

Appendix D - BANDSB Support Data Extension Version 8 (Sept 2003)

Background: During an investigation of various MS data formats and the NITF 2.1 format, investigators nominated a list of orphaned band specific parameters. The NITF 2.1 file format had no defined fields/extensions to store this band level data. Included in this investigation were the following MS formats; AVIRIS, PCI(PIX), and AISA. Beneficial comments that can be used to improve this SDE should be addressed to at the Joint Interoperability Test Command, Bldg. 57305, Attn: NITF Certification Test Facility. Ft. Huachuca, AZ 85613; electronic mail: jitcn@fhu.disa.mil; voice (520) 538-5458.

Purpose: The BANDSB extension is designed to supplement information in the NITF image subheader where additional parametric data are required. This data extension is placed in each image subheader as required. Multiple BANDSB extensions may be placed within one image subheader; for example, when the amount of parametric data exceeds the maximum allowed length of a single BANDSB extension or when implementers wish to segregate certain parameters in their own extension. The format and descriptions of the user-defined fields of this extension are detailed in table below.

BANDSB – GENERAL PURPOSE BAND PARAMETERS EXTENSION FORMAT
R = REQUIRED, C = CONDITIONAL, <> = BCS SPACES ALLOWED FOR ENTIRE FIELD

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
CETAG	Unique Extension Identifier.	A/6	BANDSB	N/A	R
CEL	Length in bytes of the data contained in this extension. This length does not include the CETAG and this CEL field.	N/5	000122 to 99985 Cannot exceed maximum length of 99985 bytes.	bytes	R
...The Following Fields Define BANDSB Data					
COUNT	<u>Number of Bands</u> comprising the data cube.	N/5	00001 to 09999	N/A	R
RADIOMETRIC QUANTITY	<u>Data Representation.</u> Field describes the data held in the image data area of the associated image segment. Values are user-defined, clear text. Suggested values include, REFLECTANCE EMITTANCE EMISSIVITY RADIANCE IRRADIANCE KINETIC TEMPERATURE RADIANT TEMPERATURE	A/24	Alphanumeric	N/A	<R>

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	THERMAL INERTIA APPARENT THERMAL INERTIA RADIANT FLUX UNCALIBRATED RAW Other values are TBD.				
RADIOMETRIC QUANTITY UNIT	<u>Data Representation Unit.</u> Field indicates the unit of measure for the data held in the image data field of the associated image segment. Currently allowed values: $F = \text{Watts} = \text{J sec}^{-1}$, where J = Joule Radiance: $L = \text{W m}^{-2} \text{sr}^{-1}$ Spectral Emittance: $M = \text{W m}^{-2} \text{sr}^{-1} \mu\text{m}^{-1}$ Spectral Radiance: $S = \text{W m}^{-2} \text{sr}^{-1} \mu\text{m}^{-1}$ Emissivity: Apparent Thermal Inertia: Reflectance: $P = \text{Percentage}$ Kinetic Temperature Radiant Temperature $K = \text{Degrees Kelvin}$ Thermal Inertia $I = \text{W m}^{-2} \text{sec}^{-1/2} \text{ } ^\circ\text{K}^{-1}$ Voltage: $V = \text{Volts}$ Raw or Uncalibrated: $N = \text{None}$ Other values are TBD.	A/1	Alphanumeric		<R>
SCALE FACTOR	<u>Cube Scale Factor</u> (<i>M</i>) Multiplicative factor that has been applied to all bands of the data cube, after any individual band adjustments or scaling and before data was stored in the image data of the Image Segment.	IEEE-754 32 bit Float 4 Byte	Default value for this field is the IEEE-754 representation for "+1.00", which is 0x3F800000		R
ADDITIVE FACTOR	<u>Cube Additive Factor</u> (<i>A</i>) Constant added to all bands of the	IEEE-754 32 bit Float	Default value for this field is the IEEE-754 representation for		R

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	data cube and after multiplicative factor was applied. Stored value = A + Mx	4 Byte	“+0.00 “, which is 0x00000000		
ROW_GSD	<u>Row Ground Sample Distance</u> Nominal Row Spacing, or spacing between rows, measured pixel center to pixel center. Distance in the data cube plane between corresponding pixels of adjacent rows measured in meters; or Angular center-to-center distance (pitch) between corresponding pixels of adjacent rows measured in micro-radians (μ -radians).	N/7	000.001 to 9999.99, “-----“ (String of minus signs, 0x2D)	meters or μ radians	R
ROW_GSD_UNIT	<u>Units of Row Ground Sample Distance</u> M=meter R= μ radians	A/1	M or R		<R>
COL_GSD	<u>Column Ground Sample Distance</u> Nominal column spacing, spacing between columns, measured pixel center to pixel center. Distance in the data cube plane between adjacent pixels within a row measured in meters; or Angular center-to-center distance (pitch) between corresponding pixels of adjacent columns measured in micro-radians (μ radians).	N/7	000.001 to 9999.99 “-----“ (String of minus signs, 0x2D)	meters or μ radians	R
COL_GSD_UNITS	<u>Unit of Column Ground Sample Distance</u> M=meter R= μ radians	A/1	M or R		<R>
SPT_RESP_ROW	<u>Spatial Response Function across Rows</u> . Nominal pixel/detector size measured perpendicular to data row.	N/7	000.001 to 9999.99, “-----“ (String of minus signs, 0x2D)	meters or μ radians	R
SPT_RESP_UNIT_ROW	<u>Units of Row Spatial Response</u> . Units for the previous field SPT_RESP_ROW. M=meter, R= μ radians	A/1	M or R		<R>
SPT_RESP COL	<u>Spatial Response Function across Columns</u> . Nominal Pixel/detector size measured perpendicular to data column.	N/7	000.001 to 9999.99, “-----“ (String of minus signs, 0x2D)	meters or μ radians	R

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
SPT_RESP_UNIT_COL	<u>Units of Row Spatial Response.</u> Units for the previous field SPT_RESP_COL. M=meter, R=μradians	A/1	M or R		<R>
DATA_FLD_1	Field reserved for future use	Unsigned Integer /48	0x00 – 0xFF		<R>
EXISTENCE_MASK	<u>Bit-wise Existence Mask Field</u> 32 flags represented by the bits of this 4 byte (32 bit) field. (b ₃₁ , b ₃₀ , b ₂₉ , b ₂₈ b ₂ , b ₁ , b ₀) A bit set to zero signals that a conditional field is not present in this extension. A bit set to the value one indicates the inclusion of the conditional field. b ₃₁ signals the RADIOMETRIC ADJUSTMENT SURFACE and ATMOSPHERIC ADJUSTMENT ALTITUDE fields. b ₃₀ signals the DIAMETER field. b ₂₉ signals the DATA_FLD_2 field. b ₂₈ flags the BANDIDn field. b ₂₇ signals the BAD_BANDn field. b ₂₆ signals the NIIRSn field. b ₂₅ signals the FOCAL_LENn field. b ₂₄ signals the CWAVE and WAVE_LENGTH_UNIT fields. b ₂₃ signals the FWHM and WAVE_LENGTH_UNIT fields. b ₂₂ signals the FWHM_UNC and WAVE_LENGTH_UNIT field. b ₂₁ signals the NOM_WAVEn and WAVE_LENGTH_UNIT fields. b ₂₀ signals the NOM_WAVE_UNCn field and WAVE_LENGTH_UNIT fields. b ₁₉ signals the LBOUNDn, UBOUNDn and WAVE_LENGTH_UNIT fields. b ₁₈ signals the SCALE FACTORn, and ADDITIVE FACTORn fields. b ₁₇ signals the START_TIMEn. b ₁₆ signals the INT_TIMEn field.	Unsigned Integer /4	0x00000001 to 0xFFFFFFFFC1	N/A	R

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	<p>b₁₅ signals the CALDRK and CALIBRATION SENSITIVITY_n fields.</p> <p>b₁₄ signals the ROW_GSD_n and ROW_GSD_UNITS_n, COL_GSD_n, COL_GSD_UNITS_n fields.</p> <p>b₁₃ signals the ROW_GSD_UNC_n and COL_GSD_UNC_n fields. (If b₁₃ is set to 1 then b₁₄ must be set.)</p> <p>b₁₂ signals the BKNOISE_n and SCNNOISE_n fields.</p> <p>b₁₁ signals the SPT_RESP_FUNCTION_ROW_n, SPT_RESP_UNIT_ROW_n, SPT_RESP_FUNCTION_COL_n, SPT_RESP_UNIT_COL_n fields.</p> <p>b₁₀ signals the SPT_RESP UNC_ROW_n and SPT_RESP UNC_COL_n fields. (If b₁₀ is set to 1 then b₁₁ must be set.)</p> <p>b₉ signals the DATA_FLD_3_n field.</p> <p>b₈ signals the DATA_FLD_4_n field.</p> <p>b₇ signals the DATA_FLD_5_n field.</p> <p>b₆ signals the DATA_FLD_6_n field.</p> <p>b₅ = 0 (Not used, but present)</p> <p>b₄ = 0 (Not used, but present)</p> <p>b₃ = 0 (Not used, but present)</p> <p>b₂ = 0 (Not used, but present)</p> <p>b₁ = 0 (Not used, but present)</p> <p>b₀ = signals the NUM_AUX_B and NUM_AUX_C fields.</p>				
RADIOMETRIC ADJUSTMENT SURFACE	<p><u>Adjustment Surface</u>. The presence of this field indicates that radiometric adjustments have been done to the associated image data cube. This field will contain a value indicating at what surface radiometric adjustment has been done. Values are user-defined, clear text. Suggested values include: 'DETECTOR', 'APERTURE', 'FOCAL PLANE', 'TOP OF ATMOSPHERE', 'WITHIN ATMOSPHERE', and 'EARTH SURFACE'.</p> <p>Other values are TBD</p>	A/24	Alphanumeric		C

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
ATMOSPHERIC ADJUSTMENT ALTITUDE	<u>Adjustment Altitude Above WGS84 Ellipsoid.</u> This field contains a valid value when the Radiometric Adjustment Surface field indicates 'within atmosphere', otherwise a NAN (not a number) value, as described in ANSI/IEEE-754-1985.	IEEE-754 32 bit Float /4	Real (4 Byte IEEE-754 floating representation)	meters	C
DIAMETER	<u>Diameter of the lens</u>	N/7	0000.01 to 8999.99	cm	C
DATA_FLD_2	Reserved for future use	Unsigned Integer /32	0x00 – 0xFF		C
WAVE_LENGTH_ UNIT	<u>Wave Length Units.</u> Unit of measure for subsequent wavelength fields. U = μm = micrometers W = Wavenumber, cm^{-1} If any of following fields are present in the extension according to the Bit-wise Existence Mask Field, [FOCAL_LENn, CWAVEn, FWHMn, NOM_WAVEn, NOM_WAVE_UNCn, LBOUNDn, UBOUNDn], then the WAVE_LENGTH_UNIT field must be present.	A/1	U, W		C
The following fields repeat once for each Image Band identified in the COUNT field. The presence of any of these fields is signaled by the bit values in the EXISTENCE_MASK. Parameters are organized in band sequential mode; parameters values for band ₁ , followed by parameters values for band ₂ , followed by parameters values for band ₃ through band _n .					
BANDIDn	<u>Band n Identifier.</u> A unique identifier that represents the nth band of the associated data cube.	A/50	User-defined		C
BAD_BANDn	<u>Bad Band Flag.</u> Numeric field that signals the validity of the nth band of the associated data cube. 0 = Invalid, bad, suspect or corrupted data in the nth band. 1 = nth band contains valid data.	N/1	0,1 (0x30, 0x31)		C
NIIRSn	<u>NIIRS Value.</u> MS/HS NIIRS rating for the nth band.	N/3	0.1 – 9.9		C
FOCAL_LENn	<u>Band n Focal length</u> Focal length of the detector or optics for the nth band of the associated data cube.	N/5	00001 – 99999	mm	C
CWAVEn	<u>Band n Center Response</u>	N/7	0.00001 to	μm or-1	C

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	<u>Wavelength</u> . Wavelength or wave number at the center of a detector's band profile. This field shall only be used in conjunction with symmetrical, i.e. gaussian band profiles.		10000.0	cm ⁻¹	
FWHMn	<u>Band n Width</u> . The wavelength difference between the upper and lower bounds at the 50% (-3dB) points of the sensor spectral response.	N/7	0.00001 to 10000.0	µm or cm ⁻¹	C
FWHM_UNCn	<u>Band Width Uncertainty</u> . Uncertainty in wavelength measure in the FWHMn field.	N/7	0.00001 to 10000.0	µm or cm ⁻¹	C
NOM_WAVEn	<u>Band n Nominal Wavelength</u> . For asymmetric band profile distributions, this will be the median wavelength of which equal amounts of energy are captured above and below this nominal wavelength.	N/7	0.00001 to 10000.0	µm or cm ⁻¹	C
NOM_WAVE_UNCn	Uncertainty in band wavelength measure in the NOM_WAVEn field.	N/7	0.00001 to 10000.0	µm or cm ⁻¹	C
LBOUNDn	<u>Band n Lower Wavelength Bound</u> . The wavelength for the nth band at the lower 50% (-3dB) point of the sensor spectral response.	N/7	0.00001 to 10000.0	µm or cm ⁻¹	C
UBOUNDn	<u>Band n Upper Wavelength Bound</u> . The wavelength for the nth band at the higher 50% (-3dB) point of the sensor spectral response.	N/7	0.00001 to 10000.0	µm or cm ⁻¹	C
SCALE FACTORn	<u>Individual Scale Factor</u> (M_i) Multiplicative factor applied to nth band of the data cube before it was stored in the image data area of the associated image segment.	IEEE-754 32 bit Float /4	Real (4 Byte IEEE-754 floating representation)		C
ADDITIVE FACTORn	<u>Individual Additive Factor</u> (A_i) Constant added to nth band of the data cube before it was stored in the image data area of the associated image segment and after multiplicative factor was applied. Stored value = $A_i + M_i x$	IEEE-754 32 bit Float /4	Real (4 Byte IEEE-754 floating representation)		C
START_TIMEn	<u>Start Time</u> . The starting time and date that the nth band was collected, expressed in UTC, Zulu time zone. If portions of this date and time are	N/16	YYMMDDhhmms s.sss		C

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	unknown, implementers shall place a dash (0x2D) in place of the unknown portions of the Start_Time.				
INT_TIME _n	<u>Integration Time</u> . Total number of milliseconds the nth band was collected.	N/6	000001 to 999999	ms	C
CALDRK _n	<u>Band n Calibration (Dark)</u> . The calibrated receive power level for the nth band that corresponds to a pixel value of 0.	N/6	0000.1 to 9999.9	μW/ (cm ² -sr- μm)	C
CALIBRATION SENSITIVITY _n	<u>Band n Calibration (Increment)</u> . The mean change in power level for the nth band that corresponds to an increase of 1 in pixel value.	N/5	00.01 to 99.99	μW/ (cm ² -sr- μm)	C
ROW_GSD _n	<u>Band n Spatial Response Interval by Row</u> . nth band Row Spacing, spacing between rows of the nth band. Distance in the nth data cube plane between corresponding pixels of adjacent rows measured in meters, pixel center to pixel center; or Angular center-to-center distance (pitch), of the nth band, between corresponding pixels of adjacent rows measured in micro-radians (μ-radians).	N/7	0000.00 to 9999.99	meters or μradians	C
ROW_GSD_UNC _n	<u>Band n Spatial Response Interval Uncertainty Row</u> . Uncertainty in ROW_GSD _n , Spacing between pixels of adjacent rows.	N/7	000.001 to 9999.99	meters or μradians	C
ROW_GSD_ UNIT _n	<u>Unit of Row Spacing</u> . Units for the previous two fields ROW_GSD _n and ROW_GSD_UNC _n . M=meter, R=μradians	A/1	M or R		C
COL_GSD _n	<u>Band n Spatial Response Interval by Column</u> . Column Spacing, spacing between columns, of the nth band. Distance in the nth image plane between corresponding pixels of adjacent columns measured in meters pixel center to pixel center; or Angular center-to-center distance (pitch), of the nth band, between corresponding pixels of adjacent columns measured in micro-radians	N/7	0000.01 to 9999.99	meters or μradians	C

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	(μ -radians).				
COL_GSD_UNCn	<u>Band n Spatial Response Interval Uncertainty Column.</u> Uncertainty in COL_GSDn, Spacing between pixels of adjacent columns.	N/7	000.001 to 9999.99	meters or μ radians	C
COL_GSD_UNITn	<u>Unit of Column Spacing.</u> Units for the previous two fields COL_GSDn and COL_GSD_UNCn. M=meter, R= μ radians	A/1	M or R		C
BKNOISEn	<u>Band n Background Noise.</u> Measure of noise level of collection system with shutter closed.	N/5	00.00 to 99.99	μ W/ (cm ² -sr- μ m)	C
SCNNOISEn	<u>Band n Scene Noise.</u> Noise equivalent target of the scene. Noise level for a Signal to Noise Ratio of 1.	N/5	00.00 to 99.99	μ W/ (cm ² -sr- μ m)	C
SPT_RESP_FUNCTION_ROWn	<u>Band n Spatial Response Function across Rows.</u> Pixel/detector coverage measured at FWHM perpendicular to data rows. This is referred to as the instantaneous field of view (IFOV) for the across row direction.	N/7	000.001 to 9999.99	meters or μ radians	C
SPT_RESP UNC_ROWn	<u>Band n Spatial Response Function Uncertainty.</u> Uncertainty in SPT_RESP_FUNCTION_ROWn	N/7	000.001 to 9999.99	meters or μ radians	C
SPT_RESP_UNIT_ROW	<u>Unit of Row Spatial Response.</u> Units for the previous two fields SPT_RESP_FUNCTION_ROWn and SPT_RESP UNC_ROWn. M=meter, R= μ radians	A/1	M or R		C
SPT_RESP_FUNCTION_COLn	<u>Band n Spatial Response Function across Columns.</u> Pixel/detector coverage measured at FWHM perpendicular to data columns. This is referred to as the instantaneous field of view (IFOV) for the across column direction.	N/7	000.001 to 9999.99	meters or μ radians	C
SPT_RESP UNC_COLn	<u>Band n Spatial Response Function Uncertainty.</u> Uncertainty in SPT_RESP_FUNCTION_COLn	N/7	000.001 to 9999.99	meters or μ radians	C
SPT_RESP_UNIT_COL	<u>Unit of Column Spatial Response.</u> Units for the previous two fields SPT_RESP_FUNCTION_COLn	A/1	M or R		C

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Units	Type
	and SPT_RESP UNC_COLn. M=meter, R=μradians				
DATA_FLD_3n	Field reserved for future use.	Unsigned Integer /16	0x00 – 0xFF		C
DATA_FLD_4n	Field reserved for future use.	Unsigned Integer /24	0x00 – 0xFF		C
DATA_FLD_5n	Field reserved for future use.	Unsigned Integer /32	0x00 – 0xFF		C
DATA_FLD_6n	Field reserved for future use.	Unsigned Integer /48	0x00 – 0xFF		C
.... End of the repeating fields of this Extension.					
Note 1. Field Type values; A= BCS-A, N= BCS-N.					

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Type
NUM_AUX_B	<u>Number of Auxiliary Band Level Parameters(m)</u> . These parameters have values specified for each band held in the image product.	N/2	00 to 99	C
NUM_AUX_C	<u>Number of Auxiliary Cube Level Parameters(k)</u> . These parameters values are specified once for the entire image data cube.	N/2	00 to 99	C
NUM_AUX_B and NUM_AUX_C fields are conditional on the b ₀ of the EXISTENCE MASK. If b ₀ is set then band or cube level auxiliary parameters must be present in the extension.				
.... Starting point of band level auxiliary parameters of this extension. This section repeats according to the number of band level auxiliary parameters (NUM_AUX_B), (m).				
BAPFm	<u>Band Auxiliary Parameter Value Format</u> APNmn, APRmn and APAmn fields are required when BAPFm value is respectively I, R and A.	A/1	<i>I = Integer</i> R = Real (4 Byte IEEE-754 floating representation) A = ASCII	C
UBAPm	Unit of Band Auxiliary Parameter	A/7	DIGEST Edition 2.1, Part 3-7	C
....The following field will repeat for each band (n) of the data cube, for the current auxiliary parameter (m).				
APNmn	Auxiliary Parameter Integer Value	N/10	User defined	C
OR				
APRmn	Auxiliary Parameter Real Value	IEEE-754 32 bit Float /4	Real	C
OR				

Field	Name/Description	Type/Size ¹ (bytes)	Value Range	Type
APAmn	Auxiliary Parameter Char String Value	A/20	User-defined	C
.... End for 1 st Auxiliary parameter				
.....Start for 2 nd next Aux parameter				
BAPF ₂				
.... End for 2nd Auxiliary parameter				
.....				
BAPF _{last(n)}				
.... End for last(n) band level Auxiliary parameter				
.... Starting point of cube level auxiliary parameter section of this extension. This section repeats according to the number of cube level auxiliary parameters (NUM_AUX_C), (k)				
CAPFk	<u>Cube Auxiliary Parameter Value Format</u> APNk, APRk and APAk fields are required when CAPFk value is respectively I, R and A.	A/1	<i>I = Integer</i> R = Real (4 Byte IEEE-754 floating representation) A = ASCII	C
UCAPk	Unit of Cube Auxiliary Parameter	A/7	DIGEST Edition 2.1, Part 3-7	C
APNk	Auxiliary Parameter Integer Value	N/10	User defined	C
OR				
APRk	Auxiliary Parameter Real Value	IEEE-754 32 bit Float /4	Real	C
OR				
APAk	Auxiliary Parameter Char String Value	A/20	User-defined	C
.... End for 1 st Auxiliary parameter				
.....Start for 2 nd next Aux parameter				
CAPF ₂				
.... End for 2nd Auxiliary parameter				
.....				
CAPF _{last(k)}				
.... End for last(k) cube level Auxiliary parameter				
Note 1. Field Type values; A= BCS-A, N= BCS-N.				