

Common Phase History Data

Version 3.0

1.0 Summary

2.0 File Structure

The CPHD file structure consists of four components.

- (1) Preamble
- (2) Byte Order Marker
- (3) Narrow Band Binary Data
- (4) Once Per Vector Binary Data

Components 1 and 2 are required. Components 3 and 4 are optional.

2.1 Preamble

The Preamble is an ASCII block of parameters and parameter values that describe the radar collection parameters associated with the data. The Preamble also contains parameters describing the content of the binary data blocks contained in the file.

2.2 Byte Order Marker

The Byte Order marker is a 4 byte field used to establish the byte ordering of the binary data contained in the file. The 4 byte field is written immediately following the Preamble. The 4 byte field has hexadecimal value x'4D6F6A6F and represents ASCII string "Mojo". For files containing binary data with the MSB written first (i.e. Big Endian), the byte order marker should be written with x'4D as the first byte. For files containing binary data with the LSB written first (i.e. Little Endian), the byte order marker should be written with x'6F as the first byte. Reading the Byte Order marker as an ASCII string will yield "Mojo" for files with binary data written MSB first (Big Endian) and "ojoM" for files with binary data written LSB first (Little Endian).

2.3 Narrow Band Binary Data

Binary NB will support densely sampled antenna pattern data. The content and size of the data will be specified in the Preamble. **NOTE: Antenna pattern data is not a currently available option.**

2.4 Once Per Vector Binary Data

One per vector binary data includes both NB parameters and the WB phase history data complex samples. The NB parameters can be either interleaved with the WB phase history data or in a separate data block (i.e. non-interleaved).

3.0 Preamble Parameters

3.1 Preamble Marker Tags

Tag	Type	Required	Description
BegPreamble	n/a	REQ	Required first preamble tag.
EndPreamble	n/a	REQ	Required last preamble tag. Marks the end of the Preamble
BegWBVector	n/a	REQ	Marks the beginning of the list of tags defining the Once Per Vector WB data.
EndWBVector	n/a	REQ	Marks the end of the list of tags defining the Once Per Vector WB data.
BegNBVector	n/a	OPT	Marks the beginning of the list of tags defining the Non-Interleaved Once Per Vector NB data. Included only when parameter Interleaved = No.
EndNBVector	n/a	OPT	Marks the end of the list of tags defining the Non-Interleaved Once Per Vector NB data. Included only when parameter Interleaved = No.
BegNBBinary	n/a	OPT	Marks the beginning of the list of tags defining the NB binary data in the file. Included only when NB binary data is included.
EndNBBinary	n/a	OPT	Marks the end of the list of tags defining the NB binary data in the file. Included only when NB binary data is included.

3.2 Preamble Scalar Tags

Tag	Type	Required	Description
Version	String	REQ	CPHD Format Version Number. Must be the first tag following BegPreamble. Format: NN.nn ⇔ NN major version number, nn = minor version number.
Classification	String	REQ	Classification level – as appropriate. Recommended values: UNC, S, TS, SNSI
DateTime	String	REQ	Date and time of start of collection (UTC). Format: YYYYMMDDHHMMSS
Mission	String	OPT	Operator chosen mission identifier.
DataSetID	String	OPT	Data set identifier – unique to the collection.
Mode	String	REQ	Allowed values: Spotlight, Scan, Strip
Geometry	String	REQ	Allowed values: Monostatic, Bistatic
FixedSRP	String	REQ	Indicates fixed or varying once per vector Stabilization Reference Point. Allowed values: Yes, No
Datum	String	REQ	Reference for all geographic coordinates. Allowed values: WGS84
PHDataType	String	REQ	Indicates the data type of the stored wideband phase history data. (See Table x). Allowed values: cmplx, cmplx, cmplx, cmplx
Interleaved	String	REQ	Defines format for Once Per Vector parameters. Must precede Once Per Vector marker tags. Allowed values: No, Yes Yes ⇔ Once Per Vector NB data is interleaved with Once Per Vector WB data.

Nchannels	Int32	REQ	Number data channels contained in the file. Channels indexed by $c = 0, 1, 2, \dots, Nchannels - 1$.
Nvectors	Int32	REQ	Number of WB vectors per channel. Vectors indexed by $n = 0, 1, 2, \dots, Nvectors - 1$.
Nsamples	Int32	REQ	Number of data samples per WB vector. Samples indexed by $m = 0, 1, 2, \dots, Nsamples - 1$.
TOASaved	Float64	REQ	Span in Time Of Arrival (TOA) saved (sec) for WB data in file. Saved Range Swath computed by: $RgSwath = (c/2) * TOASaved * \cos(\beta/2)$, where β = bistatic angle ($\beta = 0$ for monostatic)
PhaseSgn	Int32	REQ	Defines the sign of the phase vs. frequency for targets off of the SRP. Allowed values: -1 or +1 . $Phase(fx) = PhaseSgn * fx * \Delta TOA_TGT$, Where fx = RF frequency and ΔTOA_TGT = target TOA relative to the SRP TOA.
ChanDesc	String	OPT	Channel descriptor. Format: c xxx where c = the channel number and xxx = text description. Separate descriptors for each channel.
Sensor	String	REQ:SNL	Sensor Name
Grid	String	REQ:SNL	Collection sampling grid type. Allowed values: Polar, Trapezoidal, Unknown
DeskewApplied	String	REQ:SNL	Fast time deskew processing applied. Allowed values: Yes, No Yes \Leftrightarrow Fast Time Deskew applied. No \Leftrightarrow Echoes skewed in fast time.
FreqReferenceIndex	Int32	REQ	Parameter to indicate RF frequency values in this CPHD product are true values or offsets relative to a reference value (fx_REF). FreqReferenceIndex = 0 \Leftrightarrow Frequency values are true values (i.e. $fx_Ref = 0$). FreqReferenceIndex ≥ 1 \Leftrightarrow Frequency values are offsets (fx_REF determined by index value). $fx(TRUE) = fx(CPHD\ parameter) + fx_REF$
NominalCenterFreq	Float64	REQ:SNL	Center RF frequency of the WB data in the file (Hz). Note: See FreqReferenceIndex above.
NominalChirpRate	Float64	REQ:SNL	FM Rate of the transmit waveform (Hz/sec) for Linear FM waveforms.
NominalADRate	Float64	REQ:SNL	Fast time ADC sample rate (samples/sec).
XmitPulseDuration	Float64	OPT	Transmit pulse length (sec).
XmtBW	Float64	OPT	Transmitted RF BW for the collection. (Hz)
XmtBWSaved	Float64	OPT	Transmitted RF BW saved and included in WB data (Hz).
IntegrationAngle	Float64	OPT	Nominal slant plane integration angle supported by this CPHD product (decimal degrees). Note: Should be included for Scan or Strip modes.
MagCal	Float64	OPT	Scale factor relating signal power for a point target to Radar Cross Section (m^2) for a target at the SRP. Note: Place holder. More parameters needed.
Comment	String	OPT	Any string acceptable – multiple comments allowed.

3.3 Preamble Structure Tags

Tag	Type	Required	Description
AreaImagedCirc	Struct	OPT	The circular ground area imaged and covered by this CPHD product. Area described by a center point and a radius. CTR = Center of the area imaged in ECF coordinates (m). Radius = Radius of a circular area centered on the SCP (m).
CTR_X	Float64		
CTR_Y	Float64		
CTR_Z	Float64		
Radius	Float64		
AreaImagedRect	Struct	OPT	The rectangular ground area imaged and covered by this CPHD product. Area described by a center point, rectangle dimensions and orientation. CTR = Center of the area imaged in ECF coordinates (m). X_Dist = Length of the rectangle along X Axis (m). Y_Dist = Length of the rectangle along the Y Axis (m). Angle_X_Axis = Angle off of North at the SCP of the +X Axis (decimal degrees).
CTR_X	Float64		
CTR_Y	Float64		
CTR_Z	Float64		
X_Dist	Float64		
Y_Dist	Float64		
Angle_X_Axis	Float64		

3.4 Preamble Once Per Vector Data Tags

Tag	Type	Required	Description
ChannelNumber	Int32	REQ	Channel number. Indexed c = 0 to Nchannels – 1. Required in both WB Once Per Vector data and NB Once Per Vector data for Interleaved = No.
VectorNumber	Int32	REQ	WB Vector number. Indexed n = 0 to Nvectors -1. Required in both WB Once Per Vector data and NB Once Per Vector data for Interleaved = No.
SRPPos SRP_X SRP_Y SRP_Z	Float64 Float64 Float64	REQ	Stabilization Reference Point in ECF (m).
TxPos TxPos_X TxPos_Y TxPos_Z	Float64 Float64 Float64	REQ	Transmit Aperture Position at time of transmit in ECF (m).
RcvPos RcvPos_X RcvPos_Y RcvPos_Z	Float64 Float64 Float64	REQ	Receive Aperture Position at time of receive in ECF (m).
TxTime	Float64	REQ	Time of transmit relative to collection start (sec). Time associated with TxPos.
RcvTime	Float64	REQ	Time of receive relative to collection start (sec). Time associated with RcvPos.
Fx0	Float64	REQ	RF frequency associated with sample m = 0 (Hz). Note: See FreqReferenceIndex above.
FxStepSize	Float64	REQ	RF frequency sample spacing (Hz/sample). RF frequency of sample m is: $fx(m) = Fx0(True) + FxStepSize * m$
AmpSF0	Float64	OPT	Amplitude scale factor due to vector specific scaling during CPHD preprocessing.
SampleData	N/A	REQ	Defines the location of the Nsamples of WB data in the Once Per Record WB data. Type is specified by parameter PHDataTypes.

3.5 Preamble NB Binary Structure Tags

Tag	Type	Required	Description
	Struct	OPT	

5.0 Preamble Examples

5.1 Example D1: Version 2.0 Example – Historic

```

BegPreamble
  Version 2.0
  Classification UNC
  DateTime YYYYMMDDHHMMSS
  DataSetID Data_Set_Identifier_Here
  Mode Spotlight
  Geometry Monostatic
  FixedSRP Yes
  Datum WGS84
  PHDataType cmplx 2 Float32 parameters per Complex Sample
  Interleaved No
  TOASaved 0.10e-05
  PhaseSgn -1
  Sensor SensorName
  Grid Polar
  DeskewApplied Yes
  NominalCenterFreq 16700000000.000000
  NominalChirpRate 1.2E12
  NominalADRate 5.8E7
  XmitPulseDuration 3.1352e-05
  Nchannels 1
  Nvectors 4000
  Nsamples 2020
BegNBVector
  ChannelNumber
  VectorNumber
  SRP
  TxPos
  RcvPos
  TxTime
  RcvTime
  Fx0
  FxStepSize
EndNBVector
BegWBVector
  ChannelNumber
  VectorNumber
  SampleData
EndWBVector
EndPreamble

```

5.2 Example 2 Version 2.0 Example – Historic

```

BegPreamble
  Version          2.0
  Classification    UNC
  DateTime          YYYYMMDDHHMMSS
  DataSetID        Data_Set_Identifier_Here
  Mode             Spotlight
  Geometry          Monostatic
  FixedSRP          Yes
  Datum            WGS84
  PHData Type      cmplx      2 Int8 parameters per Complex Sample
  Interleaved       No
  TOASaved          0.10e-05
  PhaseSgn          -1
  Sensor            SensorName
  Grid              Polar
  DeskewApplied     Yes
  NominalCenterFreq 16700000000.000000
  NominalChirpRate  1.2E12
  NominalADRate     5.8E7
  XmitPulseDuration 3.1352e-05
  Nchannels         1
  Nvectors           4000
  Nsamples          2020
BegNBVector
  ChannelNumber
  VectorNumber
  SRP
  TxPos
  RcvPos
  TxTime
  RcvTime
  Fx0
  FxStepSize
  AmpSF0           Float64 parameter Added in D2
EndNBVector
BegWBVector
  ChannelNumber
  VectorNumber
  SampleData
EndWBVector
EndPreamble

```

5.3 Example 3 SUGGESTED VERSION 3.0

BegPreamble

Version	3.0	
Classification	UNC	
DateTime	YYYYMMDDHHMMSS	
DataSetID	Data_Set_Identifier_Here	
Mode	Spotlight	
Geometry	Monostatic	
FixedSRP	Yes	
Datum	WGS84	
PHDataType	cmplx	2 Int8 parameters per Complex Sample
Interleaved	No	
TOASaved	0.10e-05	
PhaseSgn	-1	
Sensor	SensorName	
Grid	Polar	
DeskewApplied	Yes	
FreqReferenceIndex	1	Frequencies relative to a reference.
NominalCenterFreq	700000000.000000	Expressed as offset from the reference.
NominalChirpRate	1.2E12	
NominalADRate	5.8E7	
XmitPulseDuration	3.1352e-05	
Nchannels	1	
Nvectors	4000	
Nsamples	2020	
AreaImagedCirc		New Circular AOI
CTR_X	3000000.000000	
CTR_Y	4000000.000000	
CTR_Z	3000000.000000	
Radius	2000.000000	

BegNBVector

ChannelNumber
 VectorNumber
 SRP
 TxPos
 RcvPos
 TxTime
 RcvTime
 Fx0
 FxStepSize
 AmpSF0

EndNBVector

BegWBVector

ChannelNumber
 VectorNumber
 SampleData

EndWBVector

EndPreamble

5.4 Example 4 SUGGESTED VERSION 3.0

BegPreamble

Version	3.0	
Classification	UNC	
DateTime	YYYYMMDDHHMMSS	
DataSetID	Data_Set_Identifier_Here	
Mode	Spotlight	
Geometry	Monostatic	
FixedSRP	Yes	
Datum	WGS84	
PHData Type	cmplx	2 Int8 parameters per Complex Sample
Interleaved	No	
TOASaved	0.10e-05	
PhaseSgn	-1	
Sensor	SensorName	
Grid	Polar	
DeskewApplied	Yes	
FreqReferenceIndex	1	Frequencies relative to a reference.
NominalCenterFreq	700000000.000000	Expressed as offset from the reference.
NominalChirpRate	1.2E12	
NominalADRate	5.8E7	
XmitPulseDuration	3.1352e-05	
Nchannels	1	
Nvectors	4000	
Nsamples	2020	
AreaImagedRect		
CTR_X	3000000.000000	New Rect AOI – Covers circle AOI.
CTR_Y	4000000.000000	
CTR_Z	3000000.000000	
X_Dist	3000.000000	
Y_Dist	2000.000000	
Angle_X_Axis	30.000000	

BegNBVector

ChannelNumber
 VectorNumber
 SRP
 TxPos
 RcvPos
 TxTime
 RcvTime
 Fx0
 FxStepSize
 AmpSF0

EndNBVector

BegWBVector

ChannelNumber
 VectorNumber
 SampleData

EndWBVector

EndPreamble