HISTOA – History Support Data Extension

1.1 Introduction

The purpose of the Softcopy History Tagged Record Extension, HISTOA, is to provide a history of the softcopy processing functions that have been applied to NSIF imagery. It is meant to describe previous processing actions and the current state of the imagery that was distributed within the intelligence and imagery user community. To be effective, HISTOA needs to be applied to the NSIF product as early as practical and must be updated each time the image is processed and saved by a softcopy processing system. This will allow the user to know with confidence the complete history of the imagery. HISTOA may be created as the NSIF image is created, or when the imagery is first modified.

1.2 Background and Motivation

With the development of standard processing flows for national imagery, and incorporation of preprocessing to convert some baseline imagery formats into "Display-Ready" imagery, it became necessary to differentiate between the Display-Ready products and the baseline formats. Also, imagery users expressed frustration with the fact that softcopy-processing functions were being applied repeatedly to imagery, without their knowledge. This repetition of processing steps on a single image resulted in a degraded and sometimes unusable image. The users desired a method of recording the types and frequency of Softcopy processing steps applied to each image.

Based on these concerns, a BHIST Tagged Record Extension was originally developed for some national systems and approved by the US NTB in 1997. The purpose of the BHIST tag was to indicate the Display-Ready status of the image, to identify any pixel remapping, and to provide a mechanism for tracking softcopy processing functions (e.g. Dynamic Range Adjustment, Sharpening, and Tonal Transfer Curve) applied to the image. (Refer to Appendix A for a complete description of these functions.) BHIST was later expanded to include imagery produced by other national systems, plus airborne and commercial imagery, and became HISTOA.

1.3 Softcopy History Tag Structure

The structure of HISTOA is based on reporting "processing events." Each processing event consists of a series of fields that indicate the type of processing that has been applied to the image at that moment in time. In order to determine what processing has been applied to the image over time, the entire set of processing events must be read. Relevant information includes tonal processing, compression, image resolution, rectification, and magnification. A comment field is also provided in each processing event to allow users to capture relevant information not accounted for in the pre-defined fields. The structure allows for up to 99 separate processing events to be recorded. The basic structure of the tag is shown in Table 1.

The first eight fields within the tag are required to be filled when the tag is created, but are not repeated for each processing event. Therefore, when HISTOA is generated, it is structured as shown in Table 1 and the first eight fields are filled. The population of all the fields in HISTOA shall be left justified with blanks included where necessary (a blank space is denoted by BCS 0x20). Leading zeros may also be necessary in some of the numeric fields. A description of the first eight fields in the tag is given in Table 2.

To be effective, HISTOA must be updated each time a new NSIF product (file) is formulated after the image is processed by a softcopy processing system.

Table 1. HISTOA SUBHEADER FIELDS
R = Required, C = Conditional

FIELD	NAME	SIZE	RANGE	TYPE
CETAG	Unique Extension ID	6	HISTOA	R
CEL	Length of Extension Tag	5	00115 to 83512	R
SYSTYPE	System Type	20	alphanumeric	R
PC	Prior Compression	12	alphanumeric	R
PE	Prior Enhancements	4	alphanumeric	R
REMAP_FLAG	System Specific Remap	1	0 to 9; BCS 0x20	R
LUTID	Data Mapping ID from the ESD	2	00 to 64	R
NEVENTS	Number of Processing Events	2	01 to 99	R
EVENT01	First Processing Event	variable	alphanumeric	R
...	...	...	...	...
EVENTnn	Most Recent Processing Event	variable	alphanumeric	C

Table 2. HISTOA Subheader Field Descriptions

FIELD	VALUE DEFINITIONS AND CONSTRAINTS
CETAG	This field shall contain the unique extension name or ID for the Softcopy History Tag. Since this is version A of the history tag, this field will be filled with HISTOA.
CEL	This field shall contain the total length of the tag data (all of which follows this field), including all existing process events.

Table 2. HISTOA Subheader Field Descriptions	
FIELD	VALUE DEFINITIONS AND CONSTRAINTS
SYSTYPE	This field shall contain the name of the sensor from which the original image was collected. For national imagery, the valid field codes are SystemA, SystemB, SystemC, and SystemD. These codes shall not be used to indicate any other airborne or commercial systems and are reserved solely for the National systems. The codes in the SYSTYPE field shall be left justified and the remainder of the field filled with blanks to 20 characters. The NTB has requested that this tag be able to handle other types of airborne and commercial imagery currently supported by NITF. Additional valid field codes are listed below: ASARS-2 ASARS System GHR Global Hawk Radar SYERS-EO SYERS Electro-Optical System SYERS-MSI SYERS Multispectral System SYERS-IR SYERS Infrared System DSR Dark Star Radar TSAR TESAR TBD Other

Table 2. HISTOA Subheader Field Descriptions	
FIELD	VALUE DEFINITIONS AND CONSTRAINTS
PC	This field shall contain an alphanumeric string that indicates if bandwidth compression/expansion was applied to the image prior to NITF image creation. This field should be used in conjunction with the PE field to determine the state of the image prior to NITF formation. The valid field codes for the PC field is 4 byte character strings. The first two characters indicate the type of compression such as DCT or DPCM. The next two characters indicate either the bit rate or the quality level. The types of compression are indicated by the following codes: Value — Definition DP43 — DPCM (Differential Pulse Coded Modulation) – 4.3 bpp DC13 — DCT (Discrete Cosine Transform –1.3 bpp DC23 — DCT (Discrete Cosine Transform) – 2.3 bpp NJNL — NSIF JPEG – Lossless NJQ0 — NSIF JPEG – Quality Level 0 NJQ1 — NSIF JPEG – Quality Level 1 NJQ2 — NSIF JPEG – Quality Level 2 C11D — NSIF Bi-level – 1D C12S — NSIF Bi-level – 2DS C12H — NSIF Bi-level – 2DH M11D — NSIF Bi-level – 1D M12S — NSIF Bi-level with masked blocks – 2DS M12H — NSIF Bi-level with masked blocks – 2DH C207 — NITF ARIDPCM – 0.75 bpp C214 — NITF ARIDPCM – 1.40 bpp C223 — NITF ARIDPCM – 2.30 bpp C245 — NITF ARIDPCM – 4.50 bpp C3Q0 — NSIF Lossy JPEG – Q0 Custom Tables C3Q1 — NSIF Lossy JPEG – Q1 Default Tables C3Q2 — NSIF Lossy JPEG – Q2 Default Tables C3Q3 — NSIF Lossy JPEG – Q2 Default Tables C3Q4 — NSIF Lossy JPEG – Q4 Default Tables C3Q5 — NSIF Lossy JPEG – Q5 Default Tables M3Q0 — NSIF Lossy JPEG with masked blocks – Q0 Custom M3Q1 — NSIF Lossy JPEG with masked blocks – Q1 Default M3Q2 — NSIF Lossy JPEG with masked blocks – Q2 Default M3Q3 — NSIF Lossy JPEG with masked blocks – Q3 Default M3Q4 — NSIF Lossy JPEG with masked blocks – Q4 Default M3Q5 — NSIF Lossy JPEG with masked blocks – Q5 Default C4LO — NSIF Vector Quantization – Lossy M4LO — NSIF Vector Quantization with masked blocks C5NL — NSIF Lossless JPEG M5NL — NSIF Lossless JPEG with masked blocks NC00 — NSIF uncompressed NM00 — NSIF with masked blocks uncompressed

Table 2. HISTOA Subheader Field Descriptions	
FIELD	VALUE DEFINITIONS AND CONSTRAINTS
PC (continued)	I1Q1 NSIF Downsample JPEG – Q1 I1Q2 NSIF Downsample JPEG – Q2 I1Q3 NSIF Downsample JPEG – Q3 I1Q4 NSIF Downsample JPEG – Q4 I1Q5 NSIF Downsample JPEG – Q5 WVLO Wavelet Lossy WVNL Wavelet Lossless JP20 JPEG 2000 NONE No Compression UNKC Unknown Compression The entire PC field is 12 bytes long to allow for the concatenation of up to 3 compression algorithms. Consecutive 4 byte character strings shall indicate the application of two or three compression algorithms in succession. If only one compression algorithm is applied then the last eight characters are zero. If the NSIF creator does not know where the image came from or what processing has been applied to it, then the code for unknown compression (UNKC) shall be used. Examples of valid codes for the PC field are shown below. The DP43DC130000 code indicates that a concatenation of the 4.3 DPCM and the 1.3 DCT compression and expansion was applied to the image prior to its NSIF formation. The NONE00000000 code indicates that no compression was applied to the image prior to its NSIF formation.
PE	This field shall contain an alphanumeric string that indicates if any enhancements were applied to the image prior to NSIF image creation. This field should be used in conjunction with the PC field to determine the state of the image prior to NSIF formation. The valid field codes for the PC field are given below EH08 Enhanced 8 bpp from IDEX EH11 Enhanced 11 bpp from IDEX UE08 8 bpp data with DRA but no enhancements from IDEX EU11 Unenhanced 22 bpp from IDEX DGHC Digitized Hardcopy UNKP Unknown Processing NONE No prior processing The first four codes explicitly define the types of ODS (Output Data Server) products that are available for NSIF formation. Additional codes may be added for airborne systems. If the NSIF creator does not know where the image came from or what processing has been applied to it, then the code for unknown processing (UNKP) shall be used.
REMAP_FLAG	This field shall indicate whether or not a system specific remap has been applied to the image. The valid field codes are 0 – 9, and a blank (BCS 0x20), but 2 – 9 are reserved for future use. A value of 0 means that no systems specific remap has been applied. A value of 1 means that the System C specific 16 – 12 bit remap has been applied to the System C image. If the image is not a System C image, this field does not apply at this time and should be filled with a blank. Values from 2 – 9 are reserved for future use and shall not be used at this time.

Table 2. HISTOA Subheader Field Descriptions	
FIELD	VALUE DEFINITIONS AND CONSTRAINTS
LUTID	This field shall contain the DMID (Data Mapping ID) for Systems B and D imagery. The DMID is contained in IMDAT records 97 and 98 in the ESD (Exploitation Support Data). This information is also referenced in IF200EAA. The valid field codes are 07, 08, and 12 – 64. A value of 07 and 08 indicates that the image is PEDF (Piecewise Extended Density Format). A value between 12 and 64 indicates that the image is a Linlog formatted image. Numbers between 01 and 06, 09, 10, and 11 are reserved and should not be used at this time. There are no valid DMID values greater than 64. NSIF users to help determine what type of processing should be applied to the image can use this field. For all other systems, this field should be filled with 00.
NEVENTS	This field shall contain the number of *processing events* associated with the image. The tag is designed to record up to 99 separate processing events. The valid field codes are 01 to 99. The processing events are listed in chronological order, starting with the first event and ending with the most recent processing event. At a minimum, the *first processing event* shall be the processing immediately following the generation of the NSIF formatted image; however, if practical, the originator of the NSIF image can create the HISTOA TRE earlier - with the creation of the NSIF formatted image. In that instance, the *first processing event* would be the creation of the NSIF formatted image. Each successive processing event is to record what transformations have been applied to the image, once the image has been processed and saved.

1.3.1 Definition of the Processing Events

In addition to populating the first eight fields, the one initiating the *first processing event* will populate the first eight fields and additional applicable fields as necessary, designating NEVENT as “01”. In terms of implementation, a processing event is similar to a record. The NEVENTS field is a repetition factor that determines how many records or processing events must be read. A processing event has been defined as one or more of the specific processing functions shown in Table 3 that may be applied to the NSIF formatted image. In order to determine what processing has been applied to the image over time, the entire set of processing events must be read. These functions include compression and expansion, rotation, sharpening, magnification, and are normally applied to the imagery by commercial or government softcopy packages. A description of the Processing Event Fields is given in Table 4.

Table 3. Processing Event Fields
R = Required, C = Conditional

FIELD	NAME	SIZE	RANGE	TYPE
PDATE	Processing Date and Time	14	CCYYMMDDHHmmSS	R
PSITE	Processing Site	10	alphanumeric	R
PAS	Softcopy Processing Application	10	alphanumeric	R
NIPCOM	Number of Image Processing Comments	1	0 to 9	R
IPCOM1	Image Processing Comment 1	80	alphanumeric	C
IPCOMn	Image Processing Comment n	80	alphanumeric	C
IBPP	Input Bit Depth (actual)	2	01 to 64	R
IPVTYPE	Input Pixel Value Type	3	alphanumeric	R

Table 3. Processing Event Fields
R = Required, C = Conditional

FIELD	NAME	**SIZE**	RANGE	**TYPE**
INBWC	Input Bandwidth Compression	10	alphanumeric	R
DISP_FLAG	Display-Ready Flag	1	0 to 9, BCS 0x20	R
ROT_FLAG	Image Rotation	1	0, 1	R
ROT_ANGLE	Angle of Rotation	8	000.0000 to 359.9999	C
PROJ_FLAG	Image Projection	1	0, 1	R
ASYM_FLAG	Asymmetric Correction	1	0, 1, BCS 0x20	R
ZOOMROW	Mag in Line (row) Direction	7	00.0000 to 99.9999	C
ZOOMCOL	Mag in Element (column) Direction	7	00.0000 to 99.9999	C
SHARP_FLAG	Sharpening	1	0,1	R
SHARPFAM	Sharpening Family Number	2	-1, 00 to 99	C
SHARPMEM	Sharpening Member Number	2	-1, 00 to 99	C
MAG_FLAG	Symmetrical Magnification	1	0, 1	R
MAG_LEVEL	Level of Relative Magnification	7	00.0000 to 99.9999	C
DRA_FLAG	Dynamic Range Adjustment (DRA)	1	0, 1, 2	R
DRA_MULT	DRA Multiplier	7	000.000 to 999.999	C
DRA_SUB	DRA Subtractor	5	-9999 to +9999	C
TTC_FLAG	Tonal Transfer Curve (TTC)	1	0,1	R
TTCFAM	TTC Family Number	2	-1, 00 to 99	C
TTCMEM	TTC Member Number	2	-1, 00 to 99	C
DEVLUT_FLAG	Device LUT	1	0, 1	R
OBPP	Output Bit Depth (actual)	2	01 to 64	R
OPVTYPE	Output Pixel Value Type	3	alphanumeric	R
OUTBWC	Output Bandwidth Compression	10	alphanumeric	R

Table 4. Processing Event Field Descriptions

FIELD	**VALUE DEFINITIONS AND CONSTRAINTS**
PDATE	This field shall contain the date and time (UTC) on which the processing event occurred. The valid form of the field is CCYYMMDDhhmmss, where CC is the first two digits of the year (00 to 99), YY is the last two digits of the year (00 to 99), MM is the month (01 to 12), DD is the day of the month (01 to 31), hh is the hour (00 to 23), mm is the minute (00 to 59), and ss is the second (00 to 59). UTC (Zulu) is assumed to be the time zone designator to express the time of day. This field can be used in conjunction with the FDT field in the NSIF file header to determine if the History Tag has been updated each time the image was processed and saved. If the PDATE field and the FDT field are identical, the History Tag has been properly updated. If the fields are not identical, then the History Tag has not been properly updated and the data may not be accurate or timely.
PSITE	This field shall contain the name of the site or segment that performed the processing event. This 10 character alphanumeric field is free form text. Examples of PSITE entries are FOS, JWAC, or CENTCOM.
PAS	This field shall contain the processing application software used to perform the processing steps cited in the event (e.g. IDEX, VITEC, or DIEPS). The version number of the application would also be helpful to include in this field.

Table 4. Processing Event Field Descriptions

FIELD	**VALUE DEFINITIONS AND CONSTRAINTS**
NIPCOM	This field shall contain the valid number of image processing comments for this processing event. The valid field codes are 0 to 9.
IPCOM1	This field shall contain the first line of comment text. The fields IPCOM1 to IPCOMn, if present shall contain free form alphanumeric text. They are intended for use as a single comment block and shall be used that way. This field shall be omitted if the value in NIPCOM field is zero. The comment field shall be used to clarify or indicate special processing not accounted for in the Processing Event Fields. Reasons for populating this field would be to indicate alternate processing for multi-spectral imagery, to indicate the order of S/C processing steps contained within a single processing event, or to inform downstream users of potential problems with the image.
IPCOMn	This field shall contain the n^{th} line of comment text, based on the value of the NIPCOM field. See description above for IPCOM1 for usage. This field shall be omitted if the value in NIPCOM field is zero.
IBPP	This field shall contain the number of significant bits for each pixel before the processing functions denoted in the processing event have been performed and before compression. This type of pixel depth description is consistent with the ABPP field within the NSIF image subheader. For example, if an 11-bpp word is stored in 16 bits, this field would contain 11 and the NBPP field in the NSIF image subheader would contain 16. The valid IBPP field codes are 01 to 64, indicating 1 to 64 bpp.
IPVTYPE	This field shall contain an indicator of the type of computer representation used for the value of each pixel before the processing functions denoted in the processing events have been performed and before compression. Valid entries are INT for integer, SI for 2's complement signed integer, R for real, and C for complex. The databits of INT and SI values shall appear in the file in order of significance, beginning with the most significant bit (MSB) and ending with the least significant bit (LSB). INT and SI data types shall be limited to 16 bits. R values shall be represented according to IEEE 32-bit floating-point representation (IEEE754). C values shall be represented with the Real and Imaginary parts each represented in IEEE 32-bit floating point representation (IEEE754) and appearing adjacent four-byte blocks, first Real, then Imaginary. B (bi-level) pixel values shall be represented as single bits with value 1 or 0.

Table 4. Processing Event Field Descriptions

FIELD	VALUE DEFINITIONS AND CONSTRAINTS
INBWC	This field shall indicate the type of bandwidth compression or expansion that has been applied to the image prior to any enhancements denoted in the processing event. The valid field codes to describe each type of compression are 5 byte character strings. The first two characters indicate the type of compression such as DCT or DPCM. The next two characters indicate either the bit rate or the quality level. The last character indicates if the process is compression or an expansion. Compression is denoted by a C, an E denotes expansion, and 0 indicates that neither process occurred. The types of compression are indicated by the following codes: Value Definition DP43 DPCM (Differential Pulse Coded Modulation) – 4.3 bpp DC13 DCT (Discrete Cosine Transform – 2.3 bpp DC23 DCT (Discrete Cosine Transform) – 2.3 bpp NJNL NSIF JPEG – Lossless NJQ0 NSIF JPEG – Quality Level 0 NJQ1 NSIF JPEG – Quality Level 1 NJQ2 NSIF JPEG – Quality Level 2 C11D NSIF Bi-level – 1D C12S NSIF Bi-level – 2DS C12H NSIF Bi-level – 2DH M11D NSIF Bi-level – 1D M12S NSIF Bi-level with masked blocks – 2DS M12H NSIF Bi-level with masked blocks – 2DH C207 NITF ARIDPCM – 0.75 bpp C214 NITF ARIDPCM – 1.40 bpp C223 NITF ARIDPCM – 2.30 bpp C245 NITF ARIDPCM – 4.50 bpp

Table 4. Processing Event Field Descriptions

FIELD	VALUE DEFINITIONS AND CONSTRAINTS	
INBWC (cont.)	C3Q0	NSIF Lossy JPEG – Q0 Custom Tables
	C3Q1	NSIF Lossy JPEG – Q1 Default Tables
	C3Q2	NSIF Lossy JPEG – Q2 Default Tables
	C3Q3	NSIF Lossy JPEG – Q2 Default Tables
	C3Q4	NSIF Lossy JPEG – Q4 Default Tables
	C3Q5	NSIF Lossy JPEG – Q5 Default Tables
	M3Q0	NSIF Lossy JPEG with masked blocks – Q0 Custom
	M3Q1	NSIF Lossy JPEG with masked blocks – Q1 Default
	M3Q2	NSIF Lossy JPEG with masked blocks – Q2 Default
	M3Q3	NSIF Lossy JPEG with masked blocks – Q3 Default
	M3Q4	NSIF Lossy JPEG with masked blocks – Q4 Default
	M3Q5	NSIF Lossy JPEG with masked blocks – Q5 Default
	C4LO	NSIF Vector Quantization – Lossy
	M4LO	NSIF Vector Quantization with masked blocks
	C5NL	NSIF Lossless JPEG
	M5NL	NSIF Lossless JPEG with masked blocks
	NC00	NSIF uncompressed
	NM00	NSIF with masked blocks uncompressed
	I1Q1	NSIF Downsample JPEG – Q1
	I1Q2	NSIF Downsample JPEG – Q2
	I1Q3	NSIF Downsample JPEG – Q3
	I1Q4	NSIF Downsample JPEG – Q4
	I1Q5	NSIF Downsample JPEG – Q5
	WVLO	Wavelet Lossy
	WVNL	Wavelet Lossless
	JP20	JPEG 2000
	NONE	No Compression
INBWC (continued)	UNKC	Unknown Compression
	OTLO	Unknown lossy compression – requires mandatory IPCOM entry to explain technique or source
	OTNL	Unknown lossless compression – requires mandatory IPCOM entry to explain technique or source
	The entire BWC field is 10 bytes long to allow for the concatenation of up to 2 compression algorithms. Two consecutive 5 byte character strings shall indicate the application of two compression algorithms in succession. If only one operation is performed, then the remaining 5 characters are zero. Examples of valid codes for the BWC field are shown below.	
	The DP43E00000 code indicates that a 4.3 DPCM compressed input image was expanded prior to NSIF formation.	
	The DC13E00000 code indicates that 1.3 DCT compressed input image was expanded prior to NSIF formation.	
	The NONE000000 code indicates that the input image to the NSIF formation process was uncompressed.	

Table 4. Processing Event Field Descriptions

FIELD	**VALUE DEFINITIONS AND CONSTRAINTS**
DISP_FLAG	This field shall indicate if the image is “Display-Ready.” The DISP_FLAG field applies only to System B, System D, and certain other systems. Display-Ready data has had a system-specific transformation applied to it that is described in appendix A. The valid field codes are 0 to 9 and a blank (BCS 0x20). A value of 0 means that image is not Display-Ready and must be converted to a displayable format, using the pre-defined mappings for Linlog or PEDF formats. A value of 1 means that the image is Display-Ready and needs only basic tonal processing and device compensation for corrects display. Since this field applies to Systems B and D imagery currently, the field shall be filled with a blank (BCS 0x20) for all other system types. Values 2 to 9 are reserved for future use and shall not be used at this time. A more detailed explanation of the Display-Ready transformations is provided in appendix A.
ROT_FLAG	This field shall indicate if the image has been rotated. The valid field codes are 0 and 1. A value or 0 means that the image has not been rotated. A value of 1 means that the image has been rotated. If this field is equal to 1, then the ROT_ANGLE field must be filled with the angle of rotation.
ROT_ANGLE	This field shall contain the angel in degrees that the image has been rotated, where a positive angle denotes clockwise rotation. The valid field codes are 000.0000 to 359.9999. This field is conditional on the ROT_FLAG field being equal to 1. If the rotation has included an interpolation, then the interpolation method shall be described in the comment sections.
ASYM_FLAG	This field shall indicate if asymmetric correction has been applied to the image. This processing step is only allowed for certain types of EO processing. The valid field codes are 0 and 1, and a blank (BCS 0x20). A value of 0 means that asymmetric correction has not been applied to the image. A value of 1 means that asymmetric correction has been applied to the image. Since this field applies only to certain types of EO imagery, this field shall be filled with a blank (BCS 0x20) for all other system types. If this field is equal to 1, the ZOOMROW and ZOOMCOL fields must be filled with the magnification levels in the row (line) and column (element) directions, respectively.
ZOOMROW	This field shall contain the level of magnification that was applied to the image in the line or row direction, if asymmetric correction was applied. The valid field codes are 00.0000 to 99.9999. The level of magnification is relative to the input image at this processing step. This field is conditional on the ASYM_FLAG field.
ZOOMCOL	This field shall contain the level of magnification that was applied to the image in the element or column direction, if asymmetric correction was applied. The valid field codes are 00.0000 to 99.9999. The level of magnification is relative to the input image at this processing step. This field is conditional on the ASYM_FLAG field.
PROJ_FLAG	This field shall indicate if the image has been projected from the collection geometry into geometry more suitable for display. The valid field codes are 0 and 1. A value of 0 means that no geometric transformation has been applied to the image, meaning it is probably stilled in the collection geometry. A value of 1 means that the image has been projected into another geometry. If this field is equal to 1, then a description of the projection or rectification shall be given in the comment section.
SHARP_FLAG	This field shall indicate if the image has been passed through a sharpening operation. The valid field codes are 0 and 1. A value of 0 means that no sharpening has been applied to the image. A value of 1 means that sharpening has been applied to the image. If this field is equal to 1, then the SHARPFAM and SHARPMEN fields must be filled with the appropriate numbers. Refer to paragraph 15.5 for a more complete description of the sharpening kernel database.

Table 4. Processing Event Field Descriptions

FIELD	VALUE DEFINITIONS AND CONSTRAINTS
SHARPFAM	This field shall contain the number of the sharpening family, if a sharpening operation was applied to the image. The valid field codes are –1, 00 to 99. This field is conditional on the SHARP_FLAG field. Although the IDEX sharpening family numbers are one-based, many commercial softcopy systems use a zero-based system for their databases. For example, IDEX family 5 would be family 4 for many other softcopy systems. If the sharpening kernel is not a part of the existing group of families and members, a value of – shall be placed in this field and the nature of the sharpening kernel specified in the comment section. Refer to paragraph 15-5 for a more complete description of the sharpening kernel database.
SHARPMEM	This field shall contain the number of the sharpening member, if a sharpening operation was applied to the image. The valid field codes are –1, 00 to 99. This field is conditional on the SHARP_FLAG field. If the sharpening kernel is not a part of the existing group of families and members, a value of –1 shall be placed in this field and the nature of the sharpening kernel shall be specified in the comment section. Refer to 15.5 for a more complete description of the sharpening database.
MAG_FLAG	This field shall indicate if the image has been symmetrically (same amount in each direction) magnified during this processing step. The valid field codes are 0 and 1. A value of 0 means that the image was not magnified. A value of 1 means that the image has been magnified. If this field is equal to 1, then the MAG_LEVEL field shall be filled with the level of magnification.
MAG_LEVEL	This field shall contain the level of symmetrical magnification that has been applied to the image relative to the input image at this processing step. For example, a value of 02.0000 would indicate a 2X magnification relative to the input image. The valid field codes are 00.0000 to 99.9999. This field is conditional on the MAG_FLAG field. A value greater than 1 shall indicate that the image was magnified to a size larger than its previous size and a value less than 1 shall indicate the image size was decreased. The method of magnification shall be described in the comment section.
DRA_FLAG	This field shall indicate if a dynamic Range Adjustment (DRA) has been applied to the image. DRA is an affine transformation of the image pixel values of the form Y = DRA_MULT*(X – DRA_SUB), where X is the input pixel value, DRA_SUB is the DRA subtractor, DRA_MULT is the DRA multiplier, and Y is the output pixel value. The DRA is said to be spatially invariant when the DRA subtractor and DRA multiplier do not depend on pixel position. If the DRA subtractor and DRA multiplier do depend on pixel position, the DRA is said to be spatially variant. The valid field codes are 0, 1, and 2. A value of 0 means that a DRA has not been applied to the image. A value of 1 means that a spatially invariant DRA has been applied to the image. In this case, the DRA_SUB and DRA_MULT fields shall be filled with the appropriate codes. A value of 2 means that a spatially variant DRA has been applied to the image. In cases where DRA_FLAG equals 0 or 2, the DRA_SUB and DRA_MULT fields shall not be filled.
DRA_MULT	This field shall contain the multiplier value of the DRA. The valid field codes are 000.000 to 999.999. This field is conditional on the DRA_FLAG field being equal to 1.
DRA_SUB	This field shall contain the subtractor value of the DRA. The valid field codes are 000.000 to 999.999. This field is conditional on the DRA_FLAG field being equal to 1.
TTC_FLAG	This field shall indicate if a TTC (Tonal Transfer Curve) has been applied to the image. The valid field codes are 0 and 1. A value of 0 means that a TTC has not been applied to the image. A value of 1 means that a TTC has been applied to the image. If a TTC has been applied, then the TTCFAM and TTCNUM fields shall be filled with the appropriate codes. Refer to paragraph 15-5 for more complete description of the TTC database.

Table 4. Processing Event Field Descriptions

FIELD	**VALUE DEFINITIONS AND CONSTRAINTS**
TTCFAM	This field shall contain the number of the TTC family, if a TTC was applied to the image. The valid field codes are –1, 00 to 99. This field is conditional on the TTC_FLAG field. Although the IDEXZ TTC family numbers are one-based, many commercial softcopy systems use a zero-based system for their databases. For example, IDEX family 5 would be family 4 for many other softcopy systems. If the TTC is not a part of the existing group of families and members, a value of –1 shall be placed in this field and the nature of the TTC shall be specified in the comment section. Refer to paragraph 15-5 for a more complete description of the TTC database.
TTCMEM	This field shall contain the number of the TTC member, if a TTC was applied to the image. The valid field codes are 00 to 99. This field is conditional on the TTC_FLAG field. If the TTC is not a part of the existing group of families and members, a value of –1 shall be placed in this field and the nature of the TTC shall be specified in the comment section. Refer to paragraph 15-5 for a more complete description of the TTC database.
DEVLUT_ FLAG	This field shall indicate if device compensation LUT has been applied to the image. The valid field codes are 0 and 1. A value of 0 means that a device LUT has not been applied to the image. A value of 1 means that t device LUT has been applied to the image. The nature of the LUT may be specified in the comment section and should include the device for which the LUT is applied. If the device is not known, an appropriate method for describing the LUT shall be given.
OBPP	This field shall contain the number of significant bits for each pixel after the processing functions denoted in the processing event have been performed, but prior to any output compression. For example, if an 8 bpp System B image is mapped into Display-Ready space using the proper 8 to 11 bpp transformation (see appendix A), the IBPP field shall contain the actual number of data pixels, not the word length. For example, if an 11-bpp word were stored in 16 bits, this field would contain 11. The valid OBPP field codes are 01 to 64, indicating 1 to 64 bpp. In many cases, this field will match the IBPP field.
OPVTYPE	This field shall contain an indicator of the type of computer representation used for the value of each pixel after the processing functions denoted in the processing event have been performed, but prior to any output compression. Valid entries are INT for integer, B for bi-level, SI for 2’s complement signed integer, R for real, and C for complex. The data bits of INT and SI values shall appear in the file in order of significance, beginning with the MSB and ending with the LSB. INT and SI data types shall be limited to 16 bits. R values shall be represented according to IEEE 32-bit floating-point representation (IEEE754). C values shall be represented with the Real and Imaginary parts each 32-bit floating point representation (IEEE754) and appearing adjacent four-byte blocks, first Real, then Imaginary. B (bi-level) pixel values shall be represented as single bits with value 1 or 0.

Table 4. Processing Event Field Descriptions

FIELD	**VALUE DEFINITIONS AND CONSTRAINTS**
OUTBWC	This field shall indicate the type of bandwidth compression or expansion that has been applied to the image after any enhancements denoted in the processing event. The valid field codes to describe each type of compression are 5 byte character strings. The first two characters indicate the type of compression such as DCT or DPCM. The next two characters indicate either the bit rate or the quality level. The last character indicates if the process is compression or an expansion. Compression is denoted by a C, an E denotes expansion, and 0 indicates that neither process occurred. The types of compression are indicated by the same codes used in the INBWC field and can be found in the field description for INBWC. The entire BWC field is 10 bytes long to allow for the concatenation of up to 2 compression algorithms. Two consecutive 5 byte character strings shall indicate the application of two compression algorithms in succession. If only one operation is performed, then the remaining 5 characters are zero. Examples of valid codes for the BWC field are shown below. The NJQ1C00000 code indicates that the processed image was saved as a NSIF JPEG lossless compressed image. The NJNLC00000 indicates that the processed image was saved as a NSIF JPEG lossless compressed image. The C3Q3C00000 code indicates that the processed image was saved as a NSIF JPEG compressed image at quality level 3.

1.3.2 Use of the Comments Field

The comment field within HISTOAis consistent with the current NSIF image subheader. The NIPCOM field indicates how many lines of comments are utilized in each processing event. Each line of comments is 80 bytes and the maximum number of lines is 9. These lines of comments within the tag are provided in each processing event to allow users to capture relevant information not accounted for in the pre-defined fields. The types of information that might be included are an unknown input data format, a compression algorithm not accounted for in the BWC field, or details on the interpolation algorithm used for image rotation. If warping or magnification is performed on the image, the details of these functions could be described in the comment section. HISTOA assumes that the ELT package is using the IDEX-based sharpening kernels and TTCs. If an ELT package is using another type of sharpening kernel or tonal adjustment, the comment field could be used to describe these functions.

Another use for the comments field would be to describe processing functions on imagery that have not yet been standardized or well-defined. One such example is multi-spectral image products. Softcopy processing of MSI products is still in the experimental stages and a standard processing flow has not been defined. If the Softcopy History Tag is used with an MSI product, the comment section could be used to describe new processing techniques developed for this imagery.