MOTION IMAGERY STANDARDS BOARD **RECOMMENDED PRACTICE** **Integration of Motion Imagery into the STANAG 4559 Data Model**	**MISB RP 0813.1** **27 February 2014**

1 Scope

This document is technically identical to NATO EG 0803 in draft Edition 3 of AEDP-8.

2 References

[1] STANAG 4559 Ed. 3 NATO Standard ISR Library Interface (NSILI), Nov 2010
[2] STANAG 4609 Ed. 3 NATO Digital Motion Imagery Format, Oct 2009
[3] SMPTE RP 210v13:2012, Metadata Element Dictionary
[4] MISB ST 0601.7 UAS Datalink Local Metadata Set, Feb 2014
[5] MISB RP 0701 Common Metadata System: Structure, Aug 2007
[6] ISO/IEC 13818-1:2013 Information technology – Generic coding of moving pictures and associated audio information: Systems
[7] NATO EG 0803 Engineering Guideline to Facilitate Integration of Motion Imagery Products into the STANAG 4559 DATA MODEL, AEDP-8 Ed.3, Dec 2009
[8] MISP 6.6 Motion Imagery Standards Profile, Feb 2014

3 Acronyms

CSD	Coalition Shared Database
DM	Data Model
EG	Engineering Guideline
IDD	Interface Design Document
IR	Information Request
ISR	Intelligence Surveillance Reconnaissance
KLV	Key-Length-Value
MAJIIC	Multi-sensor Aerospace-ground Joint Intelligence, Surveillance and Reconnaissance Interoperability Coalition
PAT	Program Association Table
PES	Packetized Elementary Stream
PMT	Program Map Table
RP	Recommended Practice
TS	Transport Stream

4 Revision History

Revision	Date	Summary of Changes
RP 0813.1	02/27/2014	• Promoted to RP; EARS format

5 Introduction

This Recommended Practice (RP) describes the necessary conditions for integration of motion imagery products into the STANAG 4559 [1] Data Model (DM) and Interface, which is based on the MAJIIC Coalition Shared Database (CSD). The proposed approach covers both file products (clips) and streaming products with a maximum of similarity in the approach for both types.

This document describes a schema that addresses two particular challenges when integrating a STANAG 4609-compliant stream into the STANAG 4559 DM:

1) STANAG 4609 [2] allows for numerous data elements, which may have more than one key registered in SMPTE RP 210 [3] possibly used to represent particular data in a given implementation. For example, a time stamp can be represented by at least five different keys. This document facilitates integration with the STANAG 4559 DM taking into consideration the possible disparate sources of KLV information.
2) The fielded solutions streaming KLV metadata are expected to evolve from exclusive use of 16 byte Universal SMPTE keys to MISB ST 0601. This document proposes a method that considers this evolution and allows STANAG 4559 DM integration independent of the KLV encoding scheme.

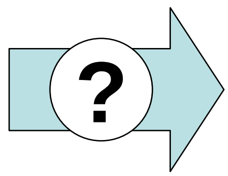
STANAG 4559 Ed 3 presents well-defined attributes for the STANAG 4559 DM to use when integrating ISR products specifically for STANAG 4609 products. This RP facilitates integration of a generically compliant 4609 product, which can use any of the keys in RP 210 [3]. It does this by identifying, from all these possible keys, how the STANAG 4559 Ed 3 IDD attributes can be populated. Figure 1 presents the objective of this RP with STANAG 4559 DM attributes in contrast to elements present in the STANAG 4609 KLV stream.

The object is to facilitate the integration of STANAG 4609 products into the STANAG 4559 DM by producing a mapping from all compliant keys to STANAG 4559 DM attributes, while including the considerations above.

In addition, the method described here does not require intensive computing resources; conceptually, one single host can receive a 4609 stream, exploit the stream, record files in real-time, and host a STANAG 4559 DM. This schema will:

- Use processes already performed on the host computer
- Require minimal additional I/O operations
- Require minimal additional use of memory
- Run in lower priority than critical real time processes as needed

Registry names of element that have to be in KLV Elementary Stream
Image Source Device
Episode Number
FC Lat&Long + Smart on ingestor
Security Classification
Release Instructions
User Defined Time Stamp
FC Lat&Long
Device designation
Platform designation
Source Organization
Elements that have to be video Elementary Stream
Video size (pixels)
Frame Rate
Video Encoding
Stream bit rate
category of sensor
Video Encoding



STANAG 4559 DM Entity.Attribute
NSIL_COMMON.source
NSIL_COMMON.identifierMission
NSIL_COVERAGE.spatialCountryCode
NSIL_METADATASECURITY.classification
NSIL_METADATASECURITY.releasability
NSIL_COVERAGE.spatialGeographicReferenceBox
NSIL_CARD.publisher
NSIL_VIDEO.frameResolution
NSIL_VIDEO.frameRate
NSIL_VIDEO.encodingScheme
NSIL_VIDEO.averageBitRate
NSIL_VIDEO.category
NSIL_VIDEO.MISMLevel
NSIL_VIDEO.metadataEncodingScheme
NSIL_STREAM.sourceURL
NSIL_STREAM.format
NSIL_STREAM.creator
NSIL_STREAM.dateTimeDeclared
NSIL_STREAM.formatVersion
NSIL_STREAM.programID

Figure 1: Mapping to STANAG 4559

6 Producing the information for STANAG 4559

6.1 Concepts

The method outlined in this RP is based on three concepts as follows:

- Definition of elements composing "*generic header information*"
- Generation of the "*generic header information*" from multiple KLV metadata elements and encoding schemes
- Simple clipping procedure to write a 4609 stream to files

These concepts are defined in the following subsections.

6.1.1 Concept 1: Definition of a "*generic header information*" element

Produce the necessary information from the 4609 metadata elements, both KLV and motion imagery parameters, in order to populate the STANAG 4559 DM attributes for stream and file products. For the purpose of this RP, this necessary information will be called the "*generic header information*" and should comprise the elements listed in Table 1 for clips and Table 2 for streams. A possible format for this information could be an XML document. This RP focuses on the necessary information required, and deliberately does not detail a specific schema to convey the information; this affords maximum flexibility in mapping from STANAG 4609 to STANAG 4559.

6.1.2 Concept 2: Generation of the "*generic header information*" from multiple KLV metadata elements and encoding scheme

Each element comprising the *generic header information* can be sourced from a number of different KLV elements in the motion imagery stream. Table 3 describes all the possible mappings, as one-to-many relationships for each element of the *generic header information*. This does not describe how to calculate each field, but provides all possible keys from which the information may be derived. For each element there may be more than one key that is registered in RP 210. For example, a time stamp can be represented by at least five different keys.

6.1.3 Concept 3: Simple Clipping Procedure to write a STANAG 4609 stream to files

This process described is a low-overhead approach for the creation of motion imagery clip files from an MPEG-2 transport stream that contains asynchronous metadata. This process does not currently account for transport streams that contain synchronous metadata.

Stream clipping is based on the following requirements:

Requirement	
RP 0813.1-01	The first MPEG-2 TS packet of a clip shall be a Program Association Table (PAT).
RP 0813.1-02	The second MPEG-2 TS packet of the clip shall be a Program Mapping Table (PMT).
RP 0813.1-03	The PAT and PMT shall be the most recent PAT and PMT in the stream.
RP 0813.1-04	All Packetized Elementary Stream (PES) packets shall be complete. This applies to all types of PES (motion imagery, audio, private, etc.) packets.
RP 0813.1-05	The first PES packet in the clip shall start with a sequence_header followed by an Intra Coded Picture (I-frame).
RP 0813.1-06	When the stream sequence does not conflict with Requirements 01 through 05 inclusive, the clip shall preserve the stream sequence.
RP 0813.1-07	The recorded clip shall have at least 2 Program Clock Reference (PCR) packets.

<u>Example:</u>

A working example is illustrated in Figure 2. The black diamond markers specify the desired clip boundaries. The placement of each MPEG-2 Transport Stream (TS) packet (into clip N, or clip N+1) is based upon the desired clip boundaries, and the aforementioned requirements.

At the beginning of the clip file:

The first packet of clip N is a PAT. The second packet of clip N is a PMT. The PAT and PMT should be the most recent PAT and PMT in the stream. For each PES present in the stream, the first TS packet in the clip has a payload_unit_start_indicator (PUSI=1). In other words, the first TS packet in the clip starts a complete PES packet for its specific elementary stream.

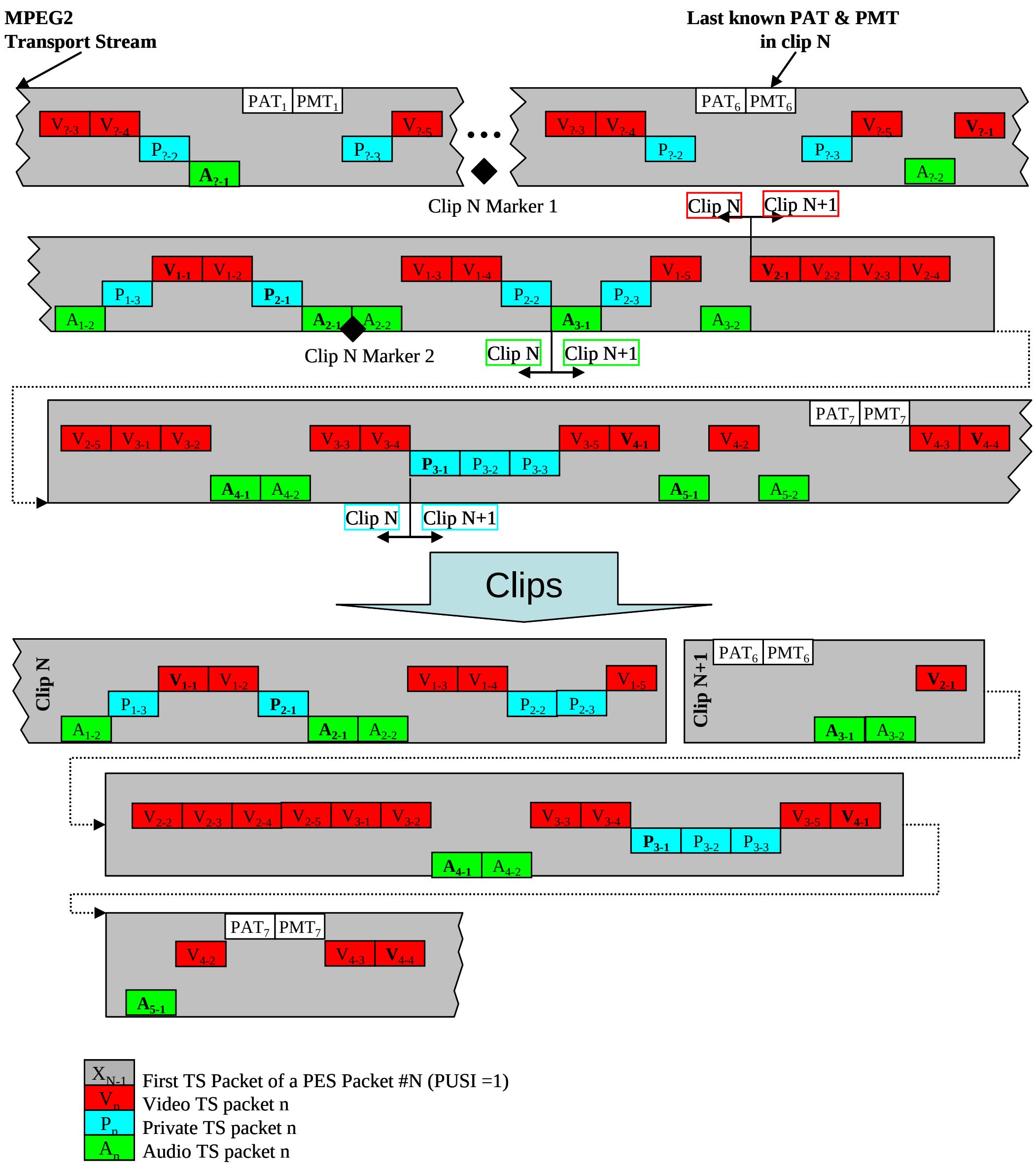


Figure 2: Illustrated example of clip boundary decisions

At the end of the clip file:

The next clip (N+1) begins with a PAT-PMT doublet. Once the marker for the end of clip 1 is reached, the first TS packets sought are the next (downstream) PAT and then the next PMT packet. These PAT and PMT packets are used for clip N+1. Once these PAT and PMT packets are found, the next (downstream) TS packets sought are, for each PES, the next packet with PUSI=1. From that point, the previous TS packets of that PES complete the packet in Clip N. All following TS packets of this elementary stream are part of clip N+1. After the last PES is complete clip N is finished. In continuous clipping all TS packets identified above as part of clip N+1 constitute the start of the next clip file.

<u>Looking downstream and preserving every packet:</u>

The clipping schema presented above is based on looking downstream, and it preserves every TS packet. The clipping procedure could also be performed looking backward (upstream) from the PAT-PMT in the stream; however, this would demand constant, high memory usage. Rejecting incomplete packets would alleviate the memory usage in this case.

The process presented minimizes both the memory usage and the number of I/O operations. It preserves each TS packet of the stream, in order, and ensures only whole PES packets will be present in clip files.

6.2 Process for Clips

Concepts introduced in the previous section are used. Each step is described in detail below.

6.2.1 First Clip

1) Connect to the stream if not already connected
2) Identify the start of the clip with Marker 1
3) Perform the clipping at the beginning of a file in accordance with the aforementioned requirements
4) Obtain the User Time Stamp from the first KLV packet for element 6 of Table 2
5) In parallel:
    a. Obtain *once* necessary data from the KLV as described in Concept 2 of Section 6.1.2 to produce elements 1, 2, 4, 5, 9 and 10 of Table 2, as they become available in the KLV stream;

    b. *Frequently* monitor the stream for the Frame Center Latitude and Longitude; from this information preserve the extreme values for the duration of the clip.

        <u>Note 1:</u> *Frequently* could mean every second. The Bounding Rectangle STANAG 4559 DM Attribute is not meant to be extremely accurate, but rather to generally describe the coverage of the clip and allow searches. With that in mind, a reasonable number for the frequency of monitoring Frame Center Latitude and Longitude should be selected depending on the dynamics of the system.

        <u>Note 2:</u> If possible apply logic to filter out instances where the Frame Center is looking too close to the horizon, and where the reported bounding rectangle would see its usefulness decreased. Possibilities include:

        - For a depression angle corresponding to an Frame Center less than 20 degrees, use for LAT and LON information one of the four corner coordinates that passes the same criteria;
        - If Frame Center *and* all corners are too close to the horizon as per the 20 degree criteria, disregard this instance; and
        - If the Frame Center is located too close to the horizon and corner information is not available or cannot be derived from the KLV, disregard this instance.

If similar logic becomes mandatory in a future version of this RP, Table 2 will have to include possible sources (a one-to-many relationship) of corner information in the KLV metadata.

6) If clipping is to be done at fixed time intervals in a continuous mode, keep track of the time by using the User Time Stamp from the KLV.
7) Once the Marker 2 is reached, indicating the end of the first clip, format the end of clip1 and the beginning of clip 2 in accordance with EG 0803 [7].
8) Produce elements 7 and 8 of Table 2.
9) Using the information gathered during the duration of the clip, generate the *generic header information* - as per Concepts 1 and 2 of Section 6.1.

6.2.2 Subsequent clips in a continuous clipping process

1) The beginning of the file was formatted in the process of the previous packet at step 7 above (in the process of closing the files for the first clip) or step 5 below (for subsequent clips).
2) Obtain the User Time Stamp from the first KLV packet for element 6 of Table 2.
3) In parallel:
   a. Obtain *once* necessary data from the KLV as described in Concept 3 of Section 6.1.3 to produce elements 1, 2, 4, 5, and 8 of Table 2, as they come available in the KLV stream. Ensure these values have not changed from the last clips.
   b. *Frequently* monitor the stream for the Frame Center Latitude and Longitude. From this information preserve the extreme values for the duration of the clip.
4) If clipping is to be done at fixed time intervals in a continuous mode, then keep track of the time in using the User Time Stamp from the KLV.
5) Once the Marker 2 is reached, indicating the end of the first clip, format the end of clip1 and the beginning of clip 2 in accordance with the clipping principles.
6) Produce elements 7 and 8 of Table 2.
7) Generate the *generic header information* as per Concepts 1 and 2 of Section 6.1, as was done for the clip 1.

6.3 Process for Streams

Concepts introduced in the Section 6.1 are used to generate the *generic header information* for a stream. Each step is described in detail below:

1) Connect to the stream if not already connected.
2) Obtain values for elements 1, 2, and 7 through 20, which will all remain constant for the life of the stream.
3) Use the stream for the Frame Center Latitude and Longitude and corners or Field of View parameter to determine a representative Georeference Bounding Box. Use the same logic as for clips from Section 6.2 to filter out instances when the Frame Center is looking too close to the horizon.

4) Produce the *generic header information* as often as required, for example every minute or every five seconds

6.4 Limiting I/O operations and memory usage

The clipping concept presented in this document minimizes the memory usage. If in parallel there is a process for parsing the KLV, for example to display the product to a user, it would save time if this process could be leveraged to find the information required to generate the *generic header information*.

Table 1: Clips – Mapping between suggested *generic header information* and the STANAG 4559 DM attributes

STANAG 4559 DM Entity.Attribute	El #	generic header information (suggested elements)
NSIL_COMMON.source	1	= Sensor Identification
NSIL_COMMON.identifierMission	2	= Mission Identification
NSIL_COVERAGE.spatialCountryCode	3	= Object Country Codes
NSIL_METADATASECURITY.classification	4	= Security Classification
NSIL_METADATASECURITY.releasability	5	= Release Instructions
NSIL_COVERAGE.temporalStart	6	= Clip Start Time (UTC)
NSIL_COVERAGE.temporalEnd	7	= Clip End Time (UTC)
NSIL_COVERAGE.spatialGeographicReferenceBox	8	= Georeferenced_Bounding_Rectangle
NSIL_CARD.publisher	9	= Source Organization
NSIL_FILE.creator	10	= Platform Designation(see context)
NSIL_VIDEO.frameResolution	11	= (1) Motion Imagery Density (pixels)
NSIL_VIDEO.frameRate	12	= (1) Frame Rate
NSIL_VIDEO.encodingScheme	13	= (1)Motion Imagery Encoding
NSIL_VIDEO.averageBitRate	14	= (1) Stream bit rate
NSIL_VIDEO.category	15	= (1) Category of sensor
NSIL_VIDEO.MISMLevel	16	= (1) based on resolution, bandwidth, etc as per STANAG 4609
NSIL_VIDEO.metadataEncodingScheme	17	= Metadata encoding present in the PMT information

Table Footnotes:
(1) Data not present in KLV but retrievable from the motion imagery PES
(2) To know if a STANAG 4559 DM attribute is optional or mandatory refer to the STANAG 4559 documentation

Table 2: Streams – Mapping between suggested *generic header information* and the STANAG 4559 DM attributes

STANAG 4559 DM Entity.Attribute	El #	generic header information (suggested elements)
NSIL_COMMON.source	1	= Sensor Identification

NSIL_COMMON.identifierMission	2	= Mission Identification
NSIL_COVERAGE.spatialCountryCode	3	
NSIL_METADATASECURITY.classification	4	= Security Classification
NSIL_METADATASECURITY.releasability	5	= Release Instructions
NSIL_COVERAGE.spatialGeographicReferenceBox	6	= Georeferenced_Bounding_Rectangle
NSIL_CARD.publisher	7	= Source organization
NSIL_VIDEO.frameResolution	8	= (1) Motion Imagery Density (pixels)
NSIL_VIDEO.frameRate	9	= (1) Frame Rate
NSIL_VIDEO.encodingScheme	10	= (1) Motion imagery encoding
NSIL_VIDEO.averageBitRate	11	= (1) Stream bit rate
NSIL_VIDEO.category	12	= (1) Category of sensor
NSIL_VIDEO.MISMLevel	13	= (1) based on resolution, bandwidth, etc as per STANAG 4609
NSIL_VIDEO.metadataEncodingScheme	14	= Motion imagery encoding present in the PMT information
NSIL_STREAM.sourceURL	15	= (1) Stream Connection Information
NSIL_STREAM.format	16	= STANAG 4609
NSIL_STREAM.creator	17	= Platform designation(see context)
NSIL_STREAM.dateTimeDeclared	18	= User Time Stamp
NSIL_STREAM.formatVersion	19	= Edition of the STANAG 4609
NSIL_STREAM.programID	20	= Program ID (from the PAT)

Table Footnotes:
(1) Data not present in KLV but retrievable from the motion imagery PES
(2) To know if a STANAG 4559 DM attribute is optional or mandatory refer to the STANAG 4559 documentation

Table 3: Possible 4609 compliant KLV element required to produce the *generic header information* (one-to-many)

	generic header information element name	Defining Document(s)	Key
1	Sensor Identification	RP 210 [3]	0x060E2B34010101010104200102010100 00
		RP 210	0x060E2B34010101010904200102010101 00
		ST 0601 [4]	0d11
		RP 0701 [5]	TBD
2	Mission Identification	RP 210	0x060E2B34010101010101050500000000 00
		RP 210	0x060E2B34010101010301050501000000 00
		ST 0601	0d03
		RP 0701	TBD
3	Security Classification	RP 210	0x060E2B34010101010302080201000000 00
		RP 210	0x060E2B34010101010902080201010000 00
		ST 0601	0d48.(0d01)
		RP 0701	TBD
4	Release Instructions	RP 210	0x060E2B34010101010307012001020900 00

			ST 0601	0d48.(0d06)
			RP 0701	TBD
5 & 6	Clip Start time (UTC) (1) & Clip End time (UTC)		RP 210	0x060E2B34010101010702010101010000
			RP 210/ST 309/ST 331	0x060E2B34010101010702010101030000
			RP 210/ST 12-1/ST 331	0x060E2B34010101010702010101040000
			RP 210	0x060E2B34010101030702010101050000
			ST 0601	0d02
			RP 0701	TBD
7	Bounding_Rectangle	Lat	RP 210	0x060E2B34010101010701020103020000
			RP 210	0x060E2B34010101030701020103020200
			RP 210/ST 330	0x060E2B34010101010701020103030000
			ST 0601	0d23
			RP 0701	TBD
		Lon	RP 210	0x060E2B34010101010701020103040000
			RP 210	0x060E2B34010101030701020103040200
			RP 210/ST 330	0x060E2B34010101010701020103050000
			ST 0601	0d24
			RP 0701	TBD
		Lat & Lon	RP 210	0x060E2B34010101010701020103060000
		Image Coord. System	RP 210	0x060E2B34010101010701010100000000
			ST 0601	0d12
			RP 0701	TBD
8	Platform Designation		RP 210	0x060E2B34010101030101210100000000
			RP 210	0x060E2B34010101090101210101000000
			RP 210	0x060E2B34010101010101200100000000(3)
			ST 0601	0d10
			RP 0701	TBD
9	Source Organization		RP 210	0x060E2B34010101010101200100000000(3)
			ST 0601	0d10
			RP 0701	TBD

TABLE FOOTNOTES:

(1) EVENT START DATE AND TIME – UTC AND VIDEO CLIP DURATION ELEMENT OF THE *GENERIC HEADER INFORMATION* REFERS TO THE BEGINNING OF THE CLIP AND THEREFORE USES THE *TIMESTAMP* OF THE FIRST KLV PACKET ENCOUNTERED IN THE CLIP IT DOES USES THE *EVENT START DATE AND TIME – UTC* KEY THAT CAN POSSIBLY BE USED IN THE STREAM.

(2) SHORT VERSION OF SMPTE REFERENCES ARE USED, WHERE 330M CORRESPONDS TO SMTPE 330M. SIMILAR REFERENCES ARE MADE FOR 12M, 309M AND 331M

(3) SOME 4609 IMPLEMENTATIONS MAY USE ‘DEVICE DESIGNATION’ TO IDENTIFY THE PLATFORM. THAT’S A MISUSE SINCE ‘DEVICE’ REFERS TO THE SENSOR.

Table 4: STANAG 4559 DM Description of the attributes

STANAG 4559 DM Attribute	*generic header information* related elements	Description (STANAG 4559 Ed 3)
NSIL_COMMON. source	Image Source Sensor	Refer to **assets** (e.g. platform IDs) from which the tagged data asset is derived Sources may be derived partially or wholly, and it is recommended that an identifier (such as a string or number from a formal identification system) be used as a reference. In case of multiple sources, these shall be separated by a BCS Comma (could happen for container files like AAF, MXF and NSIF). 'Source' is different from 'creator' in that the 'source' entity is the provider of the data content, while the 'creator' is the entity responsible for assembling the data (provided by "sources") into a file. Note: Examples of assets are 'EO Nose', 'EO Zoom (DLTV)', 'EO Spotter', 'IR Mitsubishi PtSi Model 500', 'IR InSb Amber Model TBT', 'LYNX SAR Imagery', ' NADIA DLTV '
NSIL_COMMON. identifierMission	Episode Number	An alphanumeric identifier that identifies the mission (e.g. a reconnaissance mission) under which the product was collected/generated. As an example, for products collected by sensors on an aircraft, the mission identifier should be the 'Mission Number' from the Air Tasking Order (ATO).
NSIL_SECURITY. classification	Security Classification	NATO Security markings that determine the physical security given to the information in storage and transmission, its circulation, destruction and the personnel security clearance required for access as required by [C-M(2002)49]
NSIL_SECURITY. releasability	Release Instructions	An additional marking to further limit the dissemination of classified information in accordance with [C-M (2002)49]. Values include one or more three character country codes as found in STANAG 1059 edition 9 separated by a single BCS Comma (code 0x2C). Default value should be NATO. Note: Although STANAG 1059v9 includes the 'XXN' entry for NATO, the full 'NATO' name shall be used to indicate NATO releasability to avoid any confusion from established and common used terms.
NSIL_COVERAGE. temporalStart	Event Start Date and Time - UTC	Start time of a period of time for the content of the dataset (start time of content acquisition). For products capturing a single instant in time, start time and end time will be equal ((or the end time could be omitted).
NSIL_COVERAGE. temporalEnd	temporalStart + Video Clip Duration	End time of a period of time for the content of the dataset (end time of content acquisition). For products capturing a single instant in time, start time and end time will be equal (or the end time could be omitted).

STANAG 4559 DM Attribute	*generic header information* related elements	Description (STANAG 4559 Ed 3)
NSIL_COVERAGE. spatialGeographicReferenceBox	Bounding_Rectangle	Geographic location of the dataset. Always in WGS-84 reference system, and using decimal degrees. The first coordinate represents the most North-Western corner, the second the most South-Eastern corner. The x-value in a UCOS:Coordinate2D struct represents the longitude, the y-value represents the latitude.
NSIL_CARD. publisher	Source Organization	The name of the **organization** responsible for making the resource (product) available in an IPL. By doing so, the publisher enables the discovery of that resource by a requestor entity (client). Examples of organizations are 'CJTF', 'LCC', 'ACC' etc.
NSIL_FILE. creator	Platform Designation	An entity primarily responsible for making the content of the resource. The creator is responsible for the intellectual or creative content of the resource. With raw sensor products, a creator is the **unit** that runs the sensor. With exploited products it is the **exploitation station**, with an Information Request (IR) or an IR Management system/service. Note: Examples of the unit running the sensor or exploitation station: 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc. ‘CF Sperwer TUAV’, ‘USArmy One System’, ‘ISUAV GCS’ etc.