922-20007002

M3 IMB Beamformed Data Format

Document revisions

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1.0	Aug. 22, 11	AZ	JR/PF	MM
1.1	Oct. 05, 11	AZ	CS	MM
1.2	May. 03, 13	AZ	CS	BC

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Document history

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1.0	First revision.
1.1	Modified mounting and beam angle drawing
1.2	Added bHeadSensorVersion, HeadHWStatus, fInternalSensorHeading, fInternalSensorPitch, fInternalSensorRoll, sAxesRotatorOffsets, nStartElement, nEndElement, strCustomText1, strCustomText2, fLocalTimeOffset

DATA FORMAT

1. Common data type

Data Type	Description		
unsigned int16	**16-bit unsigned integer**		
unsigned int32	**32-bit unsigned integer**		
float	**32-bit floating point**		
double	**64-bit floating point**		
Ipp32fc	**32-bit floating point complex(I and Q)**		
char	**8 bit character**		
byte	**8 bit unsigned integer**		
TVG_PARAMS	**unsigned int16**	**factor A, the spreading coefficient**	
	unsigned int16	**factor B, the absorption coefficient in dB/km**	
	float	**factor C, the TVG curve offset in dB**	
	float	**factor L, the maximum gain limit in dB**	
M3_ROTATOR_OFFSETS	**float**	**Offset A in meters**	
	float	**Offset B in meters**	
	float	**Offset R in degrees**	
	float	**Rotator angle in degrees**	

2. Data structure

The data packets are packed with packet header and packet footer for data integrity purpose.

Packet Header

Data Header

Data Body

Packet Footer
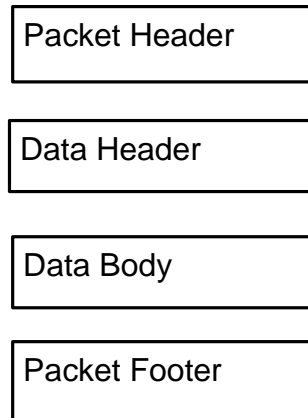
Packet Header Prefix

Size	Type	Description
2 bytes	unsigned int16	**Synchronization word, always 0x8000**
2 bytes	unsigned int16	**Synchronization word, always 0x8000**
2 bytes	unsigned int16	**Synchronization word, always 0x8000**
2 bytes	unsigned int16	**Synchronization word, always 0x8000**
2 bytes	unsigned int16	Data type, always 0x1002
2 bytes	unsigned int16	Reserved field
40 bytes	unsigned int32[10]	40 reserved bytes
4 bytes	unsigned int32	Packet body size.

Packet Footer

Size	Type	Description
4 bytes	unsigned int32	Packet body size.
40 bytes	unsigned int32[10]	40 reserved bytes

Data integrity checking procedure

- Check the "Synchronization word" 0x8000,0x8000, 0x8000, 0x8000
- "Packet body size" in "Packet Header" and "Packet Footer" should be the same.

2.1 Packet body Description

Packet body contains Data Header and Data Body.

Data Header

Data Header is an n bytes long field prefixed to the data body.

Field	Item size (bytes)	Data type	Description
dwVersion	4	unsigned int32	**Version of this header.** **Current version 5.** v1: TVG parameters v2: HW_Status, Sensor_Version v3: nStartElement, nEndElement v4: bHeadSensorVersion, HeadHWStatus, fInternalSensorHeading, fInternalSensorPitch, fInternalSensorRoll v5: for alignment purpose, added wReserved1, wReserved2, byReserved1, byReserved2
dwSonarID	4	unsigned int32	**Sonar identification**
dwSonarInfo[8]	32	unsigned int32[8]	**Sonar information such as serial number, power up configurations.**
dwTimeSec	4	unsigned int32	**Time stamp of current ping in seconds elapse since midnight (00:00:00), January 1, 1970.**
dwTimeMillisec	4	unsigned int32	**Milliseconds part of current ping.**
fVelocitySound	4	float	**Speed of sound in m/s**
nNumSamples	4	unsigned int32	**Total number of image samples.**

fNearRange	4	float	**Near range in meters. No image below this range.**
fFarRange	4	float	**Far range in meters**
fSWST	4	float	**Sampling Window Start Time in seconds**
fSWL	4	float	**Sampling Window Length**
nNumBeams	2	unsigned int16	**Total number of beams.**
wReserved1	2	unsigned int16	**Reserved field**
fBeamList[1024]	4096	float[1024]	**A list of angles for all beams up to the number of beams specified in nNumBeams field.**
fImageSampleInterval	4	float	**Image sample interval in seconds**
wImageDestination	2	unsigned int16	**Image designation, 0: main image window, n: zoom image window n, n<=4**
wReserved2	2	unsigned int16	**Reserved field**
dwModeID	4	unsigned int32	**Unique mode ID, application ID**
nNumHybridPRI	4	signed int 32	**Number of PRIs in a hybrid mode.** **1 if not in hybrid mode.**
nHybridIndex	4	signed int 32	**0 based index used in hybrid mode up to** (nNumHybridPRI -1)
nPhaseSeqLength	2	unsigned int 16	**Spatial phase sequence length**
iPhaseSeqIndex	2	unsinged int 16	**Spatial phase sequence length index 0..(nPhaseSeqLength – 1)**
nNumImages	2	unsigned int 16	**Number sub-images for one PRI**
iSubImageIndex	2	unsigned int 16	**Sub-image index 0 .. (nNumImages – 1)**
dwSonarFreq	4	unsigned int 32	**Sonar frequency in Hz.**
dwPulseLength	4	unsigned int 32	**Transmit pulse length in microseconds.**
dwPingNumber	4	unsigned int32	**Ping counter. Rolls back to zero if reaches 0xFFFFFFFF**
fRXFilterBW	4	float	**RX filter bandwidth in Hz**
fRXNominalResolution	4	float	**RX nominal resolution in metres**
fPulseRepFreq	4	float	**Pulse Repetition Frequency in Hz**
strAppName	128	char[128]	**Application name, null terminated. Maximum 128 characters.**
strTXPulseName	64	char[64]	**TX pulse name, null terminated. Maximum 64 characters.**
sTVGParameters	12	TVG_PARAMS	**TVG Parameters: (Available if dwVersion >=1)**
fCompassHeading	4	float	**heading of current ping in decimal degrees**

fMagneticVariation	4	float	**Magnetic variation in decimal degrees**
fPitch	4	float	**Pitch in decimal degrees**
fRoll	4	flaot	**Roll in decimal degrees**
fDepth	4	float	**Depth in decimal meters**
fTemperature	4	float	**Temperature in decimal Celsius**
fXOffset	4	float	**Translational offset in X axis**
fYOffset	4	float	**Translational offset in Y axis**
fZOffset	4	float	**Translational offset in Z axis**
fXRotOffset	4	float	**Rotational offset about X axis(Pitch offset).**
fYRotOffset	4	float	**Rotational offset about Y axis(Roll offset)**
fZRotOffset	4	float	**Rotational offset about Z axis(Yaw offset)**
dwMounting	4	unsigned int 32	**Mounting configuration.** **0: mounting Down or Aft** **1: mounting Up or Fore**
dbLatitude	8	double	**Latitude of current ping in decimal degrees**
dbLongitude	8	double	**Longitude of current ping in decimal degrees**
fTXWST	4	float	**TX Window Start Time in seconds. Available if** (dwVersion >= 4)
bHeadSensorVersion	1	byte	**Head Sensor Version**
HeadHWStatus	1	byte	**Head hardware status:** **0: Normal** **1: High temperature warning** **2: High temperature shutdown**
byReserved1	1	byte	**Reserved field**
byReserved2	1	byte	**Reserved field**
fInternalSensorHeading	4	float	**Heading from internal sensor**
fInternalSensorPitch	4	float	**Pitch from internal sensor**
fInternalSensorRoll	4	float	**Roll from internal sensor**
sAxesRotatorOffsets	48	M3_ROTATOR_OFFSETS[3]	**Rotator offset for a rotator mounted M3 system**
nStartElement	2	unsigned int 16	**Used if** nNumImages > 1. **Zero based start element of the sub array for the current sub image.**
nEndElement	2	unsigned int 16	**Used if** nNumImages > 1.

			Zero based end element of the sub array for the current sub image.
strCustomText1	32	char[32]	**Custom text field 1**
strCustomText2	32	char[32]	**Custom text field 2**
fLocalTimeOffset	4	float	**Local time zone offset in decimal hours relative to UTC.**
Reserved	3876	byte	**3896 reserved bytes**

Data Body

The data body contains beamformed sonar data in 32 bits floating point complex format.

$$\begin{bmatrix} I_{00}Q_{00} & I_{01}Q_{01} & \cdots\cdots & I_{0(m-1)}Q_{0(m-1)} \\ I_{10}Q_{10} & I_{10}Q_{10} & \cdots\cdots & I_{1(m-1)}Q_{1(m-1)} \\ & \vdots & & \vdots \\ I_{(n-1)0}Q_{(n-1)0} & \cdots\cdots & & I_{(n-1)(m-1)}Q_{(n-1)(m-1)} \end{bmatrix}$$

Where:

m = Total number of beams, declared in field nNumBeams

n = Total number of image samples, declared in field nNumSamples

Note 1:

How to calculate image sample N position P(N) in meters:

if (dwVersion < 4)

P(N) = ((fSWST − 0.000025) + fImageSampleInterval * N) * fVelocitySound / 2

If (dwVersion >=4)

P(N) = ((fSWST − fTXWST) + fImageSampleInterval * N) * fVelocitySound / 2

Where N = 0 .. (n-1)

Note 2:

Sonar mounting and beam angles:

dwMounting	4	unsigned int 32	**Mounting configuration.** **0: mounting Vertical Down or Horizontal Aft** **1: mounting Vertical Up or Horizontal Fore**

Use "dwMounting" field to find the sonar head mounting configuration and plot image angles according to the following drawing.
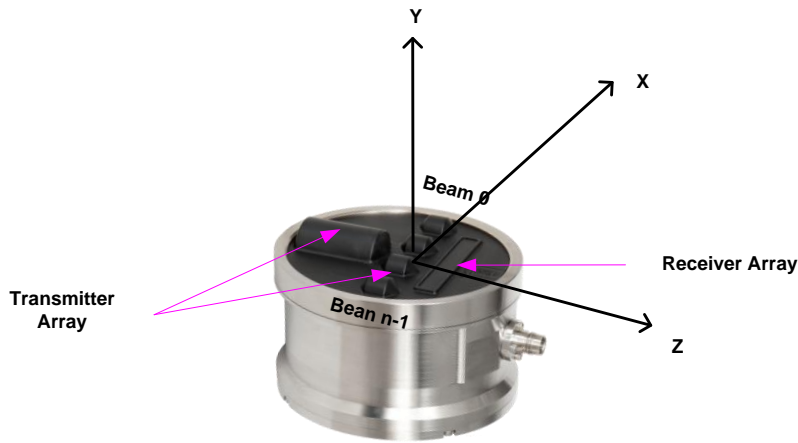
3. Ethernet output

Protocol: TCP/IP

Socket Port: 20001

The Beamformed data packets are exported through M3 software (version >= 1.2) over TCP/IP. The third party software TCP/IP client can issue a TCP/IP socket connection at port 20001 to receive beamformed streaming socket data. No configuration in M3 is required.

Sonar Head

Mounting Definition

Vertical Down

The sonar head is installed with the Z direction up, the transmitter array is below the receiver array. Beam 0 (negative angle) is to the starboard, beam n-1 (positive angle) is to the Port.

Horizontal Aft

The sonar head is installed with Y direction down, the transmitter array is to the stern and the receiver array is to the bow. Beam 0 (negative angle) is to the starboard, beam n-1 (positive angle) is to the Port.

Vertical Up

The sonar head is installed with the Z direction down, the transmitter array is above the receiver array. Beam 0 (negative angle) is to the port, beam n-1 (positive angle) is to the Starboard.

Horizontal Fore

The sonar head is installed with Y direction down, the transmitter array is to the bow and the receiver array is to the stern. Beam 0 (negative angle) is to the Port, beam n-1 (positive angle) is to the Startboard.

Typical Sonar Mounting

Vertical Down (Top view) — Beam 127 / Beam 0

Vertical Up (Top view) — Beam 0 / Beam 127

Horizontal Fore (Back view) — Beam 0 / Beam 127

Horizontal Aft (Back view) — Beam 127 / Beam 0