall be represented by an Entity Identifier Record (see DIS V7 6.2.28). (see Record Definitions-Entity Identifier Record)

f) ***Force ID.*** This field shall identify the force to which the issuing entity belongs and shall be represented by a UVINT8. This field shall only be present if indicated by the Field Present Flags-Force ID = 1. This field shall be provided on the first and last PDU update, and at least once during every entity CDIS_FULL_UPDATE_PERIOD.

g) ***Number of Variable Parameter Records.*** This field shall specify the number of Variable Parameter records present. This field shall be represented by an 8-bit unsigned integer (see DIS V7 Annex I). This field shall only be present if indicated by the Field Present Flags-Variable Parameters = 1.

h) ***Entity Type.*** This field shall identify the entity type to be displayed by members of the same force as the issuing entity. This field shall be represented by an Entity Type record (see DIS V7 6.2.30). This field shall only be present if indicated by the Field Present Flags-Entity Type = 1. This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD. (see Record Definitions-Entity Type).

i) ***Alternate Entity Type*.** This field is optional and may never be provided. Receivers should assume this field is all zeroes until this data is explicitly provided. This field shall only be present if indicated by the Field Present Flags-Alternate Entity Type = 1. This field shall identify the entity type to be displayed by members of forces other than that of the issuing entity and shall be represented by an Entity Type record (see DIS V7 6.2.30). (see Record Definitions-Entity Type).

j) ***Entity Linear Velocity.*** This field shall specify an entity's linear velocity. The coordinate system for an entity's linear velocity depends on the dead reckoning algorithm used. This field shall be represented by a Linear Velocity Vector record [see DIS V7 item c) in 6.2.96]. Velocities shall always be in a geocentric or body frame of reference, even though in C-DIS the location is provided as Latitude, Longitude, and Altitude. This field shall only be provided when the DR algorithm requires this data (DR Algorithms = 2, 3, 4, 5, 6, 7, 8, 9). This field shall only be present if indicated by the Field Present Flags-Entity Linear Velocity = 1. (See Record Definitions-Linear Velocity).

k) ***Entity Location.*** This field shall specify an entity's physical location in the simulated world and shall be represented by a World Coordinates record. (see Record Definitions-World Coordinates Record). This field shall only be present if indicated by the Field Present Flags-Entity Location = 1. This field shall be provided on the first and last PDU update, and at least once during every entity CDIS_FULL_UPDATE_PERIOD.

l) ***Entity Orientation.*** This field shall specify an entity's orientation and shall be represented by an Euler Angles record (see DIS V7 6.2.32). This field shall only be present if indicated by the Field Present Flags-Entity Orientation = 1 (see Record Definitions-Orientation). This field shall be provided on the first and last PDU update, and at least once during every entity CDIS_FULL_UPDATE_PERIOD.

m) ***Entity Appearance.*** This field shall specify the dynamic changes to the entity's appearance attributes. This field shall be represented by an Entity Appearance record (see DIS V7 6.2.26). This field shall only be present if indicated by the Field Present Flags-Entity Appearance = 1. This field shall be provided on the first and last PDU update, and at least once during every entity CDIS_FULL_UPDATE_PERIOD.

n) ***Dead Reckoning Parameters.*** This field will be used to provide parameters for dead reckoning the position and orientation of the entity. The dead reckoning algorithm in use shall always be provided. The One-hundred-twenty "Other" bits defined in DIS V7 should not be used unless required. This will be indicated by the Fields Present Flags-Dead Reckoning Params-Other flag.

o) ***Entity Linear Acceleration.*** This field shall specify an entity's linear acceleration. This field shall be represented by a Linear Acceleration Vector record [see DIS V7 item b) in 6.2.96]. This field shall only be provided when the DR algorithm requires this data (DR Algorithms = 4, 5, 8, and 9). This field shall only be present if indicated by the Field Present Flags-Dead Reckoning Params-Entity Linear Acceleration = 1. (See Record Definitions-Linear Acceleration).

p) ***Entity Angular Velocity.*** This field shall specify an entity's angular velocity and shall be represented by an Angular Velocity Vector record (see DIS V7 6.2.7). This field shall only be provided when the DR algorithm requires this data (DR Algorithms = 3, 4, 7, and 8). This field shall only be present if indicated by the Field Present Flags-Dead Reckoning Params-Entity Angular Velocity = 1. (See Record Definitions-Angular Velocity)

q) ***Entity Marking.*** This field shall identify any unique markings on an entity (for example, a bumper number, call sign, or country symbol). This field shall be represented by an Entity Marking record (see DIS V7 6.2.29). This field shall be provided on the first PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD. The presence of this field shall be indicated by the Field Present Flags-Entity Marking flag. The Marking Length shall be filled with the number of characters actually required by the marking. Example "VIPER1" = 6 characters in length. Character Set shall not be used. CharBitSize flag = 0 indicates 5-bit Characters, flag = 1 indicates 6-bit Characters. Only C-DIS supported characters will be passed. Note that only upper case letters are supported. Lower case letters will be translated to upper case. Unsupported characters will be replaced with an asterisk "*" see Table 38 for valid five and six bit characters. Five bit characters are the most commonly used letters (determined for Morse Code) minus least used letters J, K, Q, X, and Z to fit letters and all numeric digits into five bits.

r) ***Capabilities.*** This field is optional and may never be provided. Receivers should initialize the capabilities to zero until a capabilities update is explicitly received. This field shall specify the entity's capabilities. This field shall be represented by an Entity Capabilities record (see DIS V7 6.2.27). The presence of this field shall be indicated by the Field Present Flags-Capabilities flag.

s) ***Variable Parameter Records.*** This field shall specify the parameter values for each Variable Parameter record that is included (see DIS V7 6.2.94 and DIS V7 Annex I). Variable Parameter Records may or may not be compressed (see Variable Parameter Records section for details).

The format of the Entity State PDU shall be as shown in Table 46.

Table 46—Entity State PDU

C-DIS MESSAGE Format-Entity State PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Force ID		1	0 = None, 1 = Present
	Variable Parameters		1	Number of Variable Parameter Records, Variable Parameter Records 0 = None Present, 1 = All Present
	Entity Type		1	0 = None, 1 = Present
	Alternate Entity Type		1	0 = None, 1 = Present
	Entity Linear Velocity		1	0 = None, 1 = Present
	Entity Location		1	0 = None, 1 = Present
	Entity Orientation		1	0 = None, 1 = Present
	Entity Appearance		1	0 = None, 1 = Present
	Dead Reckoning Params-Other		1	0 = None, 1 = Present

C-DIS MESSAGE Format-Entity State PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
	Dead Reckoning Params-Entity Linear Acceleration		1	0 = None, 1 = Present
	Dead Reckoning Params-Entity Angular Velocity		1	0 = None, 1 = Present
	Entity Marking		1	0 = None Present, 1 = Entity Marking Present
	Capabilities		1	0 = None, 1 = Present
Units	Entity Location Altitude		1	0 = centimeters (cm), 1 = dekameters (dam)
Full Update Flag			1	0 = Partial Update, 1 = Full Update
Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Force ID		8	UVINT8	[UID 6]
Number of Variable Parameter Records		8	UVINT8	Present only if Variable Parameters present flag is true
Entity Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]
Alt Entity Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]

C-DIS MESSAGE Format-Entity State PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Entity Linear Velocity	X	32	SVINT16	+32767, -32768 decimeter/sec (6369.59 knots max)
	Y	32	SVINT16	+32767, -32768 decimeter/sec (6369.59 knots max)
	Z	32	SVINT16	+32767, -32768 decimeter/sec (6369.59 knots max)
Entity Location	Latitude	64	31	+-90 degrees Lat (approx 0.93 cm accuracy)
	Longitude	64	32	+-180 degrees Lon(approx 0.93 cm accuracy)
	Altitude MSL	64	SVINT24	+8388607, -8388608 cm or Dekameter as indicated by Entity Location Altitude Units Flag (-8388608 special case indicates ECEF x = 0, y = 0, z = 0)
Entity Orientation	Psi	32	13	0.04394 degree resolution
	Theta	32	13	0.04394 degree resolution
	Phi	32	13	0.04394 degree resolution
Entity Appearance		32	32	
Dead Reckoning Parameters	Algorithm	8	4	
	Other	120	120	
	Entity Linear Acceleration X	32	SVINT14	+8191, -8192 decimeters/sec/sec (Aprox 83.5 g)
	Entity Linear Acceleration Y	32	SVINT14	+8191, -8192 decimeters/sec/sec (Aprox 83.5 g)
	Entity Linear Acceleration Z	32	SVINT14	+8191, -8192 decimeters/sec/sec (Aprox 83.5 g)
	Entity Angular Velocity Psi	32	SVINT12	+-720 degrees per second max 0.35 degrees/sec resolution
	Entity Angular Velocity Theta	32	SVINT12	+-720 degrees per second max 0.35 degrees/sec resolution
	Entity Angular Velocity Phi	32	SVINT12	+-720 degrees per second max 0.35 degrees/sec resolution
Entity Marking	Marking Length		4	Number of characters in Marking
	Char Set	8	0	Only support C-DIS ASCII characters
	CharBitSize		1	0 = 5Bit per Char, 1 = 6Bits per Char
	Marking	88	0-66	Size = Marking Length * 5 or 6 bits per char (55 or 66 max)
Capabilities		32	UVINT32	
Variable Parameter Records				

C-DIS MESSAGE Format-Entity State PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Variable Parameter Record #N	Compressed Flag		1	0 = Normal DIS, 1 = Compressed
	Record Type	8	3	[UID 56], NN = bit size of compressed variable records
	Record-Specific Fields	120	NN	

13.3 Fire PDU

The firing of a weapon or expendable shall be communicated by issuing a Fire PDU. See DIS V7 5.4.3 for specific requirements on the use of the Fire PDU. The Fire PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

   1) ***Fire Mission Index.*** Flag = 0 indicates the Fire Mission Index field shall not be provided in this PDU. Flag = 1 indicates that the Fire Mission Index field shall be provided in this PDU.

   2) ***Descriptor-Warhead Fuse.*** Flag = 0 indicates the Descriptor-Warhead and Descriptor-Fuse fields shall not be provided in this PDU. Flag = 1 indicates that the Descriptor-Warhead and Descriptor-Fuse fields shall be provided in this PDU.

   3) ***Descriptor-Quantity Rate.*** Flag = 0 indicates the Descriptor-Quantity and Descriptor-Rate fields shall not be provided in this PDU. Flag = 1 indicates that the Descriptor-Quantity and Descriptor-Rate fields shall be provided in this PDU.

   4) ***Range.*** Flag = 0 indicates the Range field shall not be provided in this PDU. Flag = 1 indicates that the Range field shall be provided in this PDU.

c) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this PDU.

   1) ***Location Altitude.*** Flag = 0 indicates that the Location Altitude Mean Sea Level shall be in units of centimeters (cm) = meters / 100. Flag = 1 indicates units of dekameters (dam) = meters * 10.

d) ***Firing Entity ID.*** This field shall identify the firing entity and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Target Entity ID.*** This field shall identify the intended target (see DIS V7 5.4.3.3). This field shall be represented by an Entity Identifier record (see Record Definitions- Entity Identifier Record and DIS V7 6.2.28).

f) ***Munition/Expendable Entity ID.*** This field shall specify the entity identification of the fired munition or expendable. This field shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

g) ***Event ID.*** This field shall contain an identification generated by the firing entity to associate related firing and detonation events. This field shall be represented by an Event Identifier record (see Record Definitions-Entity Identifier Record and V7 6.2.33).

h) ***Fire Mission Index.*** This field shall identify the fire mission (see DIS V7 5.4.3.3). This field shall be represented by a UVINT32. The Fields Present Flags-Fire Mission Index shall indicate the presence of this field.

i) ***Location in World Coordinates***. This field shall specify the location, in world coordinates (Latitude, Longitude, and Altitude MSL), from which the munition was launched and shall be represented by a World Coordinates Record (see Record Definitions- World Coordinates Record).

j) ***Descriptor.*** This field shall describe the firing or launch of a munition or expendable represented by one of the following types of Descriptor records: Munition Descriptor (see Record Definitions-Munition Descriptor) or Expendable Descriptor (see Record Definitions-Munition Descriptor). The Field Present Flags Descriptor-Warhead Fuse shall indicate the presence of the Descriptor-Warhead and Descriptor-Fuse fields. The Field Present Flags Descriptor-Quantity Rate shall indicate the presence of the Descriptor-Quantity and Descriptor-Rate fields.

k) ***Velocity.*** This field shall specify the velocity of the fired munition at the point when the issuing simulation application intends the externally visible effects of the launch (e.g., exhaust plume or muzzle blast) to first become apparent. The velocity shall be represented in world coordinates. This field shall be represented by a Linear Velocity Vector record (see Record Definitions-Linear Velocity)

l) ***Range.*** This field shall specify the range that an entity's fire control system has assumed in computing the fire control solution. This field shall be represented by UVINT32 in meters. For systems where range is unknown or unavailable the Field Present Flag-Range shall be set to zero and no range shall be provided in the PDU. Decoders shall assume a range of zero if no range is provided.

The format of the Fire PDU shall be as shown in Table 47.

Table 47—Fire PDU

C-DIS MESSAGE Format-Fire PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fire Mission Index		1	0 = None, 1 = Present
	Descriptor-Warhead Fuze		1	0 = None, 1 = Present
	Descriptor-Quantity Rate		1	0 = None, 1 = Present
	Range		1	0 = None, 1 = Present
Units	Location Altitude		1	0 = centimeters (cm), 1 = dekameters (dam)
Firing Entity ID	Site	16	UVINT16	
	Host	16	UVINT16	
	Entity	16	UVINT16	
Target Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	

C-DIS MESSAGE Format-Fire PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Munition/Expendable Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Event ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Fire Mission Index		32	UVINT32	
Location in World Coordinates	Latitude	64	31	+-90 degrees Lat (approx 0.93 cm accuracy)
	Longitude	64	32	+-180 degrees Lon(approx 0.93 cm accuracy)
	Altitude MSL	64	SVINT24	+8 388 607, -8 388 608 cm or dekameter as indicated by Location Altitude Units Flag
Descriptor-Entity Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]
Descriptor-Descriptor	Warhead	16	16	[UID 60]
	Fuse	16	16	[UID 61]
	Quantity	16	8	Max 255
	Rate	16	8	Max 255/per burst
Velocity	X	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Y	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Z	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
Range		32	UVINT32	Max 1048575 meters (~ 566 nautical miles)

13.4 Detonation PDU

The detonation or impact of munitions, as well as non-munition explosions, the burst or initial bloom of chaff, and the ignition of a flare shall be indicated using the Detonation PDU. See DIS V7 5.4.4 for

specific requirements on the use of the Detonation PDU. The Detonation PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

   1) ***Descriptor-Warhead Fuse.*** Flag = 0 indicates the Descriptor-Warhead and Descriptor-Fuse fields shall not be provided in this PDU. Flag = 1 indicates that the Descriptor-Warhead and Descriptor-Fuse fields shall be provided in this PDU.

   2) ***Descriptor-Quantity Rate.*** Flag = 0 indicates the Descriptor-Quantity and Descriptor-Rate fields shall not be provided in this PDU. Flag = 1 indicates that the Descriptor-Quantity and Descriptor-Rate fields shall be provided in this PDU.

   3) ***Variable Parameter.*** This flag is used to indicate that variable parameters are going to be used or not. If variable parameters are not used (Flag = 0) then the Number of variable parameter records field shall not be present in the PDU, and no variable parameter data shall be added to the PDU.

c) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this particular PDU.

   1) ***World Location Altitude.*** Flag = 0 indicates that the Location Altitude Mean Sea Level shall be in units of centimeters (cm) = meters / 100. Flag=1 shall indicate units of dekameters (dam) = meters * 10.

   2) ***Location in Entity's Coordinates.*** Flag = 0 indicates that the Location in Entity's coordinates shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of meters. Centimeter units shall be used unless the location is larger than the maximum +32 767, -32 768 cm value that can be encoded in entity coordinates SVINT16 XYZ field. (See Record Definitions-Entity Coordinate Vector).

d) ***Source Entity ID.*** This field shall identify the entity that fired the munition, the entity that launched the expendable, or the entity that caused the non-munition entity, or portion thereof, to explode as specified in DIS V7 5.4.4.3. This field shall be represented by an Entity Identifier record (see Record Definitions- Entity Identifier Record and DIS V7 6.2.28).

e) ***Target Entity ID*****.** This field shall identify the target entity of the munition, the target threat entity to the entity that launched the expendable, or the non-munition entity that exploded as specified in DIS V7 5.4.4.3. This field shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

f) ***Exploding Entity ID*****.** This field shall identify the munition entity or the expendable entity. This field is not applicable for non-munition detonations. Detailed requirements for setting this field are in and DIS V7 5.4.4.3. This field shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

g) ***Event ID.*** This field shall contain the same data as in the Event ID field of the Fire PDU that communicated the launch of the munition or expendable. If the detonation is not preceded by a corresponding fire event, then the Event Number field of the Event Identifier record shall be zero (e.g., land mines detonation). This field shall be represented by an Event Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.33).

h) ***Velocity*.** This field shall specify the velocity of the munition immediately before detonation/impact, the velocity of a non-munition entity immediately before exploding, or the velocity of an expendable immediately before a chaff burst or ignition of a flare. The velocity shall be represented in world coordinates. This field shall be represented by a Linear Velocity Vector record [see Record Definitions-Linear Velocity and DIS V7 item c) in 6.2.96].

i) ***Location in World Coordinates*.** This field shall specify the location of the detonation in world coordinates. This field shall be represented by a World Coordinates record (see Record Definitions-World Coordinates Record and DIS V7 6.2.98).

j) ***Descriptor*.** This field shall describe the detonation represented by one of the following types of Descriptor records: Munition Descriptor (see Record Definitions-Munition Descriptor and DIS V7 6.2.19.2), Explosion Descriptor (see Record Definitions-Munition Descriptor and DIS V7 6.2.19.3), or Expendable Descriptor (see Record Definitions-Munition Descriptor and DIS V7 6.2.19.4. The Field Present Flags Descriptor-Warhead Fuse shall indicate the presence of the Descriptor-Warhead and Descriptor-Fuse fields. The Field Present Flags Descriptor-Quantity Rate shall indicate the presence of the Descriptor-Quantity and Descriptor-Rate fields.

k) ***Location in Entity's Coordinates*.** This field shall specify the location of the munition detonation, the expendable detonation, or the non-munition explosion as specified in DIS V7 5.4.4.3. This field shall be represented by an Entity Coordinate Vector record [see Record Definitions-Entity Coordinate Vector and DIS V7 item a) in 6.2.96].

l) ***Detonation Result.*** This field shall specify the result of the detonation and shall be represented by an 8-bit enumeration encoded using UVINT8 (see [UID 62]).

m) ***Number of Variable Parameter Records.*** This field shall specify the number of Variable Parameter records present. This field shall be represented by an 8-bit unsigned integer (see DIS V7 Annex I). This field shall only be present if indicated by the Field Present Flags-Variable Parameters = 1.

n) ***Variable Parameter records.*** This field shall specify the parameter values for each Variable Parameter record that is included (see DIS V7 6.2.94 and DIS V7 Annex I). This field shall only be present if indicated by the Field Present Flags-Variable Parameters = 1.

The format of the Detonation PDU shall be as shown in Table 48.

Table 48—Detonation PDU

C-DIS MESSAGE Format-Detonation PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Descriptor-Warhead Fuse		1	0 = None, 1 = Present
	Descriptor-Quantity Rate		1	0 = None, 1 = Present
	Variable Params		1	0 = None, 1 = Present
Units	World Location Altitude		1	0 = centimeters (cm), 1 = dekameters (dam)
	Location In Entity's Coordinates		1	0 = centimeters (cm), 1 = meters (m)
Source Entity ID	Site	16	UVINT16	

C-DIS MESSAGE Format-Detonation PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
	Host	16	UVINT16	
	Entity	16	UVINT16	
Target Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Exploding Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Event ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Entity Linear Velocity	X	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Y	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Z	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
Location in World Coordinates	Latitude	64	31	+-90 degrees Lat (approx 0.93 cm accuracy)
	Longitude	64	32	+- 180 degrees Lon (approx 0.93 cm accuracy)
	Altitude MSL	64	SVINT24	+8 388 607, -8 388 608 cm or dekameter as indicated by World Location Altitude Units Flag
Descriptor-Entity Type	Kind	8	4	[UID 7] Allow 15 Max
	Domain	8	4	[UID 8] Allow 15 Max
	Country	16	9	[UID 29] Allow 511 Max
	Category	8	UVINT8	[UID 9-15, 22-28]
	Subcategory	8	UVINT8	[UID 16-22, 23]
	Specific	8	UVINT8	[UID 474, 475, 481, 482, 510-524]
	Extra	8	UVINT8	[UID 477]
Descriptor	Warhead	16	16	[UID 60]
	Fuse	16	16	[UID 61]
	Quantity	16	8	Max 255
	Rate	16	8	Max 255/per burst

C-DIS MESSAGE Format-Detonation PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Location in Entity's Coordinates	X	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag and filled only if an entity SAE is explicitly targeted
	Y	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag and filled only if an entity SAE is explicitly targeted
	Z	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag and filled only if an entity SAE is explicitly targeted
Detonation Results		8	UVINT8	[UID 62]
Number of Variable Parameter Records		8	8	Only present if Field Present Flags-Variable Params = 1
Variable Parameter Records				
Variable Parameter Record #N	Compressed Flag		1	0 = Normal, 1 = Compressed
	Record Type	8	3	[UID 56], NN = bit size of compressed variable records
	Record-Specific Fields	120	NN	

13.5 Collision PDU

Collisions between entities shall be communicated by issuing a Collision PDU. See DIS V7 5.3.3 for specific requirements on the use of the Collision PDU. The Collision PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this particular PDU.

1) ***Location in Entity's Coordinates.*** Flag = 0 indicates that the Location Altitude Mean Sea Level shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of dekameters (dam) = meters * 10.

2) ***Mass.*** Flag = 0 indicates that the mass shall be in units of grams (g). Flag = 1 indicates that the mass shall be in units of Kilograms (kg).

c) ***Issuing Entity ID.*** This field shall identify the entity that is issuing the PDU and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Colliding Entity ID.*** This field shall identify the entity that has collided with the issuing entity (see DIS V7 5.3.3.4). This field shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Event ID.*** This field shall contain an identification generated by the issuing simulation application to associate related collision events. This field shall be represented by an Event Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.33).

f) ***Collision Type.*** This field shall identify the type of collision. The Collision Type field shall be represented by a bit flag which shall be 0 = Inelastic, 1 = Elastic [UID 189].

g) ***Velocity.*** This field shall contain the velocity (at the simulation time the collision is detected) of the issuing entity. The velocity shall be represented in world coordinates. This field shall be represented by the Linear Velocity Vector record [see DIS V7 item c) in 6.2.96].

h) ***Mass.*** This field shall contain the mass of the issuing entity and shall be represented by a UVINT32 whose units shall be determined using the Units-Mass flag.

i) ***Location.*** This field shall specify the location of the collision with respect to the entity with which the issuing entity collided. The Location field shall be represented by an Entity Coordinate Vector record [see DIS V7 item a) in 6.2.96].

The format of the Collision PDU shall be as shown in Table 49.

Table 49—Collision PDU

C-DIS MESSAGE Format-Collision				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Units	Location In Entity's Coordinates		1	0 = centimeters (cm), 1 = meters (m)
	Mass		1	0 = grams, 1 = kilograms
Issuing Entity ID	Site	16	UVINT16	
	Host	16	UVINT16	
	Entity	16	UVINT16	
Colliding Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Event ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Event Number	16	UVINT16	
Collision Type		8	1	[UID 189]
Padding		8	0	Not applicable
Velocity	X	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Y	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)
	Z	32	SVINT16	+32 767, -32 768 decimeter/sec (6369.59 knots max)

C-DIS MESSAGE Format-Collision				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Mass		32	UVINT32	+65 535 g or kg as indicated by the bit flag Units-Mass
Location (with respect to entity)	X	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag
	Y	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag
	Z	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag

13.6 Create Entity PDU

The creation of a new entity shall be communicated using a Create Entity PDU. See DIS V7 5.6.5.2 for specific requirements on the use of the Create Entity PDU. The Create Entity PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

c) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Request ID.*** This field shall identify the entity creation request being made by the Simulation Manager and shall be represented by UVINT32 (see DIS V7 6.2.75).

The format of the Create Entity PDU shall be as shown in Table 50.

Table 50—Create Entity

C-DIS MESSAGE Format-Create Entity				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Originating Entity	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving Entity	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Request ID		32	UVINT32	

13.7 Remove Entity PDU

The removal of an entity from an exercise shall be communicated with a Remove Entity PDU. See DIS V7 5.6.5.3 for specific requirements on the use of the Remove Entity PDU. The Remove Entity PDU shall consist of the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

c) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Request ID.*** This field shall identify the specific and unique entity removal request being made by the Simulation Manager. This field shall be represented by a UVINT32.

The format of the Remove Entity PDU shall be as shown in Table 51.

Table 51—Remove Entity PDU

C-DIS MESSAGE Format-Remove Entity				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Request ID		32	UVINT32	

13.8 Start/Resume PDU

The Start/Resume of an entity/exercise shall be communicated using a Start/Resume PDU. See DIS V7 5.6.5.4 for specific requirements on the use of the Start/Resume PDU. The Start/Resume PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

c) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Real-World Time.*** This field shall specify the real-world time at which the entity is to start/resume in the exercise. This information shall be used by the participating simulation applications to start/resume an exercise synchronously. This field shall be represented by a Clock Time record (see Record Definitions-Clock Time Record and DIS V7 6.2.14).

e) ***Simulation Time***. The shared time being simulated within a simulation exercise. This time is established ahead of time by simulation management and is common to all participants in a particular exercise. Simulation time may be either Absolute Time or Relative Time. This field shall be represented by a Clock Time record (see Record Definitions-Clock Time Record and DIS V7 6.2.14).

f) ***Request ID.*** This field shall identify the specific and unique start/resume request being made by the Simulation Manager and shall be represented by a UVINT32.

The format of the Start/Resume PDU shall be as shown in Table 52.

Table 52—Start/Resume PDU

C-DIS MESSAGE Format-Start/Resume				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Real-World Time	Hour	32		
	Time Past Hour	32		
Simulation Time	Hour	32		
	Time Past Hour	32		
Request ID		32	UVINT32	

13.9 Stop/Freeze

The stopping or freezing of an entity/exercise shall be communicated using a Stop/Freeze PDU. See DIS V7 5.6.5.5 for specific requirements on the use of the Stop/Freeze PDU. The Stop/Freeze PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

c) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Real-World Time.*** This field shall specify the real-world time at which the entity is to stop/freeze in the exercise and shall be represented by a Clock Time record (see Record Definitions-Clock Time Record and DIS V7 6.2.14).

e) ***Reason.*** This field shall specify the reason that an entity or exercise was stopped/frozen and shall be represented by a 4-bit enumeration. (See [UID 67]).

f) ***Frozen Behavior.*** This field shall specify the internal behavior of the simulation application and its appearance while frozen to the other participants of the exercise and shall be represented by a 2-bit record. (See [UID 68]).

g) ***Request ID.*** This field shall identify the specific and unique stop/freeze request being made by the Simulation Manager and shall be represented by a UVINT32.

The format of the Stop/Freeze PDU shall be as shown in Table 53.

Table 53—Stop/Freeze PDU

C-DIS MESSAGE Format-Stop/Freeze				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Real-World Time	Hour	32		
	Time Past Hour	32		
Reason		8	4	[UID 67]
Frozen Behavior		8	2	[UID 68]
Padding		16	0	Not Applicable
Request ID		32	UVINT32	

13.10 Acknowledge PDU

The acknowledgment of the receipt of a Start/Resume PDU, Stop/Freeze PDU, Create Entity PDU, or Remove Entity PDU shall be communicated by issuing an Acknowledge PDU. See 5.6.5.6 for specific requirements on the use of the Acknowledge PDU. The Acknowledge PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

c) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) **Acknowledge Flag.** This field shall indicate what type of message has been acknowledged and shall be represented by a 3-bit enumeration (see [UID 69]).

e) **Response Flag.** This field shall indicate whether or not the receiving entity was able to comply with the request and shall be represented by a 2-bit enumeration (see [UID 70]).

f) **Request ID.** This field shall identify the matching response to the specific Start/Resume, Stop/Freeze, Create Entity, or Remove Entity PDU sent by the Simulation Manager. This field shall be represented by a UVINT32.

The format of the Acknowledge PDU shall be as shown in Table 54.

Table 54—Acknowledge PDU

C-DIS MESSAGE Format-Acknowledge PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Acknowledge Flag		16	3	[UID 69]
Response Flag		16	2	[UID 70]
Request ID		32	UVINT32	

13.11 Action Request PDU

A request from a Simulation Manager to a managed entity to perform a specified action shall be communicated using an Action Request PDU. See DIS V7 5.6.5.7 for specific requirements on the use of the Action Request PDU. The Action Request PDU shall consist of the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Request ID.*** This field shall identify the request being made by the Simulation Manager and shall be represented by a UVINT32.

f) ***Action ID.*** This field shall specify the particular action that is requested by the Simulation Manager and shall be represented by a UVINT32 (see [UID 71]).

g) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

h) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums

i) ***Fixed Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

j) ***Variable Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Variable Datums

The format of the Action Request PDU shall be as shown in Table 55.

Table 55—Action Request PDU

C-DIS MESSAGE Format-Action Request				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	Number of Fixed Datum Records, Fixed Datums, 0 = None, 1 = Present
	Variable Datums		1	Number of Variable Datum Records, Variable Datums 0 = None, 1 = Present
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Request ID		32	UVINT32	
Action ID		32	UVINT32	[UID 71]
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)				
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)				
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	up to 16 383 bits (2047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value-K1 bits	32	NN	NN=the number of bits actually used for real data with no padding
	Padding to 64-bit boundry	32	0	No padding on Variable datums to make up padding

13.12 Action Response PDU

When an entity receives an Action Request PDU, that entity shall acknowledge the receipt of the Action Request PDU with an Action Response PDU. See DIS V7 5.6.5.8 for specific requirements on the use of the Action Response PDU. The Action Response PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

   1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

   2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Request ID.*** This field shall identify the request being made by the Simulation Manager and shall be represented by a UVINT32.

f) ***Request Status.*** This field shall identify the status of the requested action and shall be represented by an enumeration and encoded as UVINT32 (see [UID 72]).

g) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

h) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

i) ***Fixed Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

j) ***Variable Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

The format of the Action Response PDU shall be as shown in Table 56.

Table 56—Action Response PDU

C-DIS MESSAGE Format-Action Response				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	Number of Fixed Datum Records, Fixed Datums, 0 = None, 1 = Present
	Variable Datums		1	Number of Variable Datum Records, Variable Datums 0 = None, 1 = Present
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Request ID		32	UVINT32	
Request Status		32	UVINT32	[UID 72]
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)				
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)				
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	up to 16 383 bits (2047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value-K1 bits	32	NN	NN=the number of bits actually used for real data with no padding
	Padding to 64-bit boundry	32	0	No padding on Variable datums to make up padding

13.13 Data Query PDU

A request for data from an entity shall be communicated by issuing a Data Query PDU. See DIS V7 5.6.5.9 for specific requirements on the use of the Data Query PDU. The Data Query PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

   1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

   2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Request ID***. This field shall identify the data query request being made by the Simulation Manager and shall be represented by a UVINT32.

f) ***Time Interval.*** This field shall specify the reference time interval between issues of Data PDUs (see DIS V7 5.6.5.9.3). This field shall be represented by a 26-bit C-DIS timestamp (see DIS Header-Timestamp and DIS V7 6.2.88). The scale of the time value contained in the most significant 25 bits of the timestamp shall be determined by letting zero represent the start of the hour and letting $2^{25} - 1$ represent one time unit before the start of the next hour. The next hour then starts back at zero. This results in each time unit representing exactly 3600 / (2^{25}) seconds (approximately 107.288361 µsec). Scale = (2^{25} / 3600).

g) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

h) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

i) ***Fixed Datums.*** This field shall specify the types of datum for which information is required and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.17). Datum IDs, but not datum values, are listed in the Datum Specification record. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

j) ***Variable Datums.*** This field shall specify the types of datum for which information is required and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.17). Datum IDs, but not datum values, are listed in the Datum Specification record. The presence of this field shall be indicated by the Field Present Flags-Variable Datums. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

The format of the Data Query PDU shall be as shown in Table 57.

Table 57—Data Query PDU

C-DIS MESSAGE Format-Data Query				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	0 = None, 1 = Present
	Variable Datums		1	0 = None, 1 = Present
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Request ID		32	UVINT32	
Time Interval		32	26	107 µsec smallest time unit (LSB = Absolute Time Flag just like DIS, Original DIS 31 bits = 1.67 µsec)
Number of Fixed Datum Record IDs		32	UVINT8	
Number of Variable Datum Record IDs		32	UVINT8	
Fixed Datum IDs (1-nn)				
Fixed Datum IDs (1-nn)	Fixed Datum ID	32	32	
Variable Datum IDs (1-nn)				
Variable Datum IDs (1-nn)	Variable Datum ID	32	32	

13.14 Set Data PDU

Initializing or changing internal state information shall be communicated using a Set Data PDU. See DIS V7 5.6.5.10 for specific requirements on the use of the Set Data PDU. The Set Data PDU shall consist of the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Request ID.*** This field shall identify the set data request being made by the Simulation Manager and shall be represented by a UVINT32.

f) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

g) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

h) ***Fixed Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

i) ***Variable Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

The format of the Set Data PDU shall be as shown in Table 58.

Table 58—Set Data PDU

C-DIS MESSAGE Format-Set Data				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	Number of Fixed Datum Records, Fixed Datums, 0 = None, 1 = Present
	Variable Datums		1	Number of Variable Datum Records, Variable Datums 0 = None, 1 = Present
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	

C-DIS MESSAGE Format-Set Data				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Request ID		32	UVINT32	
Padding		32	0	Not applicable
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)				
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)				
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	up to 16 383 bits (2047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value-K1 bits	32	NN	NN=the number of bits actually used for real data with no padding
	Padding to 64-bit boundry	32	0	No padding on Variable datums to make up padding

13.15 Data PDU

Information issued in response to a Data Query PDU or Set Data PDU shall be communicated using a Data PDU. See DIS V7 5.6.5.11 for specific requirements on the use of the Data PDU. The Data PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Request ID.*** This field shall identify the matching response to a Data Query PDU or Set Data PDU made by the Simulation Manager and shall be represented by a UVINT32.

f) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

g) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

h) ***Fixed Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

i) ***Variable Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

The format of the Data PDU shall be as shown in Table 59.

Table 59—Data PDU

C-DIS MESSAGE Format-Data				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	0 = None, 1 = Present
	Variable Datums		1	0 = None, 1 = Present
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Request ID		32	UVINT32	
Padding		32	0	Not applicable
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)				
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)				
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	up to 16 383 bits (2047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value-K1 bits	32	NN	NN=the number of bits actually used for real data with no padding
	Padding to 64-bit boundry	32	0	No padding on Variable datums to make up padding

13.16 Event Report PDU

A managed entity shall report the occurrence of a significant event to the Simulation Manager using an Event Report PDU. See and DIS V7 5.6.5.12 for specific requirements on the use of the Event Report PDU.

The Event Report PDU shall consist of the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Event Type*****.** This field shall specify the type of event that caused the issue of an Event PDU and shall be represented by an enumeration encoded in a UVINT8 (see [UID 73]).

f) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

g) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

h) ***Fixed Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

i) ***Variable Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

The format of the Event Report PDU shall be as shown in Table 60.

Table 60—Event Report PDU

C-DIS MESSAGE Format-Event Report				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	Number of Fixed Datum Records, Fixed Datums, 0 = None, 1 = Present
	Variable Datums		1	Number of Variable Datum Records, Variable Datums 0 = None, 1 = Present
Originating ID	Site	16	UVINT16	

C-DIS MESSAGE Format-Event Report				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Event Type		32	UVINT32	[UID 73]
Padding		32	0	Not Applicable
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)				
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)				
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	up to 16 383 bits (2047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value-K1 bits	32	NN	NN=the number of bits actually used for real data with no padding
	Padding to 64-bit boundary	32	0	No padding on Variable datums to make up padding

13.17 Comment PDU

Arbitrary messages (character strings, for example) shall be entered into the data stream by using a Comment PDU. See DIS V7 5.6.5.13 for specific requirements on the use of the Comment PDU. The Comment PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Fixed Datums.*** Flag = 0 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Fixed Datum Records and the actual Fixed Datum records shall be present in the PDU.

2) ***Variable Datums.*** Flag = 0 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall not be present in the PDU. Flag = 1 indicates that the Number of Variable Datum Records and the actual Variable Datum records shall be present in the PDU.

c) ***Originating ID.*** This field shall identify the originator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

d) ***Receiving ID.*** This field shall identify the receiver and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

e) ***Number of Fixed Datum Records.*** This field shall indicate the number of fixed datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

f) ***Number of Variable Datum Records.*** This field shall indicate the number of variable datum records and shall be represented by a UVINT8. The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

g) ***Fixed Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Fixed Datums.

h) ***Variable Datums.*** This field shall specify the types of datum and their value to be communicated and shall be represented by a Datum Specification record (see Record Definitions-Datum Specification Record and DIS V7 6.2.18). The presence of this field shall be indicated by the Field Present Flags-Variable Datums.

The format of the Comment PDU shall be as shown in Table 61.

Table 61—Comment PDU

C-DIS MESSAGE Format-Comment				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Fixed Datums		1	Number of Fixed Datum Records, Fixed Datums, 0 = None, 1 = Present
	Variable Datums		1	Number of Variable Datum Records, Variable Datums 0 = None, 1 = Present
Originating ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Receiving ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	

C-DIS MESSAGE Format-Comment				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Number of Fixed Datum Records (N)		32	UVINT8	
Number of Variable Datum Records (N)		32	UVINT8	
Fixed Datums (1-nn)				
Fixed Datums (1-nn)	Fixed Datum ID	32	32	
	Fixed Datum Value	32	32	
Variable Datums (1-nn)				
Variable Datums (1-nn)	Variable Datum ID	32	32	
	Variable Datum Length = K1	32	14	up to 16 383 bits (2047 bytes which is larger than 1500 byte PDU size)
	Variable Datum Value-K1 bits	32	NN	NN=the number of bits actually used for real data with no padding
	Padding to 64-bit boundry	32	0	No padding on Variable datums to make up padding

13.18 Electromagnetic Emission (EE) PDU

Information about active electromagnetic emissions shall be communicated using an EE PDU. See DIS V7 5.7.3 for specific requirements on the use of the EE PDU.

The EE PDU has been more aggressively compressed than other PDUs due to its redundant nature, common usage, and relatively large potential size. The PDU structure has been modified to accomplish greater compression. The encoder shall be required to create lists of unique Fundamental Parameters, Beam Data, and Site App pairs for all data contained in the EE PDU. This may require multiple passes through the PDU to encode emission data.

Encoders shall create a list of unique fundamental parameters and beams which will then be indexed by the beams rather than containing the actual fundamental parameter data and beam data. When multiple beams use the same fundamental parameter data or beam data this allows that data to only occur once in the PDU, but to be referenced via index by all beams that use that same information. This reduces the size of complex EE PDUs. This approach is used for both Fundamental Parameter Data and Beam Data records. Identical fundamental parameters shall not be placed on the Fundamental Params List. Identical Beam Data shall not be placed on the Beam Data List. Every entry on the Fundamental Params List and Beam Data List shall be unique.

When operating in partial update mode if data has not changed in the Fundamental Params from the previous update then it may be entirely left off of the Fundamental Params list. Emitter Beams shall indicate that data has not changed by setting the Beam Field Present Flags-Fundamental Parameters = 0 and not providing the Fundamental Params Index in the Beam. Decoders shall continue to use the previously received Fundamental Params values if no Fundamental Params Index is provided.

When operating in partial update mode if data has not changed in the Beam Data then it may be entirely left off of the Beam Data list. Emitter Beams shall indicate that data has not changed by setting the Beam Field Present Flags-Beam Data Details = 0 and not providing the Beam Data Index in the Beam. Decoders shall continue to use the previously received Beam Data values if no Beam Data Index is provided.

Many entities are often created by a single application and therefore use the same Site App value making this data redundant in the EE PDU. In order to compress this data the encoder shall create a list of unique Site App pairs from all Track/Jam Lists in the PDU. The Track/Jam List entries shall index the Site App pairs list to reference the appropriate Site App pair. The Track/Jam List shall have an Entity ID that will be used to complete the SAE value in the decoder. Every entry on the Site App Pairs List shall be unique.

The encoder shall set the "Full Update" flag for full updates, and shall provide a full list of unique Fundamental Params, Beam Params, and Site App Pairs simultaneously in the update in order to provide a full object state that decoders can use to properly initialize emission objects.

The EE PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Full Update Flag.*** This field shall contain a bit flag to indicate if this PDU represents a Full Update or Partial Update. C-DIS Decoders shall only create a new object when a Full Update is received in order to have a complete and accurate initial object state. Flag = 0 shall indicate a Partial Update. Flag = 1 shall indicate a Full Update.

c) ***Number of Fundamental Params.*** Number of Fundamental Params in the Fundamental Params list. This field shall be represented by a 5-bit unsigned integer.

d) ***Number of Beam Params.*** Number of Beam Params in the Beam Params list. This field shall be represented by a 5-bit unsigned integer.

e) ***Number of Site App Params.*** Number of Site App Params in the Site App Params list. This field shall be represented by a 6-bit unsigned integer.

f) ***Emitting Entity ID.*** This field shall identify the entity that is the source of the emissions and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

g) ***Event ID.*** This field shall contain an identification generated by the issuing simulation application to associate related events and shall be represented by an Event Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.33).

h) ***State Update Indicator.*** Use of this field is optional (see DIS V7 5.7.3.3.3). 0 = State Update, 1 = Changed Data Update. This field shall always be provided (see [UID 77]).

i) ***Number of Systems.*** This field shall specify the number of emitter systems described in the current PDU. This field shall be represented by a UVINT8.

j) ***Padding.*** Not used or required in C-DIS.

Start of the Fundamental Params List 1 to NN. Each Entry in the list will have a Fundamental Params record.

a) ***Fundamental Params.*** This field shall specify dynamic parameters of the emitter and shall be represented by an EE Fundamental Parameter Data record (see Record Definitions-EE Fundamental Parameter Data Record and DIS V7 6.2.22).

Start of the Beam Params List 1 to NN. Each Entry in the list will have a Beam Data record.

a) ***Beam Data.*** Beam Data Record. This field shall specify parameters of the beam and shall be represented by a Beam Data record (see Record Definitions-Beam Data and DIS V7 6.2.11)

Start of the Site App Pairs List 1 to NN. Each Entry in the list will have a Site App record.

a) ***Site App Data. Site App Record***

1) ***Site.*** DIS Site ID encoded in a UVINT16.

2) ***Application.*** DIS Application ID encoded in a UVINT16.

Beginning of the Emitter Systems

The following information shall be provided for each emitter system in the PDU:

a) ***System Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the System Record of the EE PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Emitter System Details.*** Flag = 0 indicates that the Emitter System Name and Emitter System Function shall not be provided in this PDU. Flag = 1 indicates that the Emitter System Name and Emitter System Function shall be provided in this PDU.

2) ***Location With Respect to Entity.*** Flag = 0 indicates that the Location with Respect to Entity shall not be provided in this PDU. Flag = 1 indicates that the Location with Respect to Entity shall be provided in this PDU.

b) ***System Data Length.*** *This DIS Field is not required for parsing and therefore is not used by C-DIS.*

c) ***Number of Beams.*** This field shall specify the number of beams being described in the current PDU for the emitter system being described. This field shall be represented by a 5-bit unsigned integer.

d) ***Padding.*** Not used or required in C-DIS.

e) ***Emitter System.*** This field shall specify information about a particular emitter system and shall be represented by an Emitter System record (see Record Definitions-Emitter System Record and DIS V7 6.2.23). System Field Present Flags-Emitter System Details shall indicate the presence of the Emitter Name and Emitter Function in this field.

f) ***Emitter System Record.*** Information about a particular emitter shall be represented using an emitter system record. Use of the Emitter System record in the EE PDU is described in see Record Definitions-Emitter System Record and DIS V7 5.7.3.3. System Field Present Flags-Emitter System Details shall indicate the presence of the Emitter Name and Emitter Function in this field. Emitter Number shall always be provided.

g) ***Location.*** This field shall specify the location of the antenna beam source with respect to the emitting entity's coordinate system. This location shall be the origin of the emitter coordinate system that shall have the same orientation as the entity coordinate system. This field shall be represented by an Entity Coordinate Vector record [see Record Definitions-Entity Coordinate Vector and DIS V7 item a) in 6.2.96]. Receivers shall initialize the location with respect to entity to zero until a specific location with respect to entity is received. Sending this field is optional. Units shall be in meters.

The following information shall be provided for each active beam:

a) ***Beam Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the Beam Record of the EE PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Fundamental Parameters.*** Flag = 0 indicates that the Fundamental Parameters-Frequency, Frequency Range, ERP, PRF, and Pulse width shall not be provided in this PDU. Flag = 1 indicates that the Fundamental Parameters-Frequency, Frequency Range, ERP, PRF, and Pulse Width shall be provided in this PDU.

2) ***Beam Data Details.*** Flag = 0 indicates that Beam Data–Beam AZ Center, Beam AZ Sweep, Beam EL Center, Beam EL Sweep, and Beam Sweep Sync shall not be provided in this PDU. Flag = 1 indicates that the Beam Data–Beam AZ Center, Beam AZ Sweep, Beam EL Center, Beam EL Sweep, and Beam Sweep Sync shall be provided in this PDU.

3) ***Jamming Technique Flag***. Flag = 0 indicates that the Jamming Technique shall not be provided in this PDU. Flag = 1 indicates that the Jamming Technique shall be provided in this PDU.

4) ***Jammer Track Flag***. Flag = 0 indicates that the Track/Jam Emitter Number and Beam Number shall not be provided in this PDU. Flag = 1 indicates that the Track/Jam Emitter Number and Beam Number shall be provided in this PDU. The Emitter Beam-Beam Function enumeration shall be used to determine if a beam is a Jammer. Enumeration values may be added in the future to SISO-REF-010 and therefore specific Emitter Beam-Beam Function Enumeration values that indicate jamming are not explicitly listed in C-DIS (see [UID 78]).

b) ***Beam Data Length.*** This field is not required to parse the data and therefore is not included in the C-DIS standard.

c) ***Beam ID Number.*** This field shall specify a unique number assigned to differentiate between otherwise similar or identical emitter beams within an emitter system. This field shall be represented by a UVINT8.

d) ***Beam Parameter Index.*** Used in conjunction with the Emitter Name field as a database primary key, this field shall specify a number by which receiving entities reference stored database parameters required to regenerate the beam. The mechanism by which beam parameter index values are assigned is outside the scope of this standard. This field shall be represented by a 16-bit unsigned integer.

e) ***Fundamental Params Index.*** This field shall specify an index into the Fundamental Params List that matches the values desired for this beam. Index shall range from zero to 31 and shall be encoded in an unsigned 5-bit integer.

f) ***Beam Data Index.*** This field shall specify an index into the Beam Data List that matches the values desired for this beam. Index shall range from zero to 31 and shall be encoded in a 5-bit unsigned integer.

g) ***Beam Function.*** This field shall specify the intended use of a particular beam. Typical functions include search, acquisition, tracking, illumination, jamming, and so on. This field is intended to help receiving entities determine the emission mode represented by the beam. This field shall be represented by a 5-bit enumeration (see [UID 78]).

h) ***Number of Targets.*** This field, in conjunction with the High-Density Track/Jam field, shall identify, for the current PDU and emitter beam, the number of entities tracked or under illumination (as appropriate for an emitter beam's function) or the number of targeted emitter beams (for jammers). This field shall be represented by a 4-bit unsigned integer of 0-15. If more than 15 items set this to zero and set the High-Density Track/Jam field to true = 1.

i) ***High-Density Track/Jam.*** This field shall be used to indicate that receiving simulation applications can assume that all viable targets in the field of regard specified by the beam data are being tracked or jammed. This field shall be represented by a 1-bit Flag indicating High Density Track/Jam if Flag = 1.

j) ***Beam Status.*** This field shall indicate the status of the beam (e.g., the beam is active or deactivated) and shall be represented by a 1-bit Flag indicating that Status is on if Flag = 1 or off if Flag = 0.

k) ***Jamming Technique.*** This field shall be used to identify the jamming method or methods and shall be represented by a Jamming Technique record (see Record Definitions-Jamming Technique and DIS V7 6.2.49). If the Beam Field Present Flags-Jamming Technique Flag = 0 then a Jamming Technique Record shall not be provided. If the Beam Field Present Flags-Jamming Technique Flag = 1 then a Jamming Technique Record shall be provided.

The following information shall be provided for each Track/Jam record:

a) ***Track/Jam Data.*** This field is optional for any given beam. Rules for inclusion and use are provided in DIS V7 5.7.3.3, 5.7.3.7, and 5.7.3.8. When included, this field shall be represented by a series of Track/Jam Data records (see Record Definitions-Track/Jam Data and DIS V7 6.2.90).

The EE PDU shall contain emitter system, beam, and track/jam data in an order that includes all beam and track/jam data for a particular emitter system before any data from a subsequent emitter system.

The format of the EE PDU shall be as shown in DIS V7 Figure 49 and Table 62.

Table 62—Electromagnetic Emission (EE) PDU

C-DIS MESSAGE Format-Electromagnetic Emission PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Full Update Flag			1	0 = Partial Update, 1 = Full Update
Number of Fundamental Params			5	0-31 Allowed
Number of Beam Params			5	0-31 Allowed
Number of Site App pairs			6	0-63 Allowed
Emitting ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Event ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Event Number	16	UVINT16	
State Update Indicator		8	1	[UID 77]
Number of Systems		8	UVINT8	
Padding		16	0	Not applicable

C-DIS MESSAGE Format-Electromagnetic Emission PDU					
Field Name			DIS Size (Bits)	C-DIS Size (Bits)	Comments
Start of Fundamental Params List (1 to NN)					
Fundamental Params	Frequency	Mantissa	32	17	Frequency = Unsigned Mantissa x $10^{Exponent}$
		Exponent		4	Unsigned Exponent
	Frequency Range	Mantissa	32	17	Frequency Range = Unsigned Mantissa x $10^{Exponent}$
		Exponent		4	Unsigned Exponent
	ERP		32	8	0 to 255 dBm
	PRF		32	UVINT16	Hundreds of Hz
	Pulse Width	Mantissa	32	14	Pulse Width = Unsigned Mantissa x $10^{Exponent}$
		Exponent		3	Signed Exponent +3, -4
...					
Start of Beam Data List (1 to NN)					
Beam Data	Beam Az Center		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam Az Sweep		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam El Center		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam El Sweep		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam Sweep Sync		32	10	Percent of the scan (0.097 percent max accuracy)
...					

C-DIS MESSAGE Format-Electromagnetic Emission PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Start of Site App Pairs List (1 to NN)				
Site App Pairs List	Site	16	UVINT16	
	Application	16	UVINT16	
...				
Emitter System				
System Field Present Flags	Emitter System Details		1	Emitter System Name and Function 0 = None, 1 = All Present
	Location with Respect to Entity		1	0 = None, 1 = Present
System Data Length		8	0	Informational Not required to Parse-Byte Count N/A
Number of Beams		8	5	31 Max Beams per PDU
Padding		16	0	Not applicable
Emitter System	Emitter Name	16	16	[UID 75]
	Emitter Function	8	8	[UID 76]
	Emitter Number	8	UVINT8	
Location with Respect to entity	X	32	SVINT16	meters
	Y	32	SVINT16	meters
	Z	32	SVINT16	meters

C-DIS MESSAGE Format-Electromagnetic Emission PDU				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Emitter Beam				
Beam Field Present Flags	Fundamental Parameters		1	Fundamental Parameters-Frequency, Frequency Range, ERP, PRI, Pulse Width 0 = None, 1 = All Present
	Beam Data Details		1	Beam Data-Beam Az Center, Beam Az Sweep, Beam El Center, Beam El Sweep, Beam Sweep Sync 0 = None, 1 = All Present
	Jamming Technique Flag			0 = None, 1 = Present
	Jammer Track Flag		1	0 = None, 1 = Track/Jam Emitter Number and Beam Number Present
Beam Data Length		8	0	Informational Not required to Parse-Byte Count N/A
Beam ID Number		8	UVINT8	
Beam Parameter Index		16	16	Full BPI support
Fundamental Params Index			5	Index into Fundamental Params List
Beam Data Index			5	Index into Beam Data List
Beam Function		8	5	[UID 78]
Number of Targets in Track Jam Field		8	4	If more than 15 remove list and set High Density Track Jam Flag
High Density Track Jam		8	1	Bit Flag 0 = False, 1 = True
Beam Status		8	1	Beam Active Flag 0 = No, 1 = Yes
Jamming Technique	Kind	8	UVINT8	[UID 284]
	Category	8	UVINT8	[UID 284]
	Sub Category	8	UVINT8	[UID 284]
	Specific	8	UVINT8	[UID 284]

C-DIS MESSAGE Format-Electromagnetic Emission PDU				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Track/Jam List				
Track/Jam	Site App Pair Index		6	Index into Site App Pairs List
	Entity ID	16	UVINT16	
	Emitter number	8	UVINT8	Based on Jammer Track Flag
	Beam number	8	UVINT8	Based on Jammer Track Flag

13.19 Designator PDU

Designating operations shall be communicated by issuing a Designator PDU. See DIS V7 5.7.4 for specific requirements on the use of the Designator PDU. The Designator PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Fields Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Designated Entity ID and Spot Location with respect to Entity.*** Flag = 0 indicates that Entity ID and Designator Spot Location with respect to Entity shall NOT be provided. Flag = 1 indicates that Entity ID and Designator Spot Location with respect to Entity shall both be provided.

2) ***Designator Details.*** Flag = 0 indicates that Code Name, Designator code, Power, and Wavelength shall not be provided. Flag = 1 indicates that Code Name, Designator code, Power, and Wavelength shall all be provided.

3) ***Designator Spot Location (World).*** Flag = 0 indicates that Designator Spot Location (World) shall not be provided. Flag = 1 indicates that Designator Spot Location (World) shall be provided.

4) ***Entity DR and Linear Acceleration.*** Flag = 0 indicates that Dead Reckoning Algorithm and Entity Linear Acceleration shall not be provided. Flag = 1 indicates that Dead Reckoning Algorithm and Entity Linear Acceleration shall be provided.

c) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this particular PDU.

1) ***Location with respect to Entity.*** Flag = 0 indicates that the Designator Spot Location with Respect to Designated Entity coordinates shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of meters. Centimeter units shall be used unless the location is larger than the maximum +32 767, -32 768 cm value that can be encoded in entity coordinates UVINT16 XYZ field. (See Record Definitions-Entity Coordinate Vector).

2) ***World Location Altitude.*** Flag = 0 indicates that the Location Altitude Mean Sea Level shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of dekameters (dam) = meters * 10.

d) ***Full Update Flag.*** This field shall contain a bit flag to indicate if this PDU represents a Full Update or Partial Update. C-DIS decoders shall only create a new object when a Full Update is received in order to have a complete and accurate initial object state. Flag = 0 shall indicate a Partial Update. Flag = 1 shall indicate a Full Update.

e) ***Designating Entity ID***. This field shall identify the entity that is positioning the designator and shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28).

f) ***Code Name.*** This field shall identify the code name for the designator system and shall be represented by an unsigned 16-bit enumeration (see [UID 80]). The Field Present Flags-Designator Details shall indicate the presence of this field. This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

g) ***Designated Entity ID.*** This field shall identify the entity that is currently being designated (see DIS V7 5.7.4.3). This field shall be represented by an Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28). The Field Present Flags-Designated Entity ID and Spot Location with Respect to Entity shall indicate the presence of this field.

h) ***Designator Code.*** This field shall identify the designator code being used by the designating entity and shall be represented by a UVINT16 (see [UID 81]). The Field Present Flags-Designator Details shall indicate the presence of this field. This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

i) ***Designator Power.*** This field shall identify the designator output power in Watts and shall be represented by a UVINT32. The Field Present Flags-Designator Details shall indicate the presence of this field. This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

j) ***Designator Wavelength.*** This field shall identify the designator wavelength in units of nanometers and shall be represented by a UVINT32. The Field Present Flags-Designator Details shall indicate the presence of this field. This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

k) ***Designator Spot with Respect to Designated Entity.*** This field shall specify the location of the designator spot with respect to the designated entity's coordinate system (see DIS V7 5.7.4.3). This field shall be represented by an Entity Coordinate Vector record [see Record Definitions-Entity Location and DIS V7 item a) in 6.2.96]. This field shall only be present if the Fields Present Flag-Designated Entity ID and Spot Location with respect to Entity Flag = 1. This field is optional. Receivers should initialize this value to zero until an explicit value is received.

l) ***Designator Spot Location.*** This field shall identify the location of the designator spot with respect to the world coordinate system and shall be represented by a World Coordinates record (see Record Definitions-World Coordinates Record and DIS V7 6.2.98). This field shall only be present if the Fields Present Flag- Designator Spot Location (World) Flag = 1. This field shall be provided on the first and last PDU update, and at least once during every CDIS_FULL_UPDATE_PERIOD.

m) *Dead Reckoning Parameters.* This field will be used to provide parameters for dead reckoning the position of the designator spot. Dead reckoning algorithm in use and entity acceleration shall be included as part of the dead reckoning parameters:

1) Dead Reckoning Algorithm. This field shall specify the dead reckoning algorithm in use by the issuing entity. This field shall be represented by a 4-bit enumeration (see [UID 44]). The Field Present Flags-DR and Linear Accelerations shall indicate the presence of this field.

2) Entity Linear Acceleration. This field shall specify the designator spot's linear acceleration and shall be represented by a Linear Acceleration Vector record [see Record Definitions-Linear Acceleration and DIS V7 item b) in 6.2.96]. This field shall only be present if the Field Present Flags-DR and Linear Accelerations Flag = 1.

The format of the Designator PDU shall be as shown in Table 63.

Table 63—Designator PDU

C-DIS MESSAGE Format-Designator PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Designated Entity ID and Spot Location with respect to Entity		1	Entity ID, Designator Spot Location with Respect to Designated Entity 0 = None Present, 1 = All Present
	Designator Details		1	Code Name, Designator Code, Power, and Wavelength 0 = None Present, 1 = All Present
	Designator Spot Location (World)		1	0 = None, 1 = Present
	Entity DR and Linear Acceleration		1	Dead Reckoning Algorithm and Linear Acceleration 0 = None, 1 = Present
Units	Location with respect to Entity		1	0 = centimeters (cm), 1 = meters (m)
	World Location Altitude		1	0 = centimeters (cm), 1 = dekameters (dam)
Full Update Flag			1	0 = Partial Update, 1 = Full Update
Designating Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Code Name		16	16	
Designated Entity ID	Site	16	UVINT16	Filled only If an entity is being designated
	Application	16	UVINT16	Filled only If an entity is being designated
	Entity	16	UVINT16	Filled only If an entity is being designated
Designator	Code	16	UVINT16	
	Power	32	UVINT32	watts
	Wavelength	32	UVINT32	nanometers
Designator Spot Location with Respect to Designated Entity)	X	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag and filled only if an entity is being designated
	Y	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag and filled only if an entity is being designated
	Z	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag and filled only if an entity is being designated

C-DIS MESSAGE Format-Designator PDU				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Designator Spot Location (World)	Latitude	64	31	+-90 degrees Lat (approx 0.93 cm accuracy)
	Longitude	64	32	+-180 degrees Lon(approx 0.93 cm accuracy)
	Altitude MSL	64	SVINT24	+8 388 607, -8 388 608 cm or Dekameter as indicated by World Location Altitude Units Flag
Dead Reckoning Algorithm		8	4	[UID 44]
Padding		8	0	Not applicable
Padding		16	0	Not applicable
Entity Linear Acceleration	X	32	SVINT14	+8191, -8192 decimeters / sec / sec (Aprox 83.5 g)
	Y	32	SVINT14	+8191, -8192 decimeters / sec / sec (Aprox 83.5 g)
	Z	32	SVINT14	+8191, -8192 decimeters / sec / sec (Aprox 83.5 g)

13.20 Transmitter PDU

Detailed information about a radio transmitter shall be communicated by issuing a Transmitter PDU. See DIS V7 5.8.3 for specific requirements on the use of the Transmitter PDU. The Transmitter PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the Transmitter PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Radio Type.*** Flag = 0 indicates that the Radio Type enumerated value shall not be provided in this PDU. Flag = 1 indicates that the Radio Type enumerated value shall be provided in this PDU.

2) ***Variable Parameters.*** Flag = 0 indicates that the Number of Variable Transmitter Parameters Records and Variable Transmitter Parameter Records shall not be provided in this PDU. Flag = 1 indicates that the Number of Variable Transmitter Parameters records and Variable Transmitter Parameter Records shall be provided in this PDU.

3) ***Antenna Location.*** Flag = 0 indicates that the Antenna Location shall not be provided in this PDU. Flag = 1 indicates that the Antenna Location shall be provided in this PDU.

4) ***Relative Antenna Location.*** Flag = 0 indicates that the Relative Antenna Location shall not be provided in this PDU. Flag = 1 indicates that the Relative Antenna Location shall be provided in this PDU.

5) ***Antenna Pattern.*** Flag = 0 indicates that the Antenna Pattern Type and Antenna Pattern Length shall not be provided in this PDU. Flag = 1 indicates that the Antenna Pattern Type and Antenna Pattern Length shall be provided in this PDU.

6) ***Transmitter Details.*** Flag = 0 indicates that the Transmitter Frequency, Frequency Bandwidth, Power, and Modulation Type shall not be provided in this PDU. Flag = 1 indicates that the Transmitter Frequency, Frequency Bandwidth, Power, and Modulation Type shall be provided in this PDU.

7) ***Crypto Details.*** Flag = 0 indicates that the Crypto System and Crypto Key ID shall not be provided in this PDU. Flag = 1 indicates that the Crypto System and Crypto Key ID shall be provided in this PDU.

8) ***Modulation Parameters.*** Flag = 0 indicates that the Length of Modulation Parameters and Modulation Parameters Record shall not be provided in this PDU. Flag = 1 indicates that the Length of Modulation Parameters and Modulation Parameters Record shall not be provided in this PDU shall be provided in this PDU.

c) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this particular PDU.

1) ***World Location Altitude.*** Flag = 0 indicates that the Location Altitude Mean Sea Level shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of dekameters (dam) = meters * 10.

2) ***Relative Antenna Location.*** Flag = 0 indicates that the Relative Antenna Location coordinates shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of meters. Centimeter units shall be used unless the location is larger than the maximum +32 767, -32 768 cm value that can be encoded in entity coordinates SVINT16 XYZ field. (See Record Definitions-Entity Coordinate Vector).

d) ***Full Update Flag.*** This field shall contain a bit flag to indicate if this PDU represents a Full Update or Partial Update. C-DIS decoders shall only create a new object when a Full Update is received in order to have a complete and accurate initial object state. Flag = 0 shall indicate a Partial Update. Flag = 1 shall indicate a Full Update.

e) ***Radio Reference ID.*** For attached radios, this field shall identify the Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28) or Object Identifier record (see DIS V7 6.2.63) to which the radio is attached. For unattached radios, this field shall contain the Unattached Identifier record (see DIS V7 6.2.92). Detailed requirements for setting this field are specified in DIS V7 item b2) in 5.8.3.3.

f) ***Radio Number.*** This field shall identify a particular radio that is either associated with an entity or object or is an unattached radio. The Radio Number field shall be represented by a UVINT16.

g) ***Radio Type.*** This field shall indicate the type of radio being simulated and shall be represented by a Radio Type record (see DIS V7 6.2.71). This field shall only be present if indicated by the Field Present Flags-Radio Type = 1. This field shall be provided on the first and last PDU update, and at least once during every radio CDIS_FULL_UPDATE_PERIOD. (see Record Definitions-Entity Type).

h) ***Transmit State.*** This field shall specify whether a radio is off, powered but not transmitting, or powered and transmitting and shall be represented by a 2-bit enumeration (see [UID 164]).

i) ***Input Source.*** This field shall specify which operator position or data port is using the radio associated with the entity, or that it represents an audio jamming source. This field shall be represented by an enumeration and encoded as a UVINT8 (see [UID 165]).

j) ***Number of Variable Transmitter Parameters Records.*** This field shall specify the number of Variable Transmitter Parameters records contained in the Parameter Records section. This field shall be represented by a UVINT8. This field shall only be present if indicated by the Field Present Flags-Variable Parameters = 1.

k) ***Antenna Location.*** This field shall specify the location of the radiating portion of the antenna and shall be represented by a World Coordinates record (see Record Definitions-World Coordinates Record and DIS V7 6.2.98). See DIS V7 5.8.3.3 and DIS V7 5.8.3.4 for detailed requirements. This field shall only be present if indicated by the Field Present Flags-Antenna Location = 1. This field shall be provided on the first and last PDU update, and at least once during every radio CDIS_FULL_UPDATE_PERIOD.

l) ***Relative Antenna Location.*** This field shall specify the relative location of the radiating portion of the antenna with respect to the associated entity. This field shall be represented by an Entity Coordinate Vector record [see Record Definitions-Entity Coordinate Vector and DIS V7 item a) in 6.2.96]. This field shall only be present if indicated by the Field Present Flags-Relative Antenna Location = 1.

m) ***Antenna Pattern Type.*** This field shall specify the type of representation used for the radiation pattern from the antenna. The value of this field shall determine the interpretation of the Beam Antenna Pattern Record contained in the Parameter Records section. This field shall be represented by a 3-bit enumeration (see [UID 167]). This field shall only be present if indicated by the Field Present Flags-Antenna Pattern = 1.

n) ***Antenna Pattern Length.*** This field shall specify the length in octets of the Beam Antenna Pattern Record (see Record Definitions-Beam Antenna Pattern Record and DIS V7 6.2.8). This field shall be represented by a 10-bit unsigned integer. This field shall only be present if indicated by the Field Present Flags-Antenna Pattern = 1.

o) ***Frequency.*** This field shall only be present if indicated by the Field Present Flags-Transmitter Details= 1. This field shall be provided on the first and last PDU update, and at least once during every radio CDIS_FULL_UPDATE_PERIOD.

1) *Mantissa.* This field shall specify the center frequency being used by the radio for transmission if the radio is not capable of frequency hopping or it is not currently in such a mode. Value shall be scaled to a 24-bit unsigned integer with a scale of $1 / 10^{Exponent}$ Hz (Maximum Value = 16 777 215 x 10^{15} Hz). This allows for at least seven decimal places in accuracy. For example to represent 1312.071 MHz use the value of 1 312 071 and exponent of 3 = 10^3 = 1000. This field shall also be used to indicate intercom transmissions. Detailed requirements for setting this field are specified in DIS V7 item b13) in 5.8.3.3. Units of Hz.

2) Exponent. Unsigned power of ten for Frequency encoded in a 4-bit unsigned integer

p) ***Transmit Frequency Bandwidth.*** This field shall only be present if indicated by the Field Present Flags-Transmitter Details = 1. This field shall be provided on the first and last PDU update, and at least once during every radio CDIS_FULL_UPDATE_PERIOD.

1) ***Mantissa.*** This field shall identify the band pass of the radio. Value shall be scaled to an unsigned 17-bit unsigned integer with a scale = $1 / 10^{Exponent}$ Hz (Maximum Value = 131 071 x 10^{15} Hz). Units of Hz.

2) Exponent. Unsigned power of ten for Transmit Frequency Bandwidth encoded in a 4-bit unsigned integer

q) ***Power.*** This field shall specify the power of the radio expressed as the average effective radiated power being transmitted, or that would be present if transmitting, in units of decibel-milliwatts. It shall be represented by an 8-bit unsigned integer. See DIS V7 item j) in 5.8.3.2 for additional details regarding the meaning of this field. This field shall only be present if indicated by the Field Present Flags-Transmitter Details = 1. This field shall be provided on the first and last PDU update, and at least once during every radio CDIS_FULL_UPDATE_PERIOD.

r) ***Modulation Type.*** This field shall specify the type of modulation used for radio transmission. The modulation type shall be represented by a Modulation Type record (see Record Definitions-Modulation Type Record and DIS V7 6.2.59). This field shall only be present if indicated by the Field Present Flags-Transmitter Details = 1. This field shall be provided on the first and last PDU update, and at least once during every radio CDIS_FULL_UPDATE_PERIOD.

s) ***Crypto System.*** This field shall indicate the encryption capability of the transmitter regardless of whether it is operating in plain or secure communications mode. This field shall be represented by a 4-bit enumeration (see [UID 166]). Detailed requirements for setting this field are specified in DIS V7 item b8) in 5.8.3.3. Users should zero the Crypto System until an explicit update is received. This field shall only be present if indicated by the Field Present Flags-Crypto Details = 1.

t) ***Crypto Key ID.*** This 16-bit unsigned integer record shall identify the crypto key and shall consist of the fields as identified in the Crypto Key ID Record. It is formatted the same as DIS V7 [see Record Definitions-Crypto Key ID Record and DIS V7 item b9) in 5.8.3.3]. Users should zero the Crypto System until an explicit update is received. This field shall only be present if indicated by the Field Present Flags-Crypto Details = 1.

u) ***Length of Modulation Parameters.*** This field shall specify the length in octets of the Modulation Parameters record contained in the Parameter Records section. This field shall be represented by an 8-bit unsigned integer. This field shall be present only if the Field Present Flags-Modulation Parameters = 1.

v) **Parameter Records Section.** This section consists of any parameter records applicable to this radio system type. It shall contain in order the following: zero or one Modulation Parameters record (see DIS V7 6.2.58), zero or one Beam Antenna Pattern Record (see DIS V7 6.2.8), zero or more Variable Transmitter Parameters records (see DIS V7 6.2.95).

1) ***Modulation Parameters.*** This field shall contain an optional Modulation Parameters record (see DIS V7 6.2.58) associated with the radio system identified in the Radio System field of the Modulation Type record (see DIS V7 6.2.59). Modulation Parameters records are defined in DIS V7 Annex C. Modulation parameter records shall be padded only to eight bits rather than 64 bits. This field shall be present only if the Field Present Flags-Modulation Parameters = 1.

2) ***Antenna Pattern.*** This field shall contain an optional Beam Antenna Pattern Record identified by the Antenna Pattern Type field (see Record Definitions-Beam Antenna Pattern Record and DIS V7 6.2.8). Antenna parameter records shall be padded only to eight bits rather than 64 bits. This field shall be present only if the Field Present Flags-Antenna Pattern = 1.

3) ***Variable Transmitter Parameters records.*** These fields shall contain optional Variable Transmitter Parameters records (see DIS V7 6.2.95). Variable parameter records shall be padded only to eight bits rather than 64 bits. This field shall be present only if the Field Present Flags-Variable Parameters = 1.

The format of the Transmitter PDU shall be as shown in Table 64.

Table 64—Transmitter PDU

C-DIS MESSAGE Format-Transmitter PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
	Radio Type		1	0 = None, 1 = Present

C-DIS MESSAGE Format-Transmitter PDU				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
Field Present Flags	Variable Parameters		1	Number of Variable Transmitter Parameters Records, Variable Transmitter Parameter Records 0 = None, 1 = Present
	Antenna Location		1	Antenna Location. 0 = None, 1 = Present
	Relative Antenna Location		1	Relative Antenna Location. 0 = None, 1 = Present
	Antenna Pattern		1	Antenna Pattern Type, Antenna Pattern Length, 0 = None, 1 = Present
	Transmitter Details		1	Transmitter Frequency, Frequency Bandwidth, Power, Modulation Type
	Crypto Details		1	Crypto System, Crypto Key 0 = None, 1 = Present
	Modulation Parameters		1	Length of Modulation Parameters, Modulation Parameters 0 = None, 1 = Present
Units	World Location Altitude		1	0 = centimeters (cm), 1 = dekameters (dam)
	Relative Antenna Location		1	0 = centimeters (cm), 1 = meters (m)
Full Update Flag			1	0 = Partial Update, 1 = Full Update
Radio Reference ID	Site	16	UVINT16	
	Host	16	UVINT16	
	Entity	16	UVINT16	
Radio Number		16	UVINT16	
Radio Type	Kind	8	4	[UID 7]
	Domain	8	4	[UID 8]
	Country	16	9	[UID 29]
	Category	8	UVINT8	[UID 22]
	Subcategory	8	UVINT8	[UID 23]
	Specific	8	UVINT8	
	Extra	8	UVINT8	
Transmit State		8	2	[UID 164]
Input Source		8	UVINT8	[UID 165]

C-DIS MESSAGE Format-Transmitter PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
Number of Variable Transmitter Parameters Records (N)		16	UVINT8	Present only if Variable Parameters present flag=1
Antenna Location	Latitude	64	31	+-90 degrees Lat (approx 0.93 cm accuracy)
	Longitude	64	32	+-180 degrees Lon(approx 0.93 cm accuracy)
	Alitude MSL	64	SVINT24	+8 388 607, -8 388 608 cm or Dekameter as indicated by World Location Altitude Units Flag (-8388608 special case indicates ECEF x = 0, y = 0, z = 0)
Relative Antenna Location	X	32	SVINT16	+32 767, -32 768 cm or meters as indicated by Relative Antenna Location Units flag
	Y	32	SVINT16	+32 767, -32 768 cm or meters as indicated by Relative Antenna Location Units flag
	Z	32	SVINT16	+32 767, -32 768 cm or meters as indicated by Relative Antenna Location Units flag
Antenna Pattern Type		16	3	[UID 167]
Antenna Pattern Length (A)		16	10	A Octets. Present only if Field Present Flags-Antenna Pattern = 1
Frequency	Mantissa	64	24	Frequency = Unsigned Mantissa x $10^{Exponent}$ (Allows 7 decimal digits of precision 9 999 999)
	Exponent		4	Frequency Unsigned Exponent
Transmit Frequency Bandwidth	Mantissa	32	17	Transmit Freq BW = Unsigned Mantissa x $10^{Exponent}$
	Exponent		4	Transmit Freq BW Unsigned Exponent
Power		32	8	0-255 dBm
Modulation Type	Spread Spectrum	16	4	DIS V7 defines 0-2
	Major Modulation	16	4	[UID 155]
	Detail	16	4	[UID 156-162]

C-DIS MESSAGE Format-Transmitter PDU				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
	Radio System	16	4	[UID 163]
Crypto System		16	4	[UID 166]
Cyrpto Key ID		16	16	16 bits required
Length of Modulation Parameters (M)		8	8	M Octets. Present only if Field Present Flags-Length of Modulation Parameters = 1
Padding		8	0	Not applicable
Padding		16	0	Not applicable
Parameter records Section				
Modulation Parameters 0-M (M= Length of Modulation Parameters)				
Modulation Parameters		Variable 8*M Octets		Present only if Length of Modulation Parameters present flag = 1
Beam Antenna Pattern Records 0-A (A=Antenna Pattern Length)				
Antenna Pattern		Variable 8*A Octets		Present only if Field Present Flags-Antenna Pattern flag = 1. See Record Definitions-Beam Beam Antenna Pattern Record for format
Variable Transmitter Parameter Records 1 to NN				
Variable Transmitter Parameter Records 1 to NN	Record Type	32	32	Present only if Field Present Flags-Variable Parameters = 1. No Compression applied to these records, except padding is only to eight bits not 64 bits.
	Record Length	16	16	
	Record-Specific fields	Variable 8*A Octets		
	Padding to 8-bit boundary	Pad to an eight bit boundary (not 64) so that Byte count and Bit count are equal		

13.21 Signal PDU

The actual transmission of voice, audio, or other data shall be communicated by issuing a Signal PDU. See DIS V7 5.8.4 for specific requirements on the use of the Signal PDU. The Signal PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Sample Rate.*** Flag = 0 indicates that Sample Rate shall NOT be provided. Flag = 1 indicates that Sample Rate shall be provided.

2) ***Samples.*** Flag = 0 indicates that Samples shall NOT be provided. Flag = 1 indicates that Samples shall be provided.

c) **Radio Reference ID.** For attached radios, this field shall identify the Entity Identifier record (see Record Definitions-Entity Identifier Record and DIS V7 6.2.28) or Object Identifier record (see Data Types and Records-Entity Identifier Record and DIS V7 6.2.63) to which the radio is attached. For unattached radios, this field shall contain the Unattached Identifier record (see DIS V7 6.2.92). Detailed requirements for setting this field are specified in DIS V7 item b2) in 5.8.3.3.

d) ***Radio Number.*** This field shall identify a particular radio that is either associated with an entity or object or is an unattached radio. The Radio Number field shall be represented by a UVINT16. NOTE—The combination of the Radio Reference ID and the Radio Number field uniquely identifies a particular radio within a simulation exercise. This combination is referred to as the Radio Identifier (see DIS V7 6.2.70). The Radio Identifier is used to associate Transmitter, Signal, and Receiver PDUs with the same radio.

e) ***Encoding Scheme.*** This field specifies the encoding used in the Data field of this PDU and shall be represented by an Scheme record as described in Record Definitions-Encoding Scheme Record. Detailed requirements for setting this field are specified in DIS V7 5.8.4.3.2. C-DIS treats Encoding Scheme as two separate bit fields rather than a single 16-bit encoded field.

1) Class. This field shall encode a 2-bit enumeration (see [UID 270]).

2) Type. This field shall specify the Encoding type (see [UID 271]) and be encoded as a UVINT8.

f) ***TDL Type***. This field shall specify the TDL Type and shall be represented as an 8-bit enumeration (see [UID 178]). Detailed requirements for setting this field are specified in DIS V7 5.8.4.3.2.

g) ***Sample Rate.*** This field shall specify either the sample rate or the data rate, and shall be represented by a UVINT32. It shall be samples per second (Maximum Value = 4 294 967 295) for audio, or as Kilobits/sec for other data links (Max Value = 4 294 967.295MBits/sec). Detailed requirements for setting this field are specified in DIS V7 5.8.4.3.2. Sample Rate is required if the data contains Audio. Sample Rate is optional for other data items. This field shall only be present if indicated by the Field Present Flags-Sample Rate = 1.

h) ***Data Length.*** This field shall specify the number of bits of digital voice audio or digital data being sent in this Signal PDU and shall be represented by a 14-bit unsigned integer. Detailed requirements for setting this field are specified in DIS V7 5.8.4.3.2.

i) ***Samples.*** This field shall specify the number of samples in this PDU and shall be represented by a UVINT16. Detailed requirements for setting this field are specified in DIS V7 5.8.4.3.2. Samples is required if the data contains Audio. Samples is optional for other data items. This field shall only be present if indicated by the Field Present Flags-Samples = 1.

j) ***Data.*** This field shall specify the audio or digital data conveyed by the radio transmission. The length of the valid data contained in this field shall be the value of the Data Length field in bits. The Data field shall NOT be zero-padded as required by standard DIS. Detailed requirements for setting this field are specified in DIS V7 5.8.4.3.2. C-DIS does not attempt to compress the contents of the Data field in Signal PDUs.

The format of the Signal PDU shall be as shown in Table 65.

Table 65—Signal PDU

C-DIS MESSAGE Format-Signal			
Field Name	**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**		

Field Present Flags	Sample Rate		1	0 = None, 1 = Present
	Samples		1	0 = None, 1 = Present
Radio Reference ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Radio Number		16	UVINT16	
Encoding Scheme	Class	2	2	[UID 270]
	Type	14	UVINT8	[UID 271]
TDL Type		16	8	[UID 178]
Sample Rate		32	UVINT32	Samples per sec (Audio) or Bits per sec / 1000 (all others)
Data Length		16	14	Length of valid data in bits
Samples		16	UVINT16	Applicable only to Audio-Number of Samples
Signal Data				
Data		Variable Lengths		Actual Data
Padding to 32-bit boundary			0	Not applicable

13.22 Receiver PDU

Communication of the receiver state shall be communicated with a Receiver PDU. See DIS V7 5.8.5 for specific requirements on the use of the Receiver PDU. The Receiver PDU shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Radio Reference ID*****.** For attached radios, this field shall identify the Entity Identifier record (see Data Types and Records-Entity Identifier Record and DIS V7 6.2.28) or Object Identifier record (see Data Types and Records-Entity Identifier Record and DIS V7 6.2.63) to which the radio is attached. For unattached radios, this field shall contain the Unattached Identifier record (see DIS V7 6.2.92). Detailed requirements for setting this field are specified in item b2) in DIS V7 5.8.3.3.

c) ***Radio Number*****.** This field shall identify a particular radio that is either associated with an entity or object or is an unattached radio. The Radio Number field shall be represented by a UVINT16.

   a. NOTE—The combination of the Radio Reference ID and the Radio Number field uniquely identifies a particular radio within a simulation exercise. This combination is referred to as the Radio Identifier (see DIS V7 6.2.70). The Radio Identifier is used to associate Transmitter, Signal, and Receiver PDUs with the same radio.

d) ***Receiver State.*** This field shall indicate the state of the receiver, which shall be either idle or active and shall be represented by a 2-bit enumeration (see [UID 179]).

e) ***Received Power.*** This field shall indicate the radio frequency power received, after applying any propagation loss and antenna gain, and shall be represented by a 9-bit signed integer number in units of decibel milliwatts.

f) ***Transmitter Radio Reference ID.*** This field shall identify the radio that is the source of the transmission that is currently being received. The selection of the received transmitter depends on the characteristics and state of the simulation receiver. For attached radios, this field shall identify the Entity Identifier record (see Data Types and Records-Entity Identifier Record and DIS V7 6.2.28) or Object Identifier record (see Data Types and Records-Entity Identifier Record and DIS V7 6.2.63) to which the radio is attached. For unattached radios, this field shall contain the Unattached Identifier record (see DIS V7 6.2.92). Detailed requirements for setting this field are specified in item b2) in DIS V7 5.8.3.3.

g) ***Transmitter Radio Number.*** This field shall identify the particular radio within the radio transmitter cited in item 6) that is the source of the radio transmission. The Transmitter Radio Number shall be represented by a UVINT16.

a. NOTE—The combination of the Transmitter Radio Reference ID and the Transmitter Radio Number field uniquely identifies a particular radio within a simulation exercise. This combination is referred to as the Radio Identifier (see DIS V7 6.2.70). The Radio Identifier is used to associate Transmitter, Signal, and Receiver PDUs with the same radio.

The format of the Receiver PDU shall be as shown in Table 66.

Table 66—Receiver PDU

C-DIS MESSAGE Format-Receiver PDU				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Radio Reference ID	Site	16	UVINT16	
	Host	16	UVINT16	
	Entity	16	UVINT16	
Radio Number		16	UVINT16	
Receiver State		16	2	[UID 179]
Padding		16	0	Not Applicable
Received Power		32	9	+255, -256 dBm
Transmitter Radio Reference ID	Site	16	UVINT16	
	Host	16	UVINT16	
	Reference Number	16	UVINT16	
Transmitter Radio Number		16	UVINT16	

13.23 IFF PDU

The IFF PDU is complex and depends on many optional layers. The definitions of these layers are defined in DIS V7 7.6.5. In addition to DIS V7 it may be necessary to have an understanding of the actual IFF systems in order to use the standard. The C-DIS standard adds bit flags to indicate the presence of the optional fields and allows centimeter or meter units to be provided for the Relative Antenna Location. Unused fields shall not be provided in the PDU and shall use the appropriate Field Present Flag to indicate the absence of the data field.

13.23.1 Layer 1 Basic System Data

The IFF PDU Layer 1 shall contain the following fields:

a) ***PDU Header.*** This field shall contain data common to all DIS PDUs. The PDU Header shall be represented by the PDU Header record (see C-DIS Header and DIS V7 6.2.66).

b) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU. This allows only the data to be sent that is required for a particular update and is a significant part of the compression. Some fields are entirely optional and may never be sent. Receivers should initialize the value of any field that has not been received to zero until that data is explicitly received.

1) ***Event ID.*** Flag = 0 indicates that Event ID shall NOT be provided. Flag = 1 indicates Event ID shall be provided.

2) ***Relative Antenna Location.*** Flag = 0 indicates that Relative Antenna Location shall NOT be provided. Flag = 1 indicates that Relative Antenna Location shall be provided.

3) ***System ID Details.*** Flag = 0 indicates that System ID -Type, Name, Mode, and Change/Options shall NOT be provided. Flag = 1 indicates System ID -Type, Name, Mode, and Change/Options shall be provided.

4) ***System Specific Data.*** Flag = 0 indicates that System Specific Data shall NOT be provided. Flag = 1 indicates that System Specific Data shall be provided.

5) ***Data Field 1.*** Flag = 0 indicates Data Field 1 shall NOT be provided. Flag = 1 indicates Data Field 1 shall be provided.

6) ***Data Field 2.*** Flag = 0 indicates Data Field 2 shall NOT be provided. Flag = 1 indicates Data Field 2 shall be provided.

7) ***Parameter 1.*** Flag = 0 indicates Parameter 1 shall NOT be provided. Flag = 1 indicates Parameter 1 shall be provided.

8) ***Parameter 2.*** Flag = 0 indicates Parameter 2 shall NOT be provided. Flag = 1 indicates Parameter 2 shall be provided.

9) ***Parameter 3.*** Flag = 0 indicates Parameter 3 shall NOT be provided. Flag = 1 indicates Parameter 3 shall be provided.

10) ***Parameter 4.*** Flag = 0 indicates Parameter 4 shall NOT be provided. Flag = 1 indicates Parameter 4 shall be provided.

11) ***Parameter 5.*** Flag = 0 indicates Parameter 5 shall NOT be provided. Flag = 1 indicates Parameter 5 shall be provided.

12) ***Parameter 6.*** Flag = 0 indicates Parameter 6 shall NOT be provided. Flag = 1 indicates Parameter 6 shall be provided.

c) ***Units.*** This field shall contain flags to indicate the units to be used by particular fields in this particular PDU.

1) ***Relative Antenna Location.*** Flag = 0 indicates that Relative Antenna Location shall be in units of centimeters (cm) = meters / 100. Flag = 1 shall indicate units of meters. Centimeter units shall be used unless the location is larger than the maximum +32 767, -32 768 cm value that can be encoded in entity coordinates SVINT16 XYZ field. (See Record Definitions-Entity Coordinate Vector.

d) ***Full Update Flag.*** This field shall contain a bit flag to indicate if this PDU represents a Full Update or Partial Update. C-DIS decoders shall only create a new object when a Full Update is received in order to have a complete and accurate initial object state. Flag = 0 shall indicate a Partial Update. Flag = 1 shall indicate a Full Update.

e) ***Emitting Entity ID.*** This field shall identify the entity that is the source of the emissions. This field shall be represented by an Entity Identifier record (see Record Definitions- Entity Identifier Record and DIS V7 6.2.28).

f) ***Event ID.*** This field shall contain a number generated by the issuing simulation application to associate related events. This field shall be represented by an Event Identifier record (see Record Definitions- Entity Identifier Record and DIS V7 and DIS V7 6.2.33). This field shall only be present if indicated by the Field Present Flags-Event ID = 1.

g) ***Relative Antenna Location.*** This field shall specify the relative location of a designated primary antenna for this IFF system. The antenna location shall be with respect to the emitting entity's coordinate system and shall be represented by an Entity Coordinate Vector record [see Record Definitions- Entity Coordinate Vector and DIS V7 item a) in 6.2.96]. See the Antenna Location IFF Data record (B.2.3) to indicate any auxiliary antenna locations associated with a system. This field shall only be present if indicated by the Field Present Flags-Relative Antenna Location = 1.

h) ***System ID.*** This field shall identify a specific interrogator or transponder system for the emitting system and shall be represented by a System Identifier record (see Record Definitions-System Identifier Record and DIS V7 6.2.87). This field shall only be present if indicated by the Field Present Flags-System ID Details = 1.

i) ***System Designator.*** This field is the same as DIS see [See DIS V7 item d2) in 5.7.6.1.]

j) ***System-Specific Data.*** This field is the same as DIS V7. (see DIS V7 B.5). This field shall only be present if indicated by the Field Present Flags-System Specific Data = 1.

k) ***Fundamental Operational Data.*** This field is the same as DIS (see DIS V7 6.2.39).

1) **System Status.** field is the same as DIS (see DIS V7 7.6.5.1).

2) **Data Field 1.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Data Field 1 = 1.

3) **Information Layers.** This field is the same as DIS (see DIS V7 7.6.5.1).

4) **Data Field 2.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Data Field 2 = 1.

5) **Parameter 1.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Parameter 1 = 1.

6) **Parameter 2.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Parameter 2 = 1.

7) **Parameter 3.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Parameter 3 = 1.

8) **Parameter 4.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Parameter 4 = 1.

9) **Parameter 5.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Parameter 5 = 1.

10) **Parameter 6.** This field is the same as DIS (see DIS V7 7.6.5.1). This field shall only be present if indicated by the Field Present Flags-Parameter 6 = 1.

The format of Layer 1 shall be as shown in Table 67.

Table 67—IFF Layer 1 Basic System Data

C-DIS MESSAGE Format-IFF (Layer 1)				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	Event ID		1	0 = None, 1 = Present
	Relative Antenna Location		1	0 = None, 1 = Present
	System ID Details		1	System ID Type, Name, Mode, Change/Options 0 = none, 1 = All Present
	System Specific Data		1	0 = None, 1 = Present
	Data Field 1		1	0 = None, 1 = Present
	Data Field 2		1	0 = None, 1 = Present
	Parameter 1		1	0 = None, 1 = Present
	Parameter 2		1	0 = None, 1 = Present
	Parameter 3		1	0 = None, 1 = Present
	Parameter 4		1	0 = None, 1 = Present
	Parameter 5		1	0 = None, 1 = Present
	Parameter 6		1	0 = None, 1 = Present
Units	Relative Antenna Location		1	0 = centimeters, 1 = meters
Full Update Flag			1	0 = Partial Update, 1 = Full Update
Emitting Entity ID	Site	16	UVINT16	
	Application	16	UVINT16	
	Entity	16	UVINT16	
Event ID	Site	16	UVINT16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Application	16	UVINT16	
	Event	16	UVINT16	
Relative Antenna Location	X	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag
	Y	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag
	Z	32	SVINT16	+32 767, -32 768 cm or meters as indicated by bit flag
System ID	System Type	16	4	[UID 82]
	System Name	16	5	[UID 83]
	System Mode	8	3	[UID 84]
	Change/Options	8	8	

C-DIS MESSAGE Format-IFF (Layer 1)				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
System Designator		8	8	
System Specific Data		8	8	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
Fundamental Operational Data	System Status	8	8	8-bit Field Flags all Required
	Data Field 1	8	8	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Information Layers	8	8	8-bit Field Flags all Required
	Data Field 2	8	8	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Parameter 1	16	16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Parameter 2	16	16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Parameter 3	16	16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Parameter 4	16	16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Parameter 5	16	16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B
	Parameter 6	16	16	This field is optional for some IFF systems so make it optional See DIS V7 Annex B

13.23.2 Layer 2 Emissions Data

Layer 2 shall contain the following fields:

a) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU.

1) Fundamental Parameter Data Present. Zero is not allowed. 1 = Fundamental Parameter Records are present. DIS requires a minimum of one record. This field is present in Layer 2 to be compatible will all other IFF Layers, and simplify processing.

b) ***Layer Header*****.** This field shall be represented by the Layer Header record (see Record Definitions-Layer Header Record and DIS V7 6.2.51).

c) ***Beam Data*****.** This field shall specify beam-specific data (see DIS V7 5.7.6.3) and shall be represented by a Beam Data record (see Record Definitions-Beam Data Record and DIS V7 6.2.11).

d) ***Secondary Operational Data*****.** This field shall identify certain secondary operational data for the interrogator or transponder emitting system. This field shall be represented by a Secondary Operational Data record (see DIS V7 6.2.76).

e) ***IFF Fundamental Parameter Data record*.** The fundamental energy radiation emissions characteristics of the mode(s) for an IFF system type shall be represented by an IFF Fundamental Parameter Data record (see Record Definitions-IFF Fundamental Parameter Data and DIS V7 6.2.44). At least one IFF Fundamental Parameter Data record is required. The maximum number of Layer 2 IFF Fundamental Parameter Data records that can be included in an IFF PDU is a function of the maximum PDU size.

The format of Layer 2 shall be as shown in Table 68.

Table 68—IFF Layer 2 Emissions Data

C-DIS MESSAGE Format-IFF (Layer 2) Emissions					
Field Name			**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header			**See C-DIS PDU Header Definition**		
Field Present Flags	Fundamental Parameter Data Present			1	0 = NOT Allowed. At least one set is required, 1 = Fundamental Param Data (Field required to be consistent with all Layers)
Layer Header	Layer Number		8	4	DIS V7 5 Layers defined-Allow 16
	Layer-Specific Information		8	8	
	Length		16	14	Length In Bits of the Layer including header 16 383 = max 2047 bytes
Beam Data	Beam Az Center		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam Az Sweep		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam El Center		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam El Sweep		32	SVINT13	0.00076 radian = 0.0439 degrees resolution
	Beam Sweep Sync		32	10	Percent of the scan (0.097 percent max accuracy)
Secondary Operational Data	Operational Param 1		8	8	
	Operational Param 2		8	8	
	Number of IFF Fundamental Parameter Data Records (N)		16	8	Minimum 1, Max 255
IFF Fundamental Parameter Data (1 to NN)					
IFF Fundamental Parameter Data Record	ERP		32	8	0 to 255 dBm
	Frequency	Mantissa	32	17	Frequency = Unsigned Mantissa x $10^{Exponent}$
		Exponent	0	4	Frequency Unsigned Exponent
	PgRF		32	10	Interrogations/sec (Max 1023)
	Pulse Width		32	10	µsec/10 (102.3 µsec max)
	Burst Length		32	10	Number of Bursts (Max 1023)
	Applicable Modes		8	3	[UID 339]
	System Specific Data		24	24	

13.23.3 Layer 3 Mode 5 Interrogator

The Layer 3 Mode 5 Interrogator Format shall have the following fields:

a) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU.

1) IFF Data Records Present. 0 = None. 1 = IFF Data Records are present.

b) ***Layer Header.*** This field shall be represented by the Layer Header record (Record Definitions-Layer Header Record and DIS V7 6.2.51).

c) ***Reporting Simulation.*** Site and Application. This field shall contain the simulation reporting this IFF PDU. It shall be represented by a Simulation Address record and shall be represented with UVINT16 values (see DIS V7 6.2.80).

d) ***Mode 5 Interrogator Basic Data.*** This field shall contain basic Mode 5 interrogator data that is always required to be transmitted. It shall be represented by the Mode 5 Interrogator Basic Data record (see DIS V7 B.2.26). Interrogated Site/App/Entity shall be encoded with UVINT16.

e) ***Number of IFF Data Records.*** This field shall indicate the number of IFF Data records and shall be represented by a 5-bit unsigned integer. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

f) ***IFF Data records.*** These records contain additional data for a Mode 5 interrogator. These records shall conform to the variable record format of the IFF Data Specification record (see Record Definitions-IFF Data Specification Record and DIS V7 6.2.43). See DIS V7 B.2.1.1 for a list of IFF Data records. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

The format of Layer 3 for a Mode 5 interrogator shall be as shown in Table 69.

Table 69—IFF Layer 3 Mode 5 Interrogator

C-DIS MESSAGE Format-IFF (Layer 3) Mode 5 Interrogator				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	IFF Data Records		1	0 = No IFF Data Records, 1 = Data Records
Layer Header	Layer Number	8	4	DIS V7 five Layers defined-Allow 16
	Layer-Specific Information	8	8	
	Length	16	14	Length in bits of the layer including header 16 383 bits = max 2047 bytes
Reporting Simulation	Site	16	UVINT16	
	Application	16	UVINT16	
Mode 5 Interrogator Basic Data	Mode 5 Interrogator Status	**8**	8	
	Padding	8	0	
	Padding	16	0	
	Mode 5 Message Formats Present	32	32	
	Interrogated Site	16	UVINT16	
	Interrogated App	16	UVINT16	
	Interrogated Entity	16	UVINT16	

C-DIS MESSAGE Format-IFF (Layer 3) Mode 5 Interrogator				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
	Padding	16	0	
Number of IFF Data Records (N)		16	5	Max 31 IFF Data Records (Present if IFF Data Records = 1)
IFF Data Record (1 to NN)				
IFF Data Record	Record Type	32	16	[UID 66]
	Record Length	16	8	(3 + K1 octets)
	Record Specific Fields	8	8	K1 octets
	Padding to 32-bit Boundary		0	P1 octets (No Padding)

13.23.4 Layer 3 Mode 5 Transponder

The Layer 3 Mode 5 Transponder Format shall have the following fields:

a) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU.

1) IFF Data Records Present. 0 = None. 1 = IFF Data Records are present.

b) ***Layer Header.*** This field shall be represented by the Layer Header record (Record Definitions-Layer Header Record and DIS V7 6.2.51).

c) ***Reporting Simulation.*** Site and Application. This field shall contain the simulation reporting this IFF PDU. It shall be represented by a Simulation Address record and shall be represented with UVINT16 values (see DIS V7 6.2.80).

d) ***Mode 5 Transponder Basic Data.*** This field shall contain basic Mode 5 transponder data that is always required to be transmitted. It shall be represented by the Mode 5 Transponder Basic Data record (see DIS V7 B.2.29).

e) ***Number of IFF Data Records.*** This field shall indicate the number of IFF Data records and shall be represented by a 5-bit unsigned integer. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

f) ***IFF Data records.*** These records contain additional data for a Mode 5 Transponder. These records shall conform to the variable record format of the IFF Data Specification record (see Record Definitions-IFF Data Specification Record and DIS V7 6.2.43). See DIS V7 B.2.1.1 for a list of IFF Data records. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

The format of Layer 3 for a Mode 5 transponder shall be as shown in Table 70.

Table 70—IFF Layer 3 Mode 5 Transponder

C-DIS MESSAGE Format-IFF (Layer 3) Mode 5 Transponder				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	IFF Data Records		1	0 = No IFF Data Records, 1 = Data Records
Layer Header	Layer Number	8	4	DIS V7 five Layers defined-Allow 16
	Layer-Specific Information	8	8	
	Length	16	14	Length In Bits of the Layer including header 16 383 = max 2047 bytes
Reporting Simulation	Site	16	UVINT16	
	Application	16	UVINT16	
Mode 5 Transponder Basic Data	Mode 5 Status	16	16	
	PIN	16	16	
	Mode 5 Message Formats Present	32	32	
	Enhanced Mode 1	16	16	
	National Origin	16	16	
	Supplemental	8	8	
	Navigation Source	8	3	[UID 359]
	Figure of Merit	8	5	0-31 Max DIS2012
	Padding	8		
Padding		16		
Number of IFF Data Records (N)		16	5	Max 31 IFF Data Records
IFF Data Record (1 to NN)				
IFF Data Record	Record Type	32	16	[UID 66]
	Record Length	16	8	(3 + K1 octets)
	Record Specific Fields	8	8	K1 octets
	Padding to 32-bit Boundary		0	P1 octets (No Padding)

13.23.5 Layer 4 Mode S Interrogator

The Layer 4 Mode S Interrogator Format shall have the following fields:

a) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU.

   1) IFF Data Records Present. 0 = None. 1 = IFF Data Records are present.

b) ***Layer Header.*** This field shall be represented by the Layer Header record (Record Definitions-Layer Header Record and DIS V7 6.2.51).

c) ***Reporting Simulation.*** Site and Application. This field shall contain the simulation application reporting this IFF PDU. It shall be represented by a Simulation Address record and shall be represented with UVINT16 values (see DIS V7 6.2.80).

d) ***Mode S Interrogator Basic Data.*** This field shall contain basic Mode S interrogator data that is always required to be transmitted. It shall be represented by the Mode S Interrogator Basic Data record (see DIS V7 B.2.37).

e) ***Number of IFF Data Records.*** This field shall indicate the number of IFF Data records and shall be represented by a 5-bit unsigned integer. This field shall only be present if indicated by the Field Present Flags - IFF Data Records = 1.

f) ***IFF Data records.*** These records contain additional data for a Mode S Interrogator. These records shall conform to the variable record format of the IFF Data Specification record (see Record Definitions-IFF Data Specification Record and DIS V7 6.2.43). See DIS V7 B.2.1.1 for a list of IFF Data records. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

The format of Layer 4 for a Mode S interrogator shall be as shown in Table 71.

Table 71—IFF Layer 4 Mode S Interrogator

C-DIS MESSAGE Format-IFF (Layer 4) Mode S Interrogator				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	IFF Data Records		1	0 = No IFF Data Records, 1 = Data Records
Layer Header	Layer Number	8	4	DIS V7 five Layers defined-Allow 16
	Layer-Specific Information	8	8	
	Length	16	14	Length in bits of the layer including header 16 383 bits = max 2047 bytes
Reporting Simulations	Site	16	UVINT16	
	Application	16	UVINT16	
Mode S Interrogator Basic Data	Mode S Interrogator Status	**8**	8	
	Padding	8	0	
	Mode S Levels Present	8	8	
	Padding	8	0	

C-DIS MESSAGE Format-IFF (Layer 4) Mode S Interrogator				
Field Name		DIS Size (Bits)	C-DIS Size (Bits)	Comments
	Padding - 5x32 bits unused (160 bits)	160	0	
	Padding	16	0	
Number of IFF Data Records (N)		16	5	Max 31 IFF Data Records
IFF Data Record (1 to NN)				
IFF Data Record	Record Type	32	16	[UID 66]
	Record Length	16	8	(3 + K1 octets)
	Record Specific Fields	8	8	K1 octets
	Padding to 32-bit Boundary		0	P1 octets (No Padding)

13.23.6 Layer 4 Mode S Transponder

The Layer 4 Mode S Transponder Format shall have the following fields:

a) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU.

   1) IFF Data Records Present. 0 = None. 1 = IFF Data Records are present.

b) ***Layer Header.*** This field shall be represented by the Layer Header record (Record Definitions-Layer Header Record and DIS V7 6.2.51).

c) ***Reporting Simulation.*** Site and Application. This field shall contain the simulation application reporting this IFF PDU. It shall be represented by a Simulation Address record and shall be represented with UVINT16 values (see DIS V7 6.2.80).

d) ***Mode S Transponder Basic Data***. This field shall contain basic Mode S transponder data that is always required to be transmitted. It shall be represented by the Mode S Transponder Basic Data record (see DIS V7 B.2.41).

e) ***Number of IFF Data Records.*** This field shall indicate the number of IFF Data records and shall be represented by a 5-bit unsigned integer. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

f) ***IFF Data records.*** These records contain additional data for a Mode S Transponder. These records shall conform to the variable record format of the IFF Data Specification record (see Record Definitions-IFF Data Specification Record and DIS V7 6.2.43). See DIS V7 B.2.1.1 for a list of IFF Data records. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

The format of Layer 4 for a Mode S transponder shall be as shown in Table 72.

Table 72—IFF Layer 4 Mode S Transponder

C-DIS MESSAGE Format-IFF (Layer 4) Mode S Transponder				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	IFF Data Records		1	0 = No IFF Data Records, 1 = Data Records
Layer Header	Layer Number	8	4	DIS V7 five Layers defined-Allow 16
	Layer-Specific Information	8	8	
	Length	16	14	Length in bits of the layer including header 16 383 = max 2047 bytes
Reporting Simulation	Site	16	UVINT16	
	Application	16	UVINT16	
Mode S Transponder Basic Data	Mode S Status	16	16	
	Mode S Levels Present	8	8	
	Aircraft Present Domain	8	3	[UID 356]
	Number of Characters in the Aircraft ID		4	Number of Characters in the Aircraft ID field (NC1234) = 6 Characters. Max = 8
	Aircraft Identification	64	0-64	(8 bits per ASCII Character) 0 to 64 bits length
	Aircraft Address	32	32	
	Aircraft ID Type	8	3	[UID 357]
	DAP Source	8	8	
	Mode S Altitude	16	16	
	Capability Report	8	8	
	Padding	8	0	
	Padding	16	0	
Padding		16	0	
Number of IFF Data Records (N)		16	5	Max 31 IFF Data Records
IFF Data Record (1 to NN)				
IFF Data Record	Record Type	32	16	[UID 66]
	Record Length	16	8	(3 + K1 octets)
	Record Specific Fields	8	8	K1 octets
	Padding to 32-bit Boundary		0	P1 octets (No Padding)

13.23.7 Layer 5 Data Communications

Layer 5 is used to convey additional information for transponder and interrogator systems not provided for in other layers where those layers do not have a standard variable record section and to convey transponder/interrogator data link messages when emulating the exact message formats. The specific requirements associated with a system type will indicate whether Layer 5 is required and which IFF data records are applicable (see DIS V7 5.7.6 and Annex B).

Layer 5 shall consist of the following fields:

a) ***Field Present Flags.*** This field shall contain flags that indicate the presence or absence of fields in the PDU.

   1) IFF Data Records Present. 0 = None. 1 = IFF Data Records are present.

b) ***Layer Header.*** This field shall be represented by the Layer Header record (Record Definitions-Layer Header Record and DIS V7 6.2.51).

c) ***Reporting Simulation.*** Site and Application. This field shall contain the simulation application reporting this IFF PDU. It shall be represented by a Simulation Address record and shall be represented with UVINT16 values (see DIS V7 6.2.80).

d) ***Applicable Layers*****.** This field shall indicate to which layer(s) the IFF data records contained in Layer 5 apply. This is to support data filtering at the receive simulation. It shall use the same format as the Information Layers record (see DIS V7 6.2.45) and shall be encoded as a 6-bit unsigned integer.

e) ***Data Category*****.** This field shall indicate the category of data represented by the included IFF data records. This is to support data filtering at the receive simulation. It shall be represented by a 3-bit enumeration (see [UID 369]).

f) ***Number of IFF Data Records.*** This field shall indicate the number of IFF Data records and shall be represented by a 5-bit unsigned integer. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

g) ***IFF Data records.*** These records contain additional data for IFF (Layer 5) Data Communications. These records shall conform to the variable record format of the IFF Data Specification record (see Record Definitions-IFF Data Specification Record and DIS V7 6.2.43). See DIS V7 B.2.1.1 for a list of IFF Data records. This field shall only be present if indicated by the Field Present Flags-IFF Data Records = 1.

The format of Layer 5 Data Communications is shown in Table 73.

Table 73—IFF Layer 5 Data Communications

C-DIS MESSAGE Format-IFF (Layer 5) Data Communications				
Field Name		**DIS Size (Bits)**	**C-DIS Size (Bits)**	**Comments**
PDU Header	**See C-DIS PDU Header Definition**			
Field Present Flags	IFF Data Records		1	0 = No IFF Data Records, 1 = Data Records
Layer Header	Layer Number	8	4	DIS V7 five Layers defined-Allow 16
	Layer-Specific Information	8	8	
	Length	16	14	Length in bits of the layer including header 16 383 bits = max 2047 bytes
Reporting Simulation	Site	16	UVINT16	
	Application	16	UVINT16	
Padding		16	0	
Applicable Layers		8	6	Any Existing Layer 0-5 as a bit flag
Data Category		8	3	[UID 369]
Padding		16	0	
Number of IFF Data Records (N)		16	5	Max 31 IFF Data Records
IFF Data Record (1 to NN)				
IFF Data Record	Record Type	32	16	[UID 66]
	Record Length	16	8	(3 + K1 octets)
	Record Specific Fields	8	8	K1 octets
	Padding to 32-bit Boundary		0	P1 octets (No Padding)