Motion Imagery Standards Board **Engineering Guideline:** **Predator UAV Basic Universal Metadata Set**	**MISB EG 0104.5** **14 December 2006**

1 Scope

This Engineering Guideline (EG) documents the basic Predator UAV (Unmanned Aerial Vehicle) metadata to be encoded into a standard SMPTE KLV Universal Metadata Set. This EG provides direction on the creation of a standard metadata set for reliable exchange of Predator closed caption (CC) data among digital motion imagery systems.

The scope of this EG was originally intended for metadata that originated as closed caption metadata in analog video from the Predator UAV. After several years the use of this standard has grown beyond its original purpose; some systems are using this standard to directly create universal sets. To address this issue the MISB is working on a future standard which will encompass a large list of possible metadata, provide more flexibility and aid in better motion imagery analysis. Analog video and closed caption metadata are legacy systems that may continue to be used during the transition to all-digital sensors and information infrastructures. This EG facilitates that transition only and is not intended to constitute an approved end-system implementation.

2 References

SMPTE 336M-2001, *Data Encoding Protocol Using Key-Length-Value*

SMPTE 335M-2001, *Metadata Dictionary Structure*

SMPTE RP210.8-2004, *Metadata Dictionary*

SMPTE RP210.7-2003, *Metadata Dictionary*

SMPTE RP210.3-2001, *Metadata Dictionary* (DRAFT)

Core Video Metadata Profile, Version 1.0, Video Working Group, 14 March 1997

"Predator Closed Caption ESD System", NIMA-MIPO Memorandum for Record U-001-01/ATTM, 25 February 2001 (Attached as Annex B)

MISB RP 0102.2, *Security Metadata Sets for Digital Motion Imagery*, 20 November 2003

MISB RP 0103.1, *Timing Reconciliation Metadata Set for Digital Motion Imagery*, 11 October 2001

MISB RP 0107, *Bit and Byte Order for Metadata in Motion Imagery Files and Streams*, 11 October, 2001

3 Introduction

As motion imagery systems begin to migrate to all-digital architectures there are still some systems that will be in transition and require the consistent preservation of some analog system characteristics. One such element in transition is analog closed caption metadata from the Predator UAV. Analog closed caption has been successful as a means of carrying important UAV geospatial and mission metadata with video imagery. During the transition from this low data rate method of metadata carriage to more reliable and higher capacity embedded digital

metadata it is important to preserve the general contents of the original Core Video Metadata Profile upon which the Predator UAV closed caption system was based. This metadata consists of the "raw" unprocessed metadata obtained directly from the Predator UAV platform or ground station before the signal has entered the processing and exploitation chain.

This EG identifies a way to encode, as a minimum, the original, source-derived, analog closed caption metadata from the Predator UAV and some computed information into a standard KLV digital metadata set. This standardized method of capturing the minimum Predator UAV metadata will help interoperability during motion imagery systems transition. All metadata shall be represented using big-endian (most significant byte – MSB - first) encoding. Bytes shall be big-endian bit encoding (most significant bit – msb - first).

4 Predator UAV Basic Universal Metadata Set

- This section defines a metadata set that originates from or uses information from Predator analog closed caption metadata. The Predator UAV Basic Universal Metadata Set is the KLV metadata form of the original analog closed caption metadata.

All Predator UAV Basic Universal Metadata Sets shall be SMPTE 336M KLV compliant Universal Sets as determined by the metadata originator. (While it is possible that Predator metadata could be expressed as a Global Set, a Pack or even as a Label, the decision was made to use the Universal Set to reduce ambiguity or chances for misinterpretation.)

It is the responsibility of implementers to evaluate the format of the Predator CC metadata to determine if format changes or recalculations are needed before mapping to KLV fields. NOTE: A direct entry-for-entry mapping from CC to KLV cannot be assumed and all CC source fields shown may not be present.

4.1 Predator UAV Basic Universal Metadata Set

The Predator UAV Basic Universal Metadata Set shall conform to the syntax and format of the Universal Metadata Set specified in SMPTE 336M-2001.

The Predator UAV Basic Universal Metadata Set shall consist of the metadata elements listed in Table 1 and shall have the 16-byte designator of 06 0E 2B 34 02 01 01 01 0E 01 01 02 01 01 00 00. Table 2 contains normative information on the mapping and calculations that are required to create a KLV metadata element from the Predator ESD data set.

Each Predator UAV Basic Universal Metadata Set shall contain, as a minimum, the "User Defined Timestamp" (reference Table 2) obtained either from the Predator closed caption input or defined by the originator of the metadata set at the time of encoding. The originator-defined timestamp shall come from a monotonically increasing reference source to allow users to determine accurate time intervals.

4.2 Predator Image Geoposition Corner Metadata

The Predator Corner Latitude/Longitude metadata shall consist of the elements shown in Table 1 which are mapped or calculated from original Predator analog closed caption metadata.

Corner coordinates are numbered as follows to conform to NITF numbering convention for single image frame corner coordinates:

Point 1 – upper left corner,
Point 2 – upper right corner,
Point 3 – lower right corner,
Point 4 – lower left corner.

Corners not corresponding to geographic locations, i.e., above the horizon, shall not be included..

4.3 Security Metadata Set

The Security Metadata Set is defined in MISB RP 0102.2, *Security Metadata Sets for Digital Motion Imagery*. Presence of a Security Metadata Set is mandatory in the Motion Imagery Stream or file. The EG102 Universal Data Set can be included within the Predator UAV Basic Metadata Universal Set or within the same metadata stream (e.g. private data stream (PDS) for MPEG2 transport streams or metadata included in VANC line). Even if the metadata in the Predator UAV Basic Universal Metadata Set is Unclassified an associated Security Metadata Set must be present.

4.4 Obliquity Angle Notes

The Obliquity Angle metadata item is computed from the ESD Sensor Elevation Angle – they are NOT the same value. The definition, derived from the SMPTE KLV dictionary, states "*Obliquity angle of image expressed in degrees. The inverse of sensor depression angle.*".

When EG104.1 was written the "Sensor Depression Angle" was equated to the "ESD Sensor Elevation Angle" and the angular inverse was computed for the KLV version. To compute the inverse, the ESD sensor elevation angle is subtracted from 180 degrees and is explicitly written as follows:

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Obliquity Angle = 180 – ESD Sensor Elevation Angle
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To compute the ESD Sensor Elevation Angle from the Obliquity Angle, subtract the Obliquity Angle from 180 degrees:

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ESD Sensor Elevation Angle = 180 – Obliquity Angle
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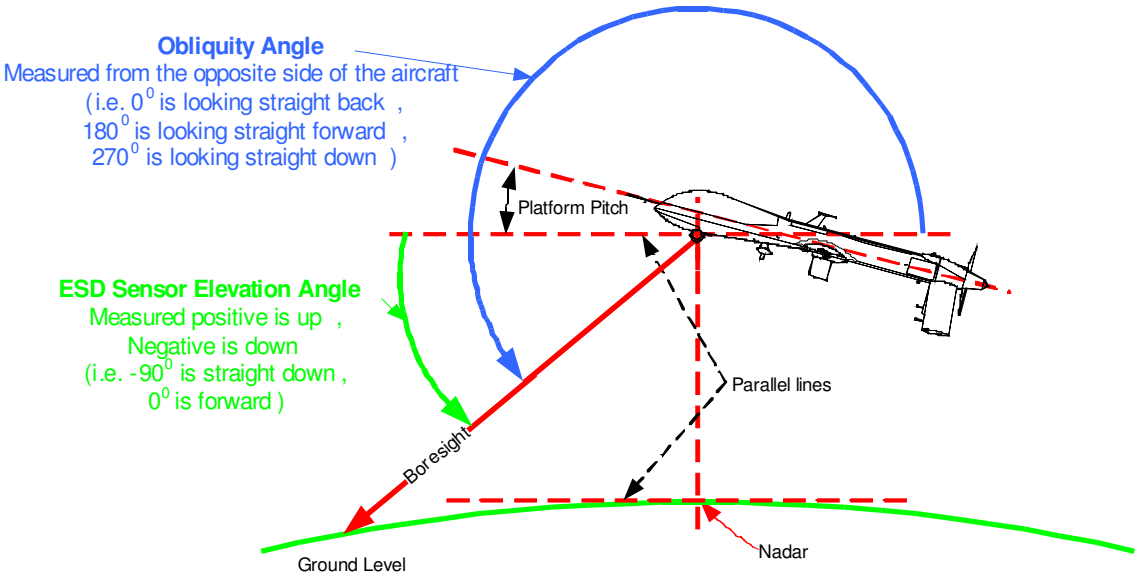
The Obliquity Angle represented in prior versions of EG0104 (i.e.: EG0104 to EG0104.4) is unclear and has caused confusion. Because there currently is a large amount of data already created using the unclear definition, as well as several systems that employ this method, this standard is not changing the meaning of Obliquity Angle.

The following illustration shows the relationship of the two angles, Obliquity Angle and Sensor Elevation Angle.


Obliquity Angle
Measured from the opposite side of the aircraft
(i.e. 0 0 is looking straight back ,
180 0 is looking straight forward ,
270 0 is looking straight down)
Platform Pitch
ESD Sensor Elevation Angle
Measured positive is up ,
Negative is down
(i.e. -90 0 is straight down ,
0 0 is forward)
Parallel lines
Boresight
Nadar
Ground Level

16-byte Metadata Label or 16-byte Set Designator	Metadata Element or Set Name	Core Video Metadata Profile Name	Name in NIMA-MIPO Memo
06 0E 2B 34 01 01 01 01 07 01 02 01 03 02 00 00	Frame Center Latitude	FRAME CENTER LATITUDE	Target Latitude
06 0E 2B 34 01 01 01 01 07 01 02 01 03 04 00 00	Frame Center Longitude	FRAME CENTER LONGITUDE	Target Longitude
06 0E 2B 34 01 01 01 0A 07 01 02 01 03 16 00 00	Frame Center Elevation	(not defined)	(not defined)
06 0E 2B 34 01 01 01 01 07 01 01 01 00 00 00 00	Image Coordinate System	IMAGE COORDINATE SYSTEM	Image Coordinate System
06 0E 2B 34 01 01 01 01 07 01 09 02 01 00 00 00	Target Width	(not defined)	Target Width
06 0E 2B 34 01 01 01 01 07 02 01 02 01 01 00 00	Start Date Time - UTC	VIDEO TIME STAMP	Date of Collection/ Time of Collection
06 0E 2B 34 01 01 01 01 07 02 01 02 07 01 00 00	Event Start Date Time - UTC	MISSION START TIME	Date of Mission Start/ Time of Mission Start
06 0E 2B 34 01 01 01 03 07 02 01 01 01 05 00 00	User Defined Time Stamp (microseconds since 1970) (msb)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 07 01 00	Corner Latitude Point 1 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 08 01 00	Corner Latitude Point 2 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 09 01 00	Corner Latitude Point 3 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 0A 01 00	Corner Latitude Point 4 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 0B 01 00	Corner Longitude Point 1 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 0C 01 00	Corner Longitude Point 2 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 0D 01 00	Corner Longitude Point 3 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 03 07 01 02 01 03 0E 0100	Corner Longitude Point 4 (Decimal Degrees)	(not defined)	(not defined)
06 0E 2B 34 01 01 01 01 07 01 08 01 01 00 00 00	Slant Range	SLANT RANGE	Slant Range
06 0E 2B 34 01 01 01 01 07 01 10 01 01 00 00 00	Sensor Roll Angle	(not defined)	Sensor roll angle*
06 0E 2B 34 01 01 01 01 07 01 10 01 02 00 00 00	Angle to North	ANGLE TO NORTH	Sensor Pointing Azimuth
06 0E 2B 34 01 01 01 01 07 01 10 01 03 00 00 00	Obliquity Angle (**IMPORTANT** – see section "Obliquity Angle Notes" above)	OBLIQUITY ANGLE (**IMPORTANT** – see section "Obliquity Angle Notes" above)	Sensor Elevation Angle (**IMPORTANT** – see section "Obliquity Angle Notes" above)
06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00	Platform Roll Angle	(not defined)	Aircraft roll angle
06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00	Platform Pitch Angle	(not defined)	Aircraft pitch angle
06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00	Platform Heading Angle	(not defined)	Aircraft heading angle
06 0E 2B 34 01 01 01 02 04 20 02 01 01 08 00 00	Field of View (Horizontal)	FIELD OF VIEW	Field of View
06 0E 2B 34 01 01 01 07 04 20 02 01 01 0A 01 00	Field of View (Vertical)	(not defined)	(not defined)

16-byte Metadata Label or 16-byte Set Designator	Metadata Element or Set Name	Core Video Metadata Profile Name	Name in NIMA-MIPO Memo
06 0E 2B 34 01 01 01 01 07 01 02 01 02 02 00 00	Device Altitude	SENSOR ALTITUDE	Sensor Altitude
06 0E 2B 34 01 01 01 03 07 01 02 01 02 04 02 00	Device Latitude	SENSOR LATITUDE	Sensor Latitude
06 0E 2B 34 01 01 01 03 07 01 02 01 02 06 02 00	Device Longitude	SENSOR LONGITUDE	Sensor Longitude
06 0E 2B 34 01 01 01 01 04 20 01 02 01 01 00 00	Image Source Device	SENSOR NAME	Sensor Name
06 0E 2B 34 01 01 01 01 01 05 05 00 00 00 00 00	Episode Number	MISSION NUMBER	Mission Number
06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00	Device Designation	PROJECT ID CODE	Project ID Code

Table 1 – Predator UAV Universal Basic Metadata Set Contents

* Planned addition to Predator analog closed caption metadata.

TO (Y) Metadata Element or Set Name	Method of Translation	FROM (X) Name in NIMA-MIPO Memo
Frame Center Latitude	No changes needed. (Y=X)	Target Latitude
Frame Center Longitude	No changes needed. (Y=X)	Target Longitude
Image Coordinate System	0: Geodetic WGS84; 1: Geocentric WGS84; 2: None (Truncate as needed.)	Image Coordinate System
Target Width	(Convert from Feet to Meters) Y=X*0.304801	Target Width
Start Date Time - UTC	Convert to ISO8601:2000 date and time format as follows: "YYYYMMDDThhmmss" where YYYY – Year MM – Month DD – Day hh – Hours mm – Minutes ss – seconds Z - Zulu time is assumed, so it is not added to the string	Date of Collection/ Time of Collection
Event Start Date Time - UTC	Convert to ISO8601:2000 date and time format as follows: "YYYYMMDDThhmmss" where YYYY – Year MM – Month DD – Day hh – Hours mm – Minutes ss – seconds Z - Zulu time is assumed, so it is not added to the string	Date of Mission Start/ Time of Mission Start
User Defined Time Stamp (microseconds since 1970)	Time at which ESD is received. May be synchronized with Date/Time of Collection.	(not defined)
Corner Latitude Point 1	Computed from other metadata.	(not defined)
Corner Latitude Point 2	Computed from other metadata.	(not defined)
Corner Latitude Point 3	Computed from other metadata.	(not defined)
Corner Latitude Point 4	Computed from other metadata.	(not defined)
Corner Longitude Point 1	Computed from other metadata.	(not defined)
Corner Longitude Point 2	Computed from other metadata.	(not defined)
Corner Longitude Point 3	Computed from other metadata.	(not defined)
Corner Longitude Point 4	Computed from other metadata.	(not defined)
Slant Range	(Convert from Nautical Miles to Meters) Y=X*1852	Slant Range
Sensor Roll Angle	No changes needed. (Y=X)	Sensor roll angle *
Angle to North	(Convert from "angle relative to sensor boresight vector" to "first row of image" – Assuming borsight vector is perpendicular to top row of image) Y=X+90 (subtract 360 if needed)	Sensor Pointing Azimuth
Obliquity Angle	(Compute the "inverse of the Sensor Elevation Angle") Y=180-X (**IMPORTANT** – see section "Obliquity Angle Notes" above)	Sensor Elevation Angle (**IMPORTANT** – see section "Obliquity Angle Notes" above)
Platform Roll Angle	No changes needed. (Y=X)	Aircraft roll angle
Platform Pitch Angle	No changes needed. (Y=X)	Aircraft pitch angle
Platform Heading Angle	No changes needed. (Y=X)	Aircraft heading angle
Field of View (Horizontal)	No changes needed. (Y=X)	Field of View

Device Altitude	(Convert from Feet to Meters) Y=X*0.304801	Sensor Altitude
Device Latitude	No changes needed. (Y=X)	Sensor Latitude
Device Longitude	No changes needed. (Y=X)	Sensor Longitude
Image Source Device	(Convert from Integer to String) 0=EO Nose, 1=EO Zoom, 2=EO Spotter 3=IR Mitsubishi PtSi Model 500 4=IR Mitsubishi PtSi Model 600 5=IR InSb Amber Model TBD	Sensor Name
Episode Number	No changes needed. (Y=X)	Mission Number
Device Designation	No changes needed. (Y=X)	Project ID Code

Table 2 – Conversion from Predator Closed Caption to Predator UAV Universal Basic Metadata Set

* Planned addition to Predator analog closed caption metadata.

Annex A (Informative) – Examples of Predator UAV Universal Basic Metadata Set

To be added later

Annex B (Normative) – Predator Closed Caption ESD System

[NOTE: The original document contained herein contains errors. Corrections contained in brackets have been inserted.]

U-001-01/ATTM 25 February 2001

MEMORANDUM FOR RECORD

SUBJECT: Predator Closed Caption ESD System

1. The Motion Imagery Program Office requires for interoperability that systems, which receive Predator closed caption Exploitation Support Data, conform to the attached memorandum.

STEPHEN W. LONG
Program Manager, MIPO

Enclosure
Memo from Pete Wiedemann, Subject: Checkout Reference Data for the Predator ESD System

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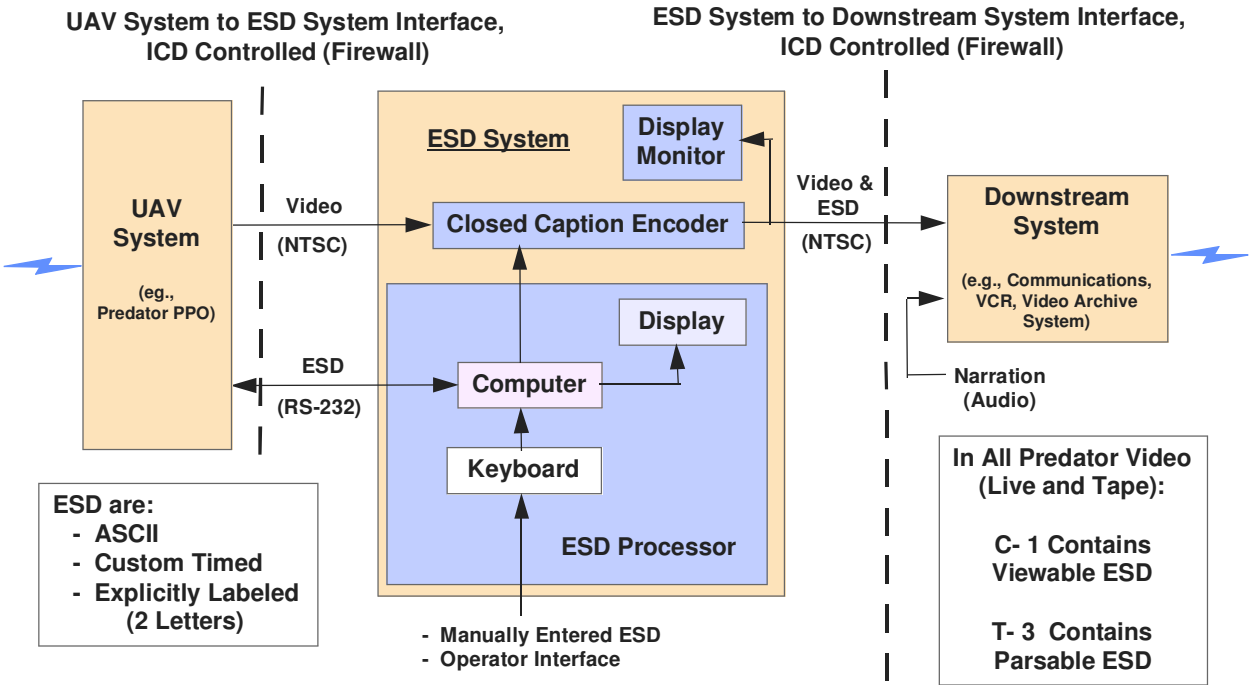
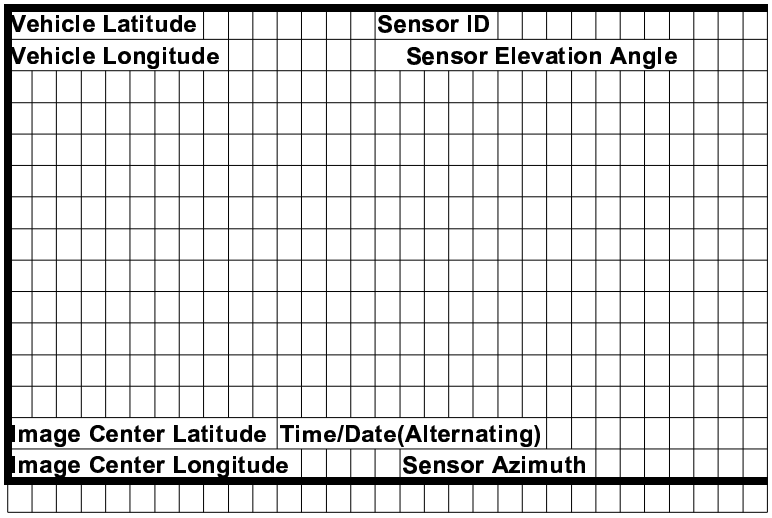
Memo

To: Executive Office for Cruise Missiles and UAVs, JPO for MAE-UAV
Subject: Checkout Reference Data for the Predator ESD System
From: Pete Wiedemann
Date: 10 March 1998

4.4.1.1 Predator ESD System, Block Diagram



Viewable ESD, Screen Location Layout



Viewable ESD, Data Format Layout, showing Time of Day

-	8	9	°	5	9	'	5	9	.	3	"				D	L	T	V					1	4	,	5	0	0	M	S
1	7	9	°	5	9	'	5	9	.	5	"			-	6	3	.	0	8	°					1	9	.	7	8	
-	8	9	°	5	9	'	5	9	.	2	"			2	3	:	4	2	:	0	5				0	7	,	8	0	0
1	7	9	°	5	9	'	5	9	.	7	"				3	5	9	.	2	6	°				0	0	,	3	0	0

Viewable ESD, Data Format Layout, showing Date

-	8	9	°	5	9	'	5	9	.	3	"				D	L	T	V					1	4	,	5	0	0	M	S
1	7	9	°	5	9	'	5	9	.	5	"			-	6	3	.	0	8	°					1	9	.	7	8	
-	8	9	°	5	9	'	5	9	.	2	"			1	2	/	3	1	/	9	8				0	7	,	8	0	0
1	7	9	°	5	9	'	5	9	.	7	"				3	5	9	.	2	6	°				0	0	,	3	0	0

4.4.2

Table of Viewable and Parsable ESD (starts on next page)

Note: There are two parsable items in the list below (Classification – Cl and Mission Number - Mn) that could be string values. These values will have some form of indicator (i.e. <esc> character) that allows parsers to recognize that the value is a string value and not a datagram (DG) character. There are two possibilities for the indicator character – either an escape character <esc> (ASCII character 27 – hex 0x1B) or a backslash character "\". The indicator character will precede each character in the value portion – for example if the Mn tag had 4 characters with the value of "ABC1" and the indicator character is a backslash "\", the stream would contain:

Mn\A\B\C1

Parsers may have to support both types of indicator characters and it is unclear if the valid lengths include the indicator characters.

DATA ITEM	DG	UNITS	RANGE	FORMAT	EXAMPLES
Target Latitude[1]	Ta	Deg/Min/Sec/ Tenths	+/- 0-90.0	PDDMMSST P: Sign (+ or -) D: Degrees digit M: Minutes digit S: Seconds digit T: Tenths	+89°59'59.9" => Ta+8959599 –34°26”37.5” => Ta–3426375
Target Longitude[2]	To	Deg/Min/Sec/ Tenths	+/- 0-180.0	PDDDMMSST P: Sign (+ or -) D: Degrees digit M: Minutes digit S: Seconds digit T: Tenths	+179°59'59.9" => To+17959599 –117°00'00.0" => To–11700000 – 5°05'17.0" => To–00505170
Target Width[3]	Tw	Meters	0-99,999	N N: from 1 to 5 digits	8,123 m => Tw8123 523 m => Tw523
Slant Range	Sr	Meters	0-99,999	N N: from 1 to 5 digits	99,999 m => Sr99999 523 m => Sr523
Sensor Pointing Azimuth[4]	Sp	Degrees	0-359.00	DDD.HH D: Degrees digit H: Hundredths digit	359.58° => Sp359.58 23.00° => Sp23.00
Sensor Elevation Angle[5]	Se	Degrees	+/- 0-180.00	PDDD.HH P: Sign (+ or -) D: Degrees digit H: Hundredths digit	+179.33° => Se+179.33 – 5.10° => Se-5.10
Field of View[6]	Fv	Degrees	0-180.00	DDD.HH D: Degrees digit H: Hundredths digit	179.33° => Fv179.33 0.41° => Fv0.41
Sensor Altitude	Sl	Feet MSL	+/- 0-99,999	PN P: Sign (+ or -) N: from 1 to 5 digits	+24,999 MSL => Sl+24999 – 1,023 MSL => Sl-1023

Sensor Latitude[1]	Sa	Deg/Min/Sec/ Tenths	+/- 0-90.0	PDDMMSST P: Sign (+ or -) D: Degrees digit M: Minutes digit S: Seconds digit T: Tenths digit	+85° 59'59.7" => Sa+8959597 – 5° 00'00.0" => Sa-0500000
Sensor Longitude[2]	So	Deg/Min/Sec/ Tenths	+/- 0-180.0	PDDDMMSST P: Sign (+ or -) D: Degrees digit M: Minutes digit S: Seconds digit T: Tenths digit	+179° 59'59.7" => So+17959597 – 5° 00'00.0" => So-00500000
Sensor Name	Sn	Name Code	0-5	0: EO Nose 1: EO Zoom (DLTV) 2: EO Spotter 3: IR Mitsubishi PtSi Model 500 4: IR Mitsubishi PtSi Model 600 5: IR InSb Amber Model TBD	DLTV => Sn1
Image Coordinate System	Ic	Coordinate Code	0-2	0: Geodetic WGS 84 1: Geocentric WGS 84 2: None	(not viewable) => Ic1
Date of Collection	Cd	Date		CCYYMMDD CC=Century YY=Year MM=Month DD=Day	05/23/98 => Cd19970523
Time of Collection	Ct	Time	0-235959	HHMMSS HH=Hour MM=Minute SS=Seconds	17:23:06 => Ct172306 03:06:27 => Ct030627
Mission Number	Mn	Number	1-9999999	N N: from 1 to 7 digits	(not viewable) => Mn3324 See Note above this table.

Mission Start Date	Md	Date		CCYYMMDD CC=Century YY=Year MM=Month, DD=Day	(not viewable) => Md19970423
Mission Start Time	Mt	Time	0-235959	HHMMSS HH=Hour MM=Minute SS=Seconds	(not viewable) => Mt212456 (not viewable) => Mt050802
Security Classification	Cl	Classification Code	U/R/C/S/T	U: Unclassified O: Sensitive (FOUO) R: Restricted C: Confidential S: Secret T: TopSecret	(not viewable) => Cl<esc>C (not viewable) => Cl<esc>S [Correction: *Some software versions report '0' for Unclassified and '1' for Restricted.*] See Note above this table.
Project ID Code[7]	Pc	Number	0-99	N N: from 1 to 2 digits	(not viewable) => Pc25
ESD ICD Version	Iv	Count	0-999	N N: from 1 to 3 digits	(not viewable) => Iv5

Notes:

1) A plus sign (+) indicates North Latitude. All Latitude coordinates use WGS84.
2) A minus sign (-) indicates East Longitude. [Correction*: A minus sign (-) indicates West Longitude.*] All Longitude coordinates use WGS84.
3) At center of image.
4) Relative to true North.
5) Relative to Planetary Tangent at Nadir. 0 is Horizon, –90 is Straight down (nadir).
6) Horizontal, across baseline of image, projected onto the terrain (flat terrain model at DTED or other best available elevation data). [Correction: *Software versions prior to 1.6 report Vertical Field of View.*]
7) The Project ID of the Collection Platform (e.g., Predator, Outrider, Pioneer, etc.).