L3
communications
ELAC Nautik

Data Exchange Format (XSE)

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Technical Description
Revision 1.8.5

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1 Format Description

1.1 Introduction

1.1.1 Overview

This document defines a new model for exchanging information between the HydroStar Software package and other software packages. The format description is not limited to a file format, although in the near future the main purpose is to introduce a more general file format than the older native ELAC file format.

The HydroStar Software can be seen as a server application that provides other software (clients) with specialized services like navigation information, multi beam or sidescan data or even status information. Data concerning ship's geometry, sound velocity and tide information can be inserted in the server application or requested from the server. Experiences in client/server data exchange communication have been collected. The client/server communication is discussed in an extra section of this document.

A section, listing and answering frequently asked questions, can be found in an extra section at the end of this documentation.

1.1.2 Document History

The following table summarizes the changes made to this document.

Version	Date	Changes
0.8	May 1998	only Navigation Group and Single Beam Groups specified and implemented
0.9	August 1998	second version of draft
0.9.1	November 1998	SeaBeam frame added
1.0	November 1998	tide groups changed; pressure group to sound velocity frame added; first sample files released
1.1	Dezember 1998	control frame specified; section about client/server communication added
1.2	January 1999	minor corrections; navigation frame extended; action group in control frame extended
1.3	April 1999	minor correction regarding multi beam frame; Figure 14 states document version with last changes and HydroStar version which implements the features; section "About the Format" updated;
1.4	May 14, 1999	groups of SeaBeam frame updated/extended
1.4.1	July, 1999	groups of SeaBeam frame finalized (team members: John Spitzak, Frank Ritters, Carsten Ziegenbein)
1.4.2	August, 1999	groups of product frame released (extended and finalized based on requirements from SeaBeam 2120 project) (team members: John Spitzak, Paul Cohen, Carsten Ziegenbein)
1.5	October, 1999	Client/Server Communication section reviewed and put under version control
1.6	November, 1999	group of SeaBeam frame changed/adjusted (team members: John Spitzak, Carsten Ziegenbein), FAQ section added
1.6.8	August, 2000	SeaBeam adjustments and minor corrections; synchronized to HydroStar Software Version 3.0.x
1.6.9	October, 2000	Adjustments and minor additions made during SeaBeam Integration meeting October 4-10, 2000 (team members: John Spitzak, Steve Zarenko, Carsten Ziegenbein)
1.7	January, 2001	Identity group in control frame added; requesting a new connection now needs to identify the client using the appropriate identity number, version number and sensor name in the identity group
1.7.1	March, 2001	Updated to HydroStar Software 3.2 beta; Third party software using the network access to HydroStar Software needs to log in with identity group included in control frame (obsolete log in procedure will be supported in version 3.2 for compatibility purposes)

Version	Date	Changes
1.7.2	Mai, 2001	Updated to cover Geomar project requirements; signals group in side scan frame added
1.8.0	July, 2001	Synchronized with Cesme project and HydroStar Software version 3.2.2
1.8.1	September, 2001	Updated to cover Geomar III project requirements; signals group in side scan frame corrected and ping type group in side scan frame added
1.8.2	December, 2001	Complex Signal Group added to side scan frame; Heading group in Navigation frame implemented
1.8.3	March, 2002	ShipFrame, general group, weighted group added to side scan frame
1.8.4	July, 2002	SeaBeam Frame: Description Beams Group extend, MotionReferenceUnitGroup Sidescan Frame: Complex Signal Group Units added ShipFrame new groups: NavigationAndMotion Group, Transducer Group added, Sensors Group expand and implemented Not supported since June 2002: Parameter Group
1.8.5	July, 2003	Navigation Frame: GPS Information added Ship Frame: Add Parameters Sidescan Frame: Description of Weighting Group corrected Added timing requirements. Correct MessageFrame Add Transducer Extended Group (Ship Frame) Control Frame: New ID Numbers in Identity Group (QINSy, PDS 2000, SeaBeam 3000, SeaBeam RawData) added SeaBeam Frame: SeaBeam3000 Groups added

Figure 1: Document History

1.1.3 About the Format

The byte order is most significant byte (MSB) first and least significant byte (LSB) last. This is big endian or UNIX byte order style. The floating point format of the XSE data is IEEE FP standard (754). The items in the frames and groups are byte aligned.

Format	Bytes	Range		N/A or NaN
char	1	-127	+127	-128 (0x80)
uchar	1	0x00	254 (0xFE)	255 (0xFF)
short	2	-32767	32767	-32768 (0x8000)
ushort	2	0x0000	65534 (0xFFFE)	65535 (0xFFFF)
long	4	-2147483647	2147483647	-2147483648 (0x80000000)
ulong	4	0x00000000	4294967294 (0xFFFFFFFE)	4294967295 (0xFFFFFFFF)
float	4	-3.402823466e+38	3.402823466e+38	0xFFFFFFFF
double	8	-1.7976931348623158e+308	1.7976931348623158e+308	0xFFFFFFFFFFFFFFFF

Figure 2: Format Ranges (float and double are IEEE)

Format	Bytes	Range		Resolution
short	2	-32.767 m	32.767 m	1 mm
ushort	2	0.0 m	65.534 m	1 mm
long	4	-2147.5 km	2147.5 km	1 mm
ulong	4	0.0 km	4295 km	1 mm
float	4			6 digits; 0.1 rad = 40 cm
double	8			15 digits; 0.0001 rad = 5 mm

Figure 3: Distance Ranges

Format	Bytes	Range		Resolution
short	2	- 360.437 deg	360.437 deg	0.011 deg
ushort	2	0.0 deg	393.204 deg	0.006 deg
long	4	- 365.072 deg	365.072 deg	1.7e-7 deg
ulong	4	0.0 deg	360.777 deg	8.4e-8 deg
float	4			6 digits
double	8			15 digits

Figure 4: Angle Ranges

Definition:

2 x Pi rad = 360 degree
1 rad = 180/ Pi degree

1.2 Items

As described in the following two sections the structure is given by the frames and group definition. However there are often sequences of items common to all frames and groups. To make the format description easier to read we introduce a number of predefined items that will be referenced in the frame and group description.

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	0x24485346		start of frame, $HSF
End	4	ulong	0x23485346		end of frame, #HSF
Start	4	ulong	0x24485347		start of group, $HSG
End	4	ulong	0x23485347		end of group, #HSG

Figure 5: Start and End Marker Item

Item	Bytes	Format	Value	Units	Description
Boolean	1	uchar	1 or 0	N/A	true or false

Figure 6: Boolean Item

Item	Bytes	Format	Value	Units	Description
Length	4	ulong	N	N/A	Text length
Text	N	char		chars	Text

Figure 7: String Item

Item	Bytes	Format	Value	Units	Description
X	8	double		m/radian	East/Longitude
Y	8	double		m/radian	North/Latitude
Z	8	double		m	Height/Ellipsoidal Height

Figure 8: Point Item

Item	Bytes	Format	Value	Units	Description
N	4	ulong	N	N/A	Description length
Description	N	char		chars	Geodetic Description
X	8	double		m/radian	East/Longitude
Y	8	double		m/radian	North/Latitude
Z	8	double		m	Height/Ellipsoidal Height

Figure 9: Geodetic Point Item

Item	Bytes	Format	Value	Units	Description
Seconds	4	ulong	N/A	sec	seconds since 00:00 1.1.1901 UTC
Micro	4	ulong	N/A	usec	micro seconds of seconds

Figure 10: Time Item

1.3 Frames

Each data frame is made up of several groups. Each frame header contains timing and status information that are common to all contained groups. The groups contained in a frame are frame specific. A frame must contain a specific group only once. The exceptions are documented along with the group description.

The Frame Id specifies the frame. Figure 12 shows the frame and there frame specific groups.

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Frame Start
Byte Count	4	ulong	N/A	bytes	between Byte Count & Frame End
Id	4	ulong	N/A	N/A	see Figure 12
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*N/A*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*	*N/A*	*usec*	*micro seconds of seconds*
…	…	…	…	…	frame specific groups
End	4	ulong	#HSF	N/A	Frame End

Figure 11: Basic Frame

Name	Id	Description
Navigation	1	Navigation, ship's motion and attitude information
Sound Velocity	2	Sound velocity profile and surface sound velocity
Tide	3	Tide
Ship	4	Ship parameter information
Side scan	5	Side scan
Multi beam	6	Multi beam
Single beam	7	Single beam
Control	8	Establishing connections and control HydroStar Software
Bathymetry	9	3D Bathymetry data from multi beam or single beam sensors
Product	10	Product (HydroStar Application) and Project information
Native	11	Framed data without knowing the true format
Geodetic	12	Ellipsoidal information, Datum information, Translation and Projections
SeaBeam	13	Handle SeaBeam 2100 multi beam sonar
Message	14	Id and/or text messages
<Reserved>	15	<Reserved>
<Reserved>	16	<Reserved>

Figure 12: Valid Frames (Examples)

1.3.1 Control Frame

A specialized frame is the Control Frame. When data exchange is done on-line by using LAN or serial ports the Control Frame serves as the base frame to exchange control data between HydroStar Software and one or more software programs.

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Frame Start
Byte Count	4	ulong	N/A	Bytes	between Byte Count & Frame End
Id	4	ulong	8	N/A	see Figure 12
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*N/A*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*	*N/A*	*usec*	*micro seconds of seconds*
Transaction	4	ulong	N/A	N/A	Transaction number
Address	4	ulong	N/A	N/A	Sender IP address
…	…	…	…	…	frame specific groups
End	4	ulong	#HSF	N/A	Frame End

1.4 Groups

The groups are wrapped in a frame structure which contains common timing and status information valid to all groups in the frame, followed by the groups themselves. The order that the groups appear in a frame at the output will be arbitrary (e.g. group 5 do not need to appear after group 4). The items in the frames and groups are byte aligned!

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Group Start
Byte Count	4	ulong	N/A	Bytes	between Byte Count & Group End
Id	4	ulong	N/A	N/A	see Figure 14
…	…	…	…	…	Group specific data
End	4	ulong	#HSG	N/A	Group End

Figure 13: Basic Group

Figure 14 summarized all available frames with corresponding groups. The column labeled "Frame" states the name and the corresponding frame id. The Column labeled "Group" shows all group names with corresponding group ids which belong to the frame. The column labeled "Reference" gives the associated figure number. The Version column labeled "Version" indicates the latest program version of HydroStar Software and the latest document version of the XSE documentation which incorporates relevant changes of the given item. No version number implies

Frame		Group		Reference	Version	
Name	Id	Name	Id		HydroStar	Document
Navigation Motion Attitude	1	General	1	Figure 15		
		Point	2	Figure 16	2.8.1	0.8
		Accuracy	3	Figure 17	3.4.0	1.8.5
		Motion Ground Truth	4	Figure 18	2.8.1	0.9
		Motion Trough Water	5	Figure 19	2.8.1	
		Current Track Steering Properties	6	Figure 20		1.2
		Heave Roll Pitch	7	Figure 21	3.1.7	1.4.1
		Heave	8	Figure 22		1.4.1
		Roll	9	Figure 23		1.4.1
		Pitch	10	Figure 24		1.4.1
		Heading	11	Figure 25	3.3.2	1.4.1
		Speed	12	Figure 26	3.4.0	1.4.1
		GPS Altitude Group	13	Figure 27	3.4.0	1.8.5
Sound Velocity	2	General	1	Figure 28		0.9
		Depth	2	Figure 29	2.8.2	0.9
		Velocity	3	Figure 30	2.8.2	0.9
		Conductivity	4	Figure 31	2.8.2	0.9
		Salinity	5	Figure 32	2.8.2	0.9
		Temperature	6	Figure 33	2.8.2	0.9
		Pressure	7	Figure 34	2.8.2	1.0
		Surface	8	Figure 35		0.9.1
		Point	9	Figure 36		1.4
Tide	3	General	1	Figure 37		0.9
		Point	2	Figure 38	3.4.0	0.9
		Time	3	Figure 39	3.4.0	1.0
		Tide	4	Figure 40	3.4.0	1.0
Ship	4	General	1	Figure 41	3.3.2	0.9
		Time	2	Figure 42		
		Draft	3	Figure 43		
		Sensors	4	Figure 44	3.3.4	1.8.4
		Motion	5	Figure 45		
		Geometry	6	Figure 46		
		Description	7	Figure 47		
		Parameter (Not supported since June 2002)	8	Figure 48	2.8.2.	0.9
		NavigationAndMotion	9	Figure 49	3.3.4	1.8.4
		Transducer	10	Figure 50	3.3.4	1.8.4
		Transducer Extended	11	Figure 51	3.4.0	1.8.5
Side scan	5	General	1	Figure 52	3.1.9	1.7.1
		Amplitude vs. Traveltime	2	Figure 53	3.2.2	0.9
		Phase vs. Traveltime	3	Figure 54		0.9
		Amplitude vs. lateral	4	Figure 55	3.1.9	1.7.1
		Phase vs. lateral	5	Figure 56		1.7.2
		Signal	6	Figure 57	3.2.2	0.9
		Ping Type	7	Figure 58	3.3.1	1.8.1
		Complex Signal	8	Figure 59	3.3.2	1.8.2
		Weighting	9	Figure 60	3.3.3	1.8.3
Multi beam	6	General	1	Figure 61	3.1.9	1.7.1
		Beam	2	Figure 62		
		Travel time	3	Figure 63	2.8.1	0.9
		Quality	4	Figure 64	2.8.1	0.9
		Amplitude	5	Figure 65	2.8.1	0.9
		Delay	6	Figure 66	2.8.1	0.9
		Lateral	7	Figure 67	3.1.7	0.9.1
		Along	8	Figure 68	3.1.7	0.9.1
		Depth	9	Figure 69	3.1.7	0.9.1
		Angle	10	Figure 70	2.8.1	0.9
		Heave	11	Figure 71	2.8.1	0.9
		Roll	12	Figure 72	2.8.1	0.9
		Pitch	13	Figure 73	2.8.1	0.9
		Gates	14	Figure 74	2.1.7	0.9.1
		Noise (signal to noise ratio)	15	Figure 75	3.1.7	0.9.1
		Echo length	16	Figure 76	3.1.7	0.9.1
		Hits	17	Figure 77	3.1.7	0.9.1
		Heave Receive	18	Figure 78	3.4.0	1.8.5
Single beam	7	General	1	Figure 79		0.8
Control	8	General	1	Figure 80		
		Change	2	Figure 81		
		Add	3	Figure 82		

Frame		Group		Reference	Version	
Name	Id	Name	Id		HydroStar	Document
		Delete	4	Figure 83		
		Action	5	Figure 84	2.8.1	1.1
		Continuous	6	Figure 85	2.8.1	1.1
		Request	7	Figure 86		1.1
		Connection	8	Figure 87	2.8.1	1.1
		Reply	9	Figure 88		1.1
		Identity	10	Figure 89	3.0.14	1.7
		Record File Name	11	Figure 90		
		Sonar Multibeam Settings	12	Figure 91		
		Sonar SB1000 Power	13	Figure 92		
Bathymetry	9	General	1	Figure 93		
		Points	2	Figure 94		
		SwathBounderies	3	Figure 95		
Product	10	General	1	Figure 96		
		ExchangeServer	2	Figure 97		
		ProjectProperties	3	Figure 98		
		Sources	4	Figure 99		
Native	11	Collectable	1	Figure 100		
		Raw	2	Figure 101		
		ELAC	3	Figure 102		
		UNB	4	Figure 103		
Geodetic	12	General	1	Figure 104		
		Ellipsoid	2	Figure 105		
		Datum	3	Figure 106		
		Projection	4	Figure 107		
		System	5	Figure 108		
		Alias	6	Figure 109		
SeaBeam	13	Properties	1	Figure 110	3.1.7	1.4
		HeaveRollPitch	2	Figure 111	3.1.7	1.4
		Setup	3	Figure 112	3.1.7	1.4
		MotionReferenceUnit	4	Figure 113	3.1.7	1.4
		Settings	5	Figure 114	3.1.7	1.4
		Beams	6	Figure 115	3.1.7	1.4
		Gates	7	Figure 116	3.1.7	1.4
		Slice	8	Figure 117	3.1.7	1.4
		Signal	9	Figure 118	3.1.7	1.4
		Sidescan	10	Figure 119	3.1.7	1.4
		Shutdown	11	Figure 120	3.1.7	1.4
		Ping	12	Figure 121	3.1.7	1.4
		Calibrate	13	Figure 122	3.1.7	1.4
		Collect	14	Figure 123	3.1.7	1.4
		Surface	15	Figure 124	3.1.7	1.4
		Hydrophone	16	Figure 125	3.1.7	1.4
		Projector	17	Figure 126	3.1.7	1.4
		Bias	18	Figure 127	3.1.7	1.4
		Acknowledge	19	Figure 128	3.1.7	1.4
		Warning	20	Figure 129	3.1.7	1.6.9
		Message	21	Figure 130	3.1.7	1.6.9
		Error	22	Figure 131	3.1.7	1.6.9
		Transmit	23	Figure 132	3.1.7	1.4.1
		Transmitter	24	Figure 133	3.1.7	1.4.1
		Amplifier	25	Figure 134	3.1.7	1.4.1
		Update	26	Figure 135	3.1.7	1.4.1
		Firmware	27	Figure 136	3.1.7	1.4.1
		Generate	28	Figure 137	3.1.7	1.4.1
		TimeVaryingGain	29	Figure 138	3.1.7	1.4.1
		Process	30	Figure 139	3.1.7	1.4.1
		Processor	31	Figure 140	3.1.7	1.4.1
		Receive	32	Figure 141	3.1.7	1.4.1
		Receiver	33	Figure 142	3.1.7	1.4.1
		Calibration	34	Figure 143	3.1.7	1.4.1
		Echo	35	Figure 144	3.1.7	1.4.1
		Protocol	36	Figure 145	3.1.7	1.4.1
		SelectSignal	37	Figure 146	3.1.7	1.6
		TransducerAdvance	38	Figure 147		1.8.4
		Seabeam 3000 Ping	39	Figure 148	3.4.0	1.8.5
		Sweep Segments	40	Figure 149	3.4.0	1.8.5
		Shut Down Amplifiers	41	Figure 150	3.4.0	1.8.5
		SB3000 Settings	42	Figure 151	3.4.0	1.8.5
		Enable / Disable Power Amplifiers	43	Figure 152	3.4.0	1.8.5

Frame		Group		Reference	Version	
Name	Id	Name	Id		HydroStar	Document
		Power Amplifier Monitoring	44	Figure 153	3.4.0	1.8.5
		Transmitter Tests	45	Figure 154	3.4.0	1.8.5
		Reset Transmitter	46	Figure 155	3.4.0	1.8.5
		Power Amplifier Monitoring Data	47	Figure 156	3.4.0	1.8.5
		Transmitter Test Result	48	Figure 157	3.4.0	1.8.5
		Raw Data	49	Figure 158	3.4.0	1.8.5
Message	14	Error	1	Figure 159	3.2.2	1.4.1
		Warning	2	Figure 160	3.2.2	1.4.1
		Info	3	Figure 161	3.2.2	1.4.1
		Debug	4	Figure 162		1.8.5
		Exception	5	Figure 163		1.8.5
		Annotation	6	Figure 164		1.8.5

Figure 14: Valid Groups

1.4.1 Navigation Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	24	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
End	4	ulong	#HSG	N/A	End Group

Figure 15: General Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	32+N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Point Group
N	*4*	*ulong*	*Geodetic Point Item*	*N/A*	*Description length*
Description	*N*	*char*		*chars*	*Geodetic Description*
X	*8*	*double*		*m/radian*	*East/Longitude*
Y	*8*	*double*		*m/radian*	*North/Latitude*
Z	*8*	*double*		*m*	*Height/Ellipsoidal Height*
End	4	ulong	#HSG	N/A	End Group

Figure 16: Point Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	24	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Accuracy Group
QualityIndicator	2	short	0: FixOrInvalid 1: SPS 2: DifferentialSPS, 3: PPS 4: RTK 5: FloatRTK 6: Estimated 7: Manual 8: Simulator		GPS QualityIndicator Fix not available or invalid; GPS SPS Mode, fix valid; Differential GPS SPS Mode, fix valid; GPS PPS Mode, fix valid; Real Time Kinematic System used in RTK mode with fixed integers; Float RTK. Satellite system used in RTK Mode, floating integers; Estimated (dead reckoning) Mode; Manual Input Mode; Simulator Mode
Satellites	1	uchar			Number of Satellites
HorizontalDilution	4	float			Horizontal Dilution of precision
DifferentialAge	4	float		sec	Age of Differential GPS data (Time in seconds since last SC104 Type 1 or 9 update, null field when DGPS is not used
DifferentialReferenceStation	4	ulong			Differential Reference Station
End	4	ulong	#HSG	N/A	End Group

Figure 17: Accuracy Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	20	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Motion Ground Truth Group
Speed	8	double		m/s	Speed made good
Course	8	double		radian	Course made good (0..2*π)
End	4	ulong	#HSG	N/A	End Group

Figure 18: Motion Ground Truth Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	20	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	Motion Through Water Group
Speed	8	double		m/s	Speed
Course	8	double		radian	Heading (0..2*π)
End	4	ulong	#HSG	N/A	End Group

Figure 19: Motion Through Water Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	60	bytes	between Byte Count & Group End
Id	4	ulong	6	N/A	Current Track Properties Group
Offset Track	8	double		m	
Offset SOL	8	double		m	
Offset EOL	8	double		m	
Distance SOL	8	double		m	Distance to Start Of Line
Azimuth SOL	8	double		radian	Azimuth to Start Of Line
Distance EOL	8	double		m	Distance to End Of Line
Azimuth EOL	8	double		radian	Azimuth to End Of Line
End	4	ulong	#HSG	N/A	End Group

Figure 20: Current Track Steering Properties Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	28	bytes	between Byte Count & Group End
Id	4	ulong	7	N/A	HeaveRollPitch Group
Heave	8	double		m	heave
Roll	8	double		radian	roll
Pitch	8	double		radian	pitch
End	4	ulong	#HSG	N/A	End Group

Figure 21: HeaveRollPitch Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Heave Group
Heave	8	double		m	Heave
End	4	ulong	#HSG	N/A	End Group

Figure 22: Heave Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Roll Group
Roll	8	double		radian	Roll
End	4	ulong	#HSG	N/A	End Group

Figure 23: Roll Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	10	N/A	Pitch Group
Pitch	8	double		radian	Pitch
End	4	ulong	#HSG	N/A	End Group

Figure 24: Pitch Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	11	N/A	Heading Ground Truth Group
Course	8	double		radian	Heading (0..2*π)
End	4	ulong	#HSG	N/A	End Group

Figure 25: Heading Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	12	N/A	Speed Group
Speed	8	double		m/s	Speed through water (Log)
End	4	ulong	#HSG	N/A	End Group

Figure 26: Speed Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	24	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Accuracy Group
MeanSeaLevel	4	float		meter	Altitude re: mean-sea-level (geoid)
GeoidalSeparation	4	float		meter	The difference between the WGS-84 earth ellipsoid surface and mean-sea-level (geoid) surface, "-" = mean-sea-level surface below WGS-84 ellipsoid surface
End	4	ulong	#HSG	N/A	End Group

Figure 27: GPS Altitude Group

1.4.2 Sound Velocity Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
Length	*4*	*ulong*	*String Item*	*N/A*	*Text length*
Text	*N*	*char*		*chars*	*Description*
State	4	ulong	1: measured 2: calculated 3: mean	bits	
End	4	ulong	#HSG	N/A	End Group

Figure 28: General Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Depth Group
N	4	ulong		N/A	Number of values
Depth	8*N	double		meter	Depth values
End	4	ulong	#HSG	N/A	End Group

Figure 29: Depth Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Velocity Group
N	4	ulong		N/A	Number of values
Velocity	8*N	double		m/s	Velocity values
End	4	ulong	#HSG	N/A	End Group

Figure 30: Velocity Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Conductivity Group
N	4	ulong		N/A	Number of values
Conductivity	8*N	double		mmho/cm	Conductivity values
End	4	ulong	#HSG	N/A	End Group

Figure 31: Conductivity Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	Salinity Group
N	4	ulong		N/A	Number of depth values
Salinity	8*N	double		o/oo	Salinity values
End	4	ulong	#HSG	N/A	End Group

Figure 32: Salinity Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	6	N/A	Temperature Group
N	4	ulong		N/A	Number of values
Temperature	8*N	double		deg Celsius	Temperature values
End	4	ulong	#HSG	N/A	End Group

Figure 33: Temperature Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	
Id	4	ulong	7	N/A	Pressure Group

Item	Bytes	Format	Value	Units	Description
N	4	ulong		N/A	Number of values
Pressure	8*N	double		bar	Pressure values
End	4	ulong	#HSG	N/A	End Group

Figure 34: Pressure Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Surface Group
Velocity	8	double		m/s	Surface sound velocity
Depth	8	Double		M	
End	4	ulong	#HSG	N/A	End Group

Figure 35: Surface Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	32+N	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Point Group
N	*4*	*ulong*		*N/A*	*Description length*
Description	*N*	*char*	*Geodetic Point Item*	*chars*	*Geodetic Description*
X	*8*	*double*		*m/radian*	*East/Longitude*
Y	*8*	*double*		*m/radian*	*North/Latitude*
Z	*8*	*double*		*m*	*Height/Ellipsoidal Height*
End	4	ulong	#HSG	N/A	End Group

Figure 36: Point Group (not implemented)

1.4.3 Tide Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
Length	*4*	*ulong*	*N*	*N/A*	*Text length*
Text	*N*	*char*		*chars*	*Description*
End	4	ulong	#HSG	N/A	End Group

Figure 37: General Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	32+N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Point Group
N	*4*	*ulong*		*N/A*	*Description length*
Description	*N*	*char*	*Geodetic Point Item*	*chars*	*Geodetic Description*
X	*8*	*double*		*m/radian*	*East/Longitude*
Y	*8*	*double*		*m/radian*	*North/Latitude*
Z	*8*	*double*		*m*	*Height/Ellipsoidal Height*
End	4	ulong	#HSG	N/A	End Group

Figure 38: Point Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+4*N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Time Group
N	4	ulong		N/A	Number of values
Time	4*N	ulong		UTC Time	Time values
End	4	ulong	#HSG	N/A	End Group

Figure 39: Time Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Tide Group
N	4	ulong		N/A	Number of values
Tide	8*N	double		meter	Tide values
End	4	ulong	#HSG	N/A	End Group

Figure 40: Tide Group

1.4.4 Ship Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	56+N	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
N	*4*	*ulong*		*chars*	*Length of ship name*
Name	*N*	*char*		*N/A*	*Ship name*
Length	8	double		m	total length
Beam	8	double		m	total width
Draft	8	double		m	maximum draft
Height	8	double		m	maximum height
Displacement	8	double		cubic m	
Weight	8	double		kg	
End	4	ulong	#HSG	N/A	End Group

Figure 41: General Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+4*N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Time Group
N	4	ulong		N/A	Number of values
Time	4*N	ulong		UTC Time	Time where draft is valid
End	4	ulong	#HSG	N/A	End Group

Figure 42: Time Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Draft Group
N	4	ulong		N/A	Number of values
Draft	8*N	double		meter	Draft values
End	4	ulong	#HSG	N/A	End Group

Figure 43: Draft Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+12*N	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Sensors Group
N	4	ulong		N/A	Number of values
Sensor Ids	4*N	ulong		ids	Sensors id values
Sensor Type	4*N	ulong	1000: 2000: 2001: 3000: 4000: 8000: 9000: 9001:	SB1000 SB2100 SB2100 V-shaped SB3000 SingleBeam EdgeTech Sidescan Surfacesound velocity sensor	
Frequency	4*N	ulong		Hz	Frequency
End	4	ulong	#HSG	N/A	End Group

Figure 44: Sensors Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	Motion Group
End	4	ulong	#HSG	N/A	End Group

Figure 45: Motion Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	6	N/A	Geometry Group
End	4	ulong	#HSG	N/A	End Group

Figure 46: Geometry Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	7	N/A	Description Group
End	4	ulong	#HSG	N/A	End Group

Figure 47: Description Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	76	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Parameter Group
Roll	4	float		rad	HRP sensor roll offset
Pitch	4	float		rad	HRP sensor pitch offset
Heading	4	float		rad	heading sensor offset
Delay	4	float		sec	navigation time delay
PTrans. x	4	float		m	port transducer x position
PTrans. y	4	float		m	port transducer y position
PTrans. z	4	float		m	port transducer z position
STrans. x	4	float		m	starboard transducer x position
STrans y	4	float		m	starboard transducer y position
STrans z	4	float		m	starboard transducer z position
PTrans. Error	4	float		rad	port transducer rotation in roll direction
STrans. Error	4	float		rad	starboard transducer rotation in roll direction
Navigation x	4	float		m	navigation antenna x position
Navigation y	4	float		m	navigation antenna y position
Navigation z	4	float		m	navigation antenna z position
HRP x	4	float		m	HRP sensor x position
HRP y	4	float		m	HRP sensor y position
HRP z	4	float		m	HRP sensor z position
End	4	ulong	#HSG	N/A	End Group

Figure 48: Parameter Group (Not supported since June 2002)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	92	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Parameter Group
Roll	8	double		rad	HRP sensor roll offset
Pitch	8	double		rad	HRP sensor pitch offset
Heave	8	double		M	HRP sensor heave offset
Gyro	8	double		rad	Gyro sensor offset
Delay	8	double		sec	navigation time delay
Navigation x	8	double		m	navigation antenna x position
Navigation y	8	double		m	navigation antenna y position
Navigation z	8	double		m	navigation antenna z position
HRP x	8	double		m	HRP sensor x position
HRP y	8	double		m	HRP sensor y position
HRP z	8	double		m	HRP sensor z position
End	4	ulong	#HSG	N/A	End Group

Figure 49: NavigationAndMotion Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N*90	bytes	between Byte Count & Group End
Id	4	ulong	10	N/A	Transducer Group
Number N	4	ulong			Transducers Number
SensorID	4*N	ulong			Sensor Ids (SensorsGroup)
Transducer	1*N	uchar	0: Hydrophone 1: Projector 2: Transducer		Kind of Transducer
Frequency	4*N	ulong		Hz	Frequency
Side	1*N	uchar	0: undefined 1: port 2: starboard 3: midship 4: SystemDefined		Transducer Side
MountingRoll	8*N	Double		rad	array mounting angle (Roll)
MountingPitch	8*N	Double		rad	array mounting angle (Pitch)
MountingAzimuth	8*N	Double		rad	array mounting angle (Azimuth)
Distance	8*N	Double		m	Horizontal distance between the innermost transducer elements of the transducer arrays to the center ship line in a V-shaped ship configuration
X	8*N	Double		m	across track offset (transducer center)
Y	8*N	Double		m	along track offset (transducer center)
Z	8*N	Double		m	vertical offset (transducer center)
Roll Bias	8*N	Double		radian	roll bias value which should be used in beam forming (port up positive)
Pitch Bias	8*N	Double		radian	pitch bias value applied to beam forming (bow up positive)
Azimuth Bias	8*N	Double		radian	compass bias value applied to beam forming (projector axis clockwise with respect to compass positive)
End	4	ulong	#HSG	N/A	End Group

Figure 50: Transducer Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N*51	bytes	between Byte Count & Group End
Id	4	ulong	11	N/A	Transducer Group
Number N	4	ulong			Transducers Number
MountingRoll	1*N	uchar	0 Auto 1 Manual		Mode
MountingPitch	1*N	Uchar	0 Auto 1 Manual		Mode
MountingAzimuth	1*N	Uchar	0 Auto 1 Manual		Mode
	48*N	uchar			unused
End	4	ulong	#HSG	N/A	End Group

Figure 51: Transducer Extended Group

1.4.5 Side scan Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	28	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
Ping	4	ulong			Ping number
Frequency	4	float		kHz	Transducer frequency
Pulse	4	float		s	Transmit pulse length
Power	4	float		dB	Transmit power
Bandwidth	4	float		Hz	Band width of receiver filter
Sample	4	float		s	Sample interval
End	4	ulong	#HSG	N/A	End Group

Figure 52: General Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+2*N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	AmplitudeTraveltime Group
Interval	4	ulong		us	Sample interval
Offset	4	ulong			Time offset
N	4	ulong		N/A	Number of values
Amplitude	2*N	short		N/A	Amplitude (normally in dB) Sample 0 is on starboard side. Sample N is in port side.
End	4	ulong	#HSG	N/A	End Group

Figure 53: Amplitude vs. Traveltime Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+2*N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	PhaseTraveltime Group
Interval	4	ulong		us	Sample interval
Offset	4	ulong		us	Time offset
N	4	ulong		N/A	Number of values
Phase	2*N	short		radian	Phase
End	4	ulong	#HSG	N/A	End Group

Figure 54: Phase vs. Traveltime Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+2*N	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	AmplitudeLateral Group
Size	4	ulong		mm	Bin size
Offset	4	ulong		mm	Lateral offset
N	4	ulong		N/A	Number of values
Amplitude	2*N	short		dB	Amplitude
End	4	ulong	#HSG	N/A	End Group

Figure 55: Amplitude vs. Lateral Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+2*N	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	PhaseLateral Group
Size	4	ulong		mm	Bin size
Offset	4	ulong		mm	Lateral offset
N	4	ulong		N/A	Number of values
Phase	2*N	short		radian	Phase
End	4	ulong	#HSG	N/A	End Group

Figure 56: Phase vs. Lateral Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	32+N*2	bytes	between Byte Count & Group End
Id	4	ulong	6	N/A	Signal Group
Number	4	ulong		N/A	Ping number
Channel	4	ulong		N/A	Channel id
Offset	8	double		N/A	Start offset
Interval	8	double		N/A	Bin size/sample interval
N	4	ulong		N/A	Number of Samples
Sample	2*N	short		N/A	Phase
End	4	ulong	#HSG	N/A	End Group

Figure 57: Signal Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	40+N	bytes	between Byte Count & Group End
Id	4	ulong	7	N/A	Ping Type Group
Frequency Mode	4	ulong	0 1	constant linear sweep	Pulse type
Start Frequency	8	double		Hz	Start frequency
End Frequency	8	double		Hz	End frequency
Duration	8	double		ms	Transmit pulse duration
Manufacturer Code	4	ulong	1 2	EdgeTech ELAC	Manufacturer code
Pulse Id	4	long			Pulse identifier (proprietary)
Name	4+N	string			Pulse name (proprietary)
End	4	ulong	#HSG	N/A	End Group

Figure 58: Ping Type Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	40+N	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Complex Signal Group
Number	4	ulong		N/A	Ping number
Channel	4	ulong		N/A	Channel id
Offset	8	double		us	Start offset
Interval	8	double		us	Bin size/sample interval
N	4	ulong		N/A	Number of Samples
Sample	4*N	short		N/A	Signal data, (1 short real, 1 short imaginary) N times
End	4	ulong	#HSG	N/A	End Group

Figure 59: Complex Signal Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	20	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Weighting Group
FactorLeft	2	short			weighting factor for block floating point expansion -- defined as 2^(-N) volts for lsb
SamplesLeft	4	ulong			
FactorRight	2	short			weighting factor for block floating point expansion -- defined as 2^(-N) volts for lsb
SamplesRight	4	ulong			
End	4	ulong	#HSG	N/A	End Group

Figure 60: Weighting Group

1.4.6 Multi beam Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	32	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
Ping	4	ulong			Ping number
Frequency	4	float		Hz	Transducer frequency
Pulse	4	float		s	Transmit pulse length
Power	4	float		dB	Transmit power
Bandwidth	4	float		Hz	Band width of receiver filter
Sample	4	float		s	Sample interval
Swath	4	float		radians	
End	4	ulong	#HSG	N/A	End Group

Figure 61: General Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+2*N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Beam Group
N	4	ulong		N/A	Number of values
Beam	2*N	ushort			Beam number
End	4	ulong	#HSG	N/A	End Group

Figure 62: Beam Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Traveltime Group
N	4	ulong		N/A	Number of values
Traveltime	8*N	double		s	Traveltime (two ways)
End	4	ulong	#HSG	N/A	End Group

Figure 63: Traveltime Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Quality Group
N	4	ulong		N/A	Number of values
Quality	N	uchar		N/A	
End	4	ulong	#HSG	N/A	End Group

Figure 64: Quality Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+2*N	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	Amplitude Group
N	4	ulong		N/A	Number of values
Amplitude	2*N	ushort		0.1 dB	Average of amplitudes
End	4	ulong	#HSG	N/A	End Group

Figure 65: Amplitude Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	6	N/A	Delay Group
N	4	ulong		N/A	Number of values
Delay	8*N	double		s	Time offset of the beam relative to frame time
End	4	ulong	#HSG	N/A	End Group

Figure 66: Delay Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	7	N/A	Lateral Group
N	4	ulong		N/A	Number of values
Lateral	8*N	double		m	Lateral distance (negative starboard, positive port)
End	4	ulong	#HSG	N/A	End Group

Figure 67: Lateral Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Along Group
N	4	ulong		N/A	Number of values
Along	8*N	double		m	Along distance (negative stern, positive bow)
End	4	ulong	#HSG	N/A	End Group

Figure 68: Along Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Depth Group
N	4	ulong		N/A	Number of values
Depth	8*N	double		m	Depth below transducer
End	4	ulong	#HSG	N/A	End Group

Figure 69: Depth Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	10	N/A	Angle Group
N	4	ulong		N/A	Number of values
Angle	8*N	double		radian	Beam angle (negative starboard, positive port) >>Launch Angle
End	4	ulong	#HSG	N/A	End Group

Figure 70: Angle Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	11	N/A	Heave Group
N	4	ulong		N/A	Number of values
Heave	8*N	double		m	
End	4	ulong	#HSG	N/A	End Group

Figure 71: Heave Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	12	N/A	Roll Group
N	4	ulong		N/A	Number of values
Roll	8*N	double		radian	
End	4	ulong	#HSG	N/A	End Group

Figure 72: Roll Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	13	N/A	Pitch Group
N	4	ulong		N/A	Number of values
Pitch	8*N	double		radian	
End	4	ulong	#HSG	N/A	End Group

Figure 73: Pitch Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	8+16*N	bytes	between Byte Count & Group End
Id	4		ulong	14	N/A	Gates Group
N	4		ulong		N/A	Number of values
Angle	8	16*N	double		radians	direction of beam
Start	4		float		s	Start gate
Stop	4		float		s	Stop gate
End	4		ulong	#HSG	N/A	End Group

Figure 74: Gates Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+4*N	bytes	between Byte Count & Group End
Id	4	ulong	15	N/A	Noise Group
N	4	ulong		N/A	Number of values
Noise	4*N	float		dB	Signal to noise ratio
End	4	ulong	#HSG	N/A	End Group

Figure 75: Noise Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+4*N	bytes	between Byte Count & Group End
Id	4	ulong	16	N/A	Length Group
N	4	ulong		N/A	Number of values
Length	4*N	float		s	Echo length
End	4	ulong	#HSG	N/A	End Group

Figure 76: Length Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+4*N	bytes	between Byte Count & Group End
Id	4	ulong	17	N/A	Hits Group
N	4	ulong		N/A	Number of values
Hits	4*N	ulong			Hits
End	4	ulong	#HSG	N/A	End Group

Figure 77: Hits Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count & Group End
Id	4	ulong	18	N/A	Heave Receive Group
N	4	ulong		N/A	Number of values
Heave	8*N	double		m	heave at time of receive
End	4	ulong	#HSG	N/A	End Group

Figure 78: Heave Receive Group

1.4.7 Single beam Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	44	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
Frequency	4	ulong		kHz	30/200 kHz transducer
Quality	4	ulong		N/A	0/1 invalid/valid
Traveltime	8	double	N/A	sec	not used (NaN)
Sound	8	double		m/s	used sound velocity
Depth	8	double		m	calculated depth
Amplitude	8	double	N/A	dB	not used (NaN)
End	4	ulong	#HSG	N/A	End Group

Figure 79: General Group

1.4.8 Control Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
End	4	ulong	#HSG	N/A	End Group

Figure 80: General Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Change Group
End	4	ulong	#HSG	N/A	End Group

Figure 81: Change Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Add Group
End	4	ulong	#HSG	N/A	End Group

Figure 82: Add Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Delete Group
End	4	ulong	#HSG	N/A	End Group

Figure 83: Delete Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	Action Group
Action	4	ulong	start actions: 0x01: record 0x02: playback 0x04: simulate 0x08: online stop actions: 0x11: record 0x12: playback 0x14: simulate 0x18: standby	bit	start and/or stop one of the following actions: storage record or play, simulate, sensor standby or online
End	4	ulong	#HSG	N/A	End Group

Figure 84: Action Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+4*N	bytes	between Byte Count & Group End
Id	4	Ulong	6	N/A	Continues Group
Frame	4	ulong			Requested frame id
Mode	4	ulong	1 2	enable disable	Enable/disable
N	4	ulong			Number of groups
Group	4	ulong			Requested group id
End	4	ulong	#HSG	N/A	End Group

Figure 85: Continuous Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	7	N/A	Request Group
Frame	4	ulong			Requested frame id
N	4	ulong			Number of groups
Group	4	ulong			Requested group id
End	4	ulong	#HSG	N/A	End Group

Figure 86: Request Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	10	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Connection Group
Port	2	short			Port number
Command	4	ulong	1: open 2: close	bit	Open or close connection
End	4	ulong	#HSG	N/A	End Group

Figure 87: Connection Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Reply Group
Transaction	4	ulong			transaction number to which this reply corresponds
Status	4	ulong	1: error 2: accepted 3: unavailable 4: processing	bit	error, accepted request or command, requested data unavailable, processing request or command
End	4	ulong	#HSG	N/A	End Group

Figure 88: Reply Group (not implemented)

L-3 Communications ELAC Nautik GmbH

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+N	bytes	between Byte Count & Group End
Id	4	ulong	10	N/A	Identity Group
Server	4	ulong	0..99: HydroStar Software 100: SeaBeam 2100 101: Isis2000 102: Hysweep 103: ISS2000 104: SMS 105: Helmsman1 106: Helmsman2 107: NaviBat 108: NAVICOURSE 109: HydroStar NDS 110: QINSy 111: PDS2000 112: SeaBeam 3000 113 SeaBeam RawData 114: GeomarSidescan	number	Identity number of sensor (client or server)
Version	4	ulong		number	version of client or server software
Name	4+N	string			name of client or server software
End	4	ulong	#HSG	N/A	End Group

Figure 89: Identity Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N	bytes	between Byte Count & Group End
Id	4	ulong	11	N/A	Identity Group
Filename	4+n	String			Filename by recording
End	4	ulong	#HSG	N/A	End Group

Figure 90: Record File Name Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong		bytes	between Byte Count & Group End
Id	4	ulong	12	N/A	Identity Group
Sensor Id	4	ulong		ids	See ShipFrame Sensor Group
Frequency		float		kHz	
Power Mode		uchar	Auto Manual		
Power		short	0, -3, … -18	db	
Pulse Mode		uchar	Auto Manual		
Pulse Length		float		ms	SB1000: 0.15 0.3 1 3
Bandwidth Mode		uchar	Auto Manual		
Bandwidth		float		kHz	SB1000: 1 kHz 3.3 kHz 12 kHz
Swath Width Mode		uchar	Auto Manual		
Swath Width		float		Rad	SB1000 in Degree: 15, 41, 63, 86, 108, 131, 153
Gain Mode		uchar	Auto Manual		
Gain		double		dB	
Gates Mode		uchar	Auto Manual		
Center Depth		float		m	Gates
Width		float		m	Gates
Sidescan		uchar	On Off		
Pixel Mode		uchar	Auto Manual		Sidescan
Pixel Size		float			Sidescan
	50				Unused
End	4	ulong	#HSG	N/A	End Group

Figure 91: Sonar Multibeam Settings Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	5	bytes	between Byte Count & Group End
Id	4	ulong	13	N/A	Identity Group
Sensor Id	4	ulong		ids	See ShipFrame Sensor Group
Remote Mode	1	uchar	0: Off 1: On		Remote Power Off Remote Power ON
End	4	ulong	#HSG	N/A	End Group

Figure 92: Sonar SB1000 Power Group (not implemented)

1.4.9 Bathymetry Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
End	4	ulong	#HSG	N/A	End Group

Figure 93: General Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N1+24*N2	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Points Group
Description	*4+N1*	*string*			*Geodetic Description*
Entries	4	ulong			Number of point items
Points	*24*N2*	*point*			*Point items*
End	4	ulong	#HSG	N/A	End Group

Figure 94: Points Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+N1+N2+N3	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	SwathBounderies Group
N1	*4*	*ulong*		*N/A*	
Description	*N1*	*char*	*Geodetic*	*chars*	*Valid Outermost Starboard*
X	*8*	*double*	*Point Item*	*m/radian*	*Position*
Y	*8*	*double*		*m/radian*	
Z	*8*	*double*		*m*	
N2	*4*	*ulong*		*N/A*	
Description	*N2*	*char*	*Geodetic*	*chars*	
X	*8*	*double*	*Point Item*	*m/radian*	*Valid Innermost Position*
Y	*8*	*double*		*m/radian*	
Z	*8*	*double*		*m*	
N3	*4*	*ulong*		*N/A*	
Description	*N3*	*char*	*Geodetic*	*chars*	*Valid Outermost Port*
X	*8*	*double*	*Point Item*	*m/radian*	*Position*
Y	*8*	*double*		*m/radian*	
Z	*8*	*double*		*m*	
End	4	ulong	#HSG	N/A	End Group

Figure 95: SwathBounderies (not implemented)

1.4.10   Product Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	24+N1+N2+N3 +N4+N5	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
Product	4+N1	string			Product Name
Vendor	4+N2	string			Vendor Name
Copyright	4+N3	string			Copyright text
Version	4+N4	string			Version text
System	4+N5	string			Operating system
End	4	ulong	#HSG	N/A	End Group

Figure 96: Application Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	18+N1+N2	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	ExchangeServer Group
Machine	4+N1	string			IP Machine Name
Address	4+N2	string			IP Machine Address
Port	2	ushort			IP Port
Version	4	ulong			XSE Server Version
End	4	ulong	#HSG	N/A	End Group

Figure 97: ExchangeServer Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	9	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	ProjectProperties Group
Playback	1	boolean			true: Playback on
Recording	1	boolean			true: Recording
On-line	1	boolean			true: On-line (Pinging)
Simulation	1	boolean			true: Simulating
Surveying	1	boolean			true: Surveying
End	4	ulong	#HSG	N/A	End Group

Figure 98: ProjectProperties Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N1*(12+N2+ N3)	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Source Group
N1	4	ulong			Number of sources
Id	4	ulong			Source Id
Version	4+N2	string			Source Version (e.g. version of sensor software)
Name	4+N3	string			Source Name
End	4	ulong	#HSG	N/A	End Group

Figure 99: Source Group (not implemented)

1.4.11   Native Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4+N	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	Collectable Group
Data	N	uchar			Collectable data
End	4	ulong	#HSG	N/A	End Group

Figure 100: Collectable Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Raw Group
Sensor	4	ulong			Sensor Id
N	4	ulong			Length of raw data
Data	N	uchar			Raw data
End	4	ulong	#HSG	N/A	End Group

Figure 101: Raw Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4+N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	ELAC Group
Data	N	uchar			ELAC data
End	4	ulong	#HSG	N/A	End Group

Figure 102: ELAC Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4+N	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	UNB Group
Data	N	uchar			UNB data
End	4	ulong	#HSG	N/A	End Group

Figure 103: UNB Group (not implemented)

1.4.12 Geodetic Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	General Group
End	4	ulong	#HSG	N/A	End Group

Figure 104: General Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	28+N1+N2	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Ellipsoid Group
Code	4+N1	string			
Name	4+N2	string			
Major	8	double			Semi-major axis
Inverse Flattening	8	double			Inverse Flattening
End	4	ulong	#HSG	N/A	End Group

Figure 105: Ellipsoid (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Datum Group
Code	4+N1	string			
Name	4+N2	string			
RefCode	4+N3	string			Code of Reference Ellipsoid defined in Figure 106
Translation		point		m	translation
Rotation		point		rad	rotation angles
Scale				ppm	Rotation scale
End	4	ulong	#HSG	N/A	End Group

Figure 106: Datum Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	Projection Group
End	4	ulong	#HSG	N/A	End Group

Figure 107: Projection Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	4	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	System Group
End	4	ulong	#HSG	N/A	End Group

Figure 108: System Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N1+N2	bytes	between Byte Count & Group End
Id	4	ulong	6	N/A	Alias Group
Name	4+N1	string			
Alias	4+N2	string			
End	4	ulong	#HSG	N/A	End Group

Figure 109: Alias Group (not implemented)

1.4.13   SeaBeam Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	52	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	Properties Group
Ping	4	ulong		number	Ping number
Gain	4	float		dB	currently used ping gain
Pulse	4	float		s	currently used pulse width
Power	4	float		dB	currently used transmit power level
Sidescan	4	float		m	currently used physical size of each pixel in side scan data
Swath	4	float		radians	currently used swath width
Interval	4	float		sec	time interval between slices (computed by the sonar based on pulse width)
Depth Mode	4	ulong	1 2 3	shallow intermediate deep	
Beam Mode	4	ulong	1 0	focused normal	focused beam mode
Sound	4	float		m/s	surface sound velocity
Frequency	4	float		kHz	frequency of sonar system
Bandwidth	4	float		kHz	receiver bandwidth
End	4	ulong	#HSG	N/A	End Group

Figure 110: Properties Group (Send with each Beams Group)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	28	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	HeaveRollPitch Group
Heave	8	double		m	sensor heave
Roll	8	double		radians	sensor roll
Pitch	8	double		radians	sensor pitch
End	4	ulong	#HSG	N/A	End Group

Figure 111: HeaveRollPitch Group (at sending time)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	28	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Setup Group
Frequency	4	float		kHz	Frequency of sonar
ShallowToIntermediate	4	ulong		us	the range at which the sonar should switch from deep (1-degree) to shallow (4-degree) beam forming
IntermediateToShallow	4	ulong		us	the range at which the sonar should switch from deep (1-degree) to shallow (4-degree) beam forming
IntermediateToDeep	4	ulong		us	the range at which the sonar should switch from shallow (4-degree) to deep (1-degree) beam forming
DeepToIntermediate	4	ulong		us	the range at which the sonar should switch from shallow (4-degree) to deep (1-degree) beam forming
Synchronizer	4	ulong		list entry number	tells the sonar what sort of external synchronizer it should use from a list of available devices (including "none"
End	4	ulong	#HSG	N/A	End Group

Figure 112: Setup Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	24	bytes	between Byte Count & Group End
Id	4	ulong	4	N/A	MotionReferenceUnit Group
Source	4	ulong	0: none 1: TSS1	list entry number	tell the MRU reader to read data from one of the devices it is familiar with
X	4	float		m	across track offset
Y	4	float		m	along track offset
Z	4	float		m	vertical offset
Latency	4	float		sec	device latency
End	4	ulong	#HSG	N/A	End Group

Figure 113: MotionReferenceUnit Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	64	bytes	between Byte Count & Group End
Id	4	ulong	5	N/A	Settings Group
Gain mode	4	ulong	2 3	auto manual	auto makes the sonar set the ping gain based on previous range measurement
Gain	4	float		dB	ping gain if gain mode is manual
Pulse mode	4	ulong	2 3	auto manual	auto makes the sonar set the pulse width based on previous range measurement
Pulse	4	float		s	pulse width if pulse mode is manual
Power mode	4	ulong	2 3	auto manual	auto makes the sonar set the power level based on previous range measurement
Power	4	float		dB	transmit power level if power mode is manual
Sidescan mode	4	ulong	2 3	auto manual	in auto the sonar will compute a sidescan pixel size which corresponds to the swath width
Sidescan size	4	float		m	physical size of each pixel in sidescan data
Swath mode	4	ulong	2 3	auto manual	
Swath width	4	float		radians	full swath width
Gates mode	4	ulong	2 3	auto manual	auto makes the sonar set the gates on previous range measurements
Gate Center	4	ulong		us	center depth (manual gate mode)
Gate Width	4	ulong		us	(manual gate mode)
Gate Slope	4	float		radians	angle of manual gates with port up positive
FocuedBeam	4	ulong	0 1 2	off on auto	
End	4	ulong	#HSG	N/A	End Group

Figure 114: Settings Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	24+40*N	bytes	between Byte Count & Group End
Id	4		ulong	6	N/A	Beams Group
Across	8		double		radians	beam width across track
Along	8		double		radians	beam width along track
Count N	4		ulong			number of beams
Number	4		ulong		number	beam number (Starboard: Beam 0, Port Beam N-1)
Flag	4		ulong	0xFF00 0x8000 0xC000 0x00FF 0x0001 0x0002 0x0004 0x0008	bit masked BDI WMT bit masked good fair bad invalid	Algorithm: beam direction index (BDI) weighted mean time (WMT) Quality: good fair bad none, invalid
Range	4	40*N	ulong		us	travel time
Vertical	4		float		radians	launch angle
Forward	4		float		radians	Bearing angle
Heave	4		float		m	Heave at receiving time
Amplitude	4		float		dB	
Signal	4		float		dB	Signal to noise ratio
Length	4		ulong		pixel	Echo length
Hits	4		ulong		counter	Number of signals above threshold
End	4		ulong	#HSG	N/A	End Group

Figure 115: Beams Group (The Beams are corrected by roll and pitch)

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	12+12*N	bytes	between Byte Count & Group End
Id	4		ulong	7	N/A	Gates Group
Mode	4		ulong			auto or manual
Count N	4		ulong			number of gates
Angle	4	12*N	float		radians	beam angle
Start	4		ulong		us	range, travel time
Stop	4		ulong		us	range, travel time
End	4		ulong	#HSG	N/A	End Group

Figure 116: Gates Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	16+4*H	bytes	between Byte Count & Group End
Id	4		ulong	8	N/A	Raw Group
Slice	4		ulong			slice number
Roll	4		float			roll valid for each slice
HydrophonesH	4		ulong			number of hydrophones
Raw	4	4*H	ulong			sampled hydrophone data
End	4		ulong	#HSG	N/A	End Group

Figure 117: Slice Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	12+4*N	bytes	between Byte Count & Group End
Id	4		ulong	9	N/A	Center Group
Beam	4		ulong			beam number
Count N	4		ulong			number of samples
Signal	4	4*N	float		dB	amplitude data
End	4		ulong	#HSG	N/A	End Group

Figure 118: Signal Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	8+2*4*N	bytes	between Byte Count & Group End
Id	4		ulong	10	N/A	Sidescan Group
Count N	4		ulong			number of pixels
Amplitude	4	8*N	float		dB	amplitude
Along	4		float		m	distance along track
End	4		ulong	#HSG	N/A	End Group

Figure 119: Sidescan Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	11	N/A	Shutdown Group
State	4	ulong	1	trigger	causes sonar to shut down gracefully
End	4	ulong	#HSG	N/A	End Group

Figure 120: Shutdown Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	12	N/A	Ping Group
State	4	ulong	1/0	on/off	causes sonar cycle to ping
End	4	ulong	#HSG	N/A	End Group

Figure 121: Ping Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	13	N/A	Calibrate Group
State	4	ulong	1	trigger	calibrate receiver on next ping
End	4	ulong	#HSG	N/A	End Group

Figure 122: Calibrate Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	14	N/A	Collect Group
State	4	ulong	1/0	on/off	collect raw hydrophone data and send it to UI
End	4	ulong	#HSG	N/A	End Group

Figure 123: Collect Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	15	N/A	Surface Group
Velocity	4	float		m/s	Surface sound velocity
End	4	ulong	#HSG	N/A	End Group

Figure 124: Surface Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	40	bytes	between Byte Count & Group End
Id	4	ulong	16	N/A	Hydrophone Group
Number	4	ulong			number of hydrophones in the hydrophone array
Spacing	4	float		m	spacing between hydrophone elements
Mounting	4	float	Starbd: < 0 Port: > 0	rad	array mounting angle
Distance	4	float		m	horizontal distance between the innermost transducer elements of the transducer arrays to the center ship line in a V-shaped ship configuration
Sound	4	float		m/s	used to compute shading coefficients
Baffle	4	float		m	
X	4	float		m	across track offset
Y	4	float		m	along track offset
Z	4	float		m	vertical offset
End	4	ulong	#HSG	N/A	End Group

Figure 125: Hydrophone Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16	bytes	between Byte Count & Group End
Id	4	ulong	17	N/A	Projector Group
X	4	float		m	across track offset
Y	4	float		m	along track offset
Z	4	float		m	vertical offset
End	4	ulong	#HSG	N/A	End Group

Figure 126: Projector Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16	bytes	between Byte Count & Group End
Id	4	ulong	18	N/A	Bias Group
Roll Bias	4	float		radian	roll bias value which should be used in beam forming (port up positive)
Pitch Bias	4	float		radian	pitch bias value applied to beam forming (bow up positive)
Azimuth Bias	4	float		radian	compass bias value applied to beam forming (projector axis clockwise with respect to compass positive)
End	4	ulong	#HSG	N/A	End Group

Figure 127: Bias Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	19	N/A	Acknowledge Group
Group	4	ulong			Group to acknowledge
State	4	ulong	0x00000001 0x00000002 0x00000004 0x10000001 0x10000002 0x10000004		accepted accepted and processed accepted but pending rejected rejected unknown group rejected incorrect values
End	4	ulong	#HSG	N/A	End Group

Figure 128: Acknowledge Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	20	N/A	Warning Group
Warning	4	ulong			Warning Id
Text	4+N	string			Warning text
End	4	ulong	#HSG	N/A	End Group

Figure 129: Warning Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	21	N/A	Message Group
Message	4	ulong			Message Id
Text	4+N	string			Message text
End	4	ulong	#HSG	N/A	End Group

Figure 130: Message Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	22	N/A	Error Group
Error	4	ulong			Error Id
Text	4+N	string			Error text
End	4	ulong	#HSG	N/A	End Group

Figure 131: Error Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	23	N/A	Transmit Group
State	4	ulong	1/0	on/off	collect transmitter/amplifier data and send it to UI
End	4	ulong	#HSG	N/A	End Group

Figure 132: Transmit Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	16+24*N	bytes	between Byte Count & Group End
Id	4		ulong	24	N/A	Transmitter Group
Result	4		ulong	0 1 2	fail pass working	
Progress	4		float	0.0 – 100.0	percentage	
Amplifiers N	4		ulong		number	number of amplifiers
Voltage	4	24*N	float		Volt	
Current	4		float		Ampere	
Phase	4		float		radian	
Impedance	4		float		Ohm	
Power	4		float		Watt	
State	4		ulong	0 1 2	fail pass working	
End	4		ulong	#HSG	N/A	End Group

Figure 133: Transmitter Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	8+4*N	bytes	between Byte Count & Group End
Id	4		ulong	25	N/A	Amplifier Group
Amplifiers N	4		ulong			number of amplifiers
Switch	4	4*N	ulong	1/0	on/off	switch the amplifier on or off
End	4		ulong	#HSG	N/A	End Group

Figure 134: Amplifier Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	12+N+S	bytes	between Byte Count & Group End
Id	4		ulong	26	N/A	Update Group
Length N	4		ulong	string item	N/A	File name length
Text	1	N	char		chars	File name
Size S	4		ulong		chars	File size
Data	1	S	char		chars	File content
End	4		ulong	#HSG	N/A	End Group

Figure 135: Update Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	16+N	bytes	between Byte Count & Group End
Id	4		ulong	27	N/A	Firmware Group
Status	4		ulong	1 2 3	dead alive working	
Length N	4		ulong	string item	N/A	Version length
Text	1	N	char		chars	Version text
Progress	4		float	0.0 - 100.0	percentage	percentage of update complete
End	4		ulong	#HSG	N/A	End Group

Figure 136: Firmware Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16	bytes	between Byte Count & Group End
Id	4	ulong	28	N/A	Generate Group
Switch	4	ulong	0: Off 1: On (Int) 2: On (Ext)		1: Internel EDG 2: External EDG
TravelTime	4	ulong		us	two-way travel time
Hydrophone	4	ulong		number	hydrophone number
End	4	ulong	#HSG	N/A	End Group

Figure 137: Generate Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	29	N/A	TimeVaryingGain Group
Gain mode	4	ulong	1 2	varying flat	use TVG function use manual gain
Gain	4	float		dB	manual gain if gain mode is flat
End	4	ulong	#HSG	N/A	End Group

Figure 138: TimeVaryingGain Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	30	N/A	Process Group
Trigger	4	ulong	1	trigger	start DSP test
End	4	ulong	#HSG	N/A	End Group

Figure 139: Process Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12	bytes	between Byte Count & Group End
Id	4	ulong	31	N/A	Processor Group
Result	4	ulong	0 1 3	fail pass working	
Progress	4	float	0.0 - 100.0	percentage	
End	4	ulong	#HSG	N/A	End Group

Figure 140: Processor Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	32	N/A	Receive Group
Trigger	4	ulong	1	trigger	start receiver test
End	4	ulong	#HSG	N/A	End Group

Figure 141: Receive Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16	bytes	between Byte Count & Group End
Id	4	ulong	33	N/A	Receiver Group
Result	4	ulong	0 1 3	fail pass working	
Noise	4	float		dB	ambient noise level
Progress	4	float	0.0 - 100.0	percentage	
End	4	ulong	#HSG	N/A	End Group

Figure 142: Receiver Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	16+4*N	bytes	between Byte Count & Group End
Id	4		ulong	34	N/A	Calibration Group
Result	4		ulong	0	fail	
				1	pass	
				3	working	
Progress	4		float	0.0 - 100.0	percentage	
Projectors N	4		ulong			number of projectors
Coefficients	4	4*N	float			shading coefficients
End	4		ulong	#HSG	N/A	End Group

Figure 143: Calibration Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	44+N	bytes	between Byte Count & Group End
Id	4		ulong	35	N/A	Echo Group
Package	4		ulong			package number
Created	*8*		*double*	*N/A*	*sec*	*Creation time*
Send	*8*		*double*	*N/A*	*sec*	*Send time*
Received	*8*		*double*	*N/A*	*sec*	*Receive time*
Processed	*8*		*double*	*N/A*	*sec*	*Process time*
Length N	4		ulong			length of data
Data	1	N	char			data
End	4		ulong	#HSG	N/A	End Group

Figure 144: Echo Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	36	N/A	Protocol Group
Trigger	4	ulong	1	test groups	test groups in this frame, do not interpret the groups
End	4	ulong	#HSG	N/A	End Group

Figure 145: Protocol Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8	bytes	between Byte Count & Group End
Id	4	ulong	37	N/A	SelectSignal Group
Mode	4	ulong	1001	off	no beam signal
			1002	center	signal from center beam
			1003	all	beam signal of all beams
End	4	ulong	#HSG	N/A	End Group

Figure 146: SelectSignal Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	54	bytes	between Byte Count & Group End
Id	4	ulong	38	N/A	Hydrophone Group
Transducer	1	uchar	0: Hydrophone 1: Projector		Kind of Transducer
Frequency	4	ulong		Hz	Frequency
Side	1	uchar	0: undefined 1: port 2: starboard 3: midship		Transducer Side
Number	4	ulong			number of transducer in the transducer array
Spacing	4	float		m	spacing between transducer elements
MountingRoll	4	float		rad	array mounting angle
MountingPitch	4	float		rad	array mounting angle
MountingAzimuth	4	float		rad	array mounting angle
Distance	4	float		m	horizontal distance between the innermost transducer elements of the transducer arrays to the center ship line in a V-shaped ship configuration
Baffle	4	float		m	
X	4	float		m	across track offset (transducer center)
Y	4	float		m	along track offset (transducer center)
Z	4	float		m	vertical offset (transducer center)
Roll Bias	4	float		radian	roll bias value which should be used in beam forming (port up positive)
Pitch Bias	4	float		radian	pitch bias value applied to beam forming (bow up positive)
Azimuth Bias	4	float		radian	compass bias value applied to beam forming (projector axis clockwise with respect to compass positive)
End	4	ulong	#HSG	N/A	End Group

Figure 147: TransducerAdvance Group (not implemented)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	13	bytes	between Byte Count & Group End
Id	4	ulong	39	N/A	Seabeam 3000 Ping Group
Width	4	float		radian	Beam width along track
Voltage	4	float		V	High voltage at start of ping
Compensation	1	uchar	0 1	no yes	Attitude compensation applied flag
End	4	ulong	#HSG	N/A	End Group

Figure 148: Seabeam 3000 Ping Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	17+36*S	bytes	between Byte Count & Group End
Id	4		ulong	40	N/A	Sweep Segments Group
Sweep Direction	1		uchar	0 1 2	static to port to starboard	Sweep direction
Azimuth	4		float		radian	Effective azimuth
Yaw Correction	4		float		radian	Yaw correction at middle of ping
Segments	4		ulong	S	N/A	Number of segments
Seconds	4	36*S	ulong		sec	Seconds since start of ping and end of sweep segment
Micro	4		ulong		usec	Micro seconds of seconds
Extrapolated Azimuth	4		float		radian	Extrapolated azimuth at center of sweep segment
Interpolated Azimuth	4		float		radian	Interpolated azimuth at center of sweep segment
Extrapolated Pitch	4		float		radian	Extrapolated pitch at center of sweep segment
Interpolated Pitch	4		float		radian	Interpolated pitch at center of sweep segment
Extrapolated Roll	4		float		radian	Extrapolated roll at center of sweep segment
Interpolated Roll	4		float		radian	Interpolated roll at center of sweep segment
Stabilized Angle	4		float		radian	Sweep segment stabilized angle
End	4		ulong	#HSG	N/A	End Group

Figure 149: Sweep Segments Group

Seconds and Micro fields: There are S sweep segments, each being defined by a start and end time. The end time of any segment is also the start time of the following segment. The start time of the first segment is given in the Properties Group (Id 1). Thus it is possible to compute all segment start and end times using the Properties and Sweep Segments Groups.

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	16 +4*A+5*C+4*T	bytes	between Byte Count & Group End
Id	4		ulong	41	N/A	Shut Down Amplifiers Group
Amplifiers	4		ulong	A	N/A	Number of non-disabled power amplifiers shut down during ping
Amplifier Id	4	A	ulong		N/A	Identificators of shut down power amplifiers
Channel Count	4		ulong	C = 0 .. 2	N/A	Number of channels that failed digital or analog test
Channel Id	4		ulong		N/A	Identificator of channel that failed a test
Test	1	5*C	uchar	1 2 3	failed analog test failed digital test failed analog and digital test	Type of failed test
Temperatures	4		ulong	T	N/A	Number of measured temperatures in cabinet
Temperature	4	T	float		degree C	Measured temperature
End	4		ulong	#HSG	N/A	End Group

Figure 150: Shut Down Amplifiers Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	7	bytes	between Byte Count & Group End
Id	4	ulong	42	N/A	SB3000 Settings Group
Sweep Direction	1	uchar	0 1 2 3	disabled to port to starboard alternating	Sweep direction
Motion Compensation	1	uchar	0 1	off on	Motion compensation (must be off if sweep disabled)
Yaw Compensation Limit	1	uchar	3, 4, 5, 6, 7, 8, 9, 10	degree	Yaw compensation limit
End	4	ulong	#HSG	N/A	End Group

Figure 151: SB3000 Settings Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+C	bytes	between Byte Count & Group End
Id	4	ulong	43	N/A	Enable / Disable Power Amplifiers Group
Amplifier Count	4	ulong	C = 312, 624	N/A	Amplifier count
Amplifier State	C	uchar	0 1	disabled enabled	Amplifier state
End	4	ulong	#HSG	N/A	End Group

Figure 152: Enable / Disable Power Amplifiers Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	13	bytes	between Byte Count & Group End
Id	4	ulong	44	N/A	Power Amplifier Monitoring Group
State	1	uchar	0 1 2	disabled round robin selected channels	State of power amplifier monitoring
Channel 1	4	ulong		N/A	First monitored power amplifier (valid only if State equals 2)
Channel 2	4	ulong		N/A	Second monitored power amplifier (valid only if State equals 2)
End	4	ulong	#HSG	N/A	End Group

Figure 153: Power Amplifier Monitoring Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	5	bytes	between Byte Count & Group End
Id	4	ulong	45	N/A	Transmitter Tests Group
Test	1	uchar	0 1	automated comprehensive test selected channels test	Selected transmitter test
End	4	ulong	#HSG	N/A	End Group

Figure 154: Transmitter Tests Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	5	bytes	between Byte Count & Group End
Id	4	ulong	46	N/A	Reset Transmitter Group
Reset	1	uchar	1	reset	Reset transmitter
End	4	ulong	#HSG	N/A	End Group

Figure 155: Reset Transmitter Group

Item	Bytes		Format	Value	Units	Description
Start	4		ulong	$HSG	N/A	Start Group
Byte Count	4		ulong	28+4*D+4*A	bytes	between Byte Count & Group End
Id	4		ulong	47	N/A	Power Amplifier Monitoring Data Group
Ping	4		ulong		N/A	Ping number
First Sample	4		ulong		N/A	Index of first digital sample
Digital Samples	4		ulong	D = 0 - 2097152	N/A	Number of digital samples (must be multiple of 8)
D/A Ratio	4		ulong	> 0: digital samples per analog sample < 0: analog samples per digital sample	N/A	Digital to analog samples ratio
Channel 1 Id	4		ulong		N/A	Channel 1 identifier
Channel 1 Digital "A" Side State	1	D	uchar	0, 1	N/A	Channel 1 digital "A" side state
Channel 1 Digital "B" Side State	1	D	uchar	0, 1	N/A	Channel 1 digital "B" side state
Channel 1 Current	2	2*A	ushort		A	Channel 1 current
Channel 2 Id	4		ulong		N/A	Channel 2 identifier
Channel 2 Digital "A" Side State	1	D	uchar	0, 1	N/A	Channel 2 digital "A" side state
Channel 2 Digital "B" Side State	1	D	uchar	0, 1	N/A	Channel 2 digital "B" side state
Channel 2 Current	2	2*A	ushort		A	Channel 2 current
End	4		ulong	#HSG	N/A	End Group

Figure 156: Power Amplifier Monitoring Data Group

There are always 8 digital samples per analog sample: D = 8*A; D/A Ratio is always 8.

Alternative packed data structures: (replace content between "D/A Ratio" and "End" fields)
1. bit-packed, data structures together

Channel 1 Id		4	ulong	N/A	Channel 1 identifier
Channel 2 Id		4	ulong	N/A	Channel 2 identifier
Channel 1 Digital "A" Side States	1	D/8	uchar	N/A	8 samples, channel 1 digital "A" side state, LSB 0th sample, MSB 7th sample
Channel 1 Digital "B" Side States	1	D/8	uchar	N/A	8 samples, channel 1 digital "B" side state, LSB 0th sample, MSB 7th sample
Channel 2 Digital "A" Side States	1	D/8	uchar	N/A	8 samples, channel 2 digital "A" side state, LSB 0th sample, MSB 7th sample
Channel 2 Digital "B" Side States	1	D/8	uchar	N/A	8 samples, channel 2 digital "B" side state, LSB 0th sample, MSB 7th sample
Channel 1 Current	2	2*A	ushort	A	Channel 1 current
Channel 2 Current	2	2*A	ushort	A	Channel 2 current
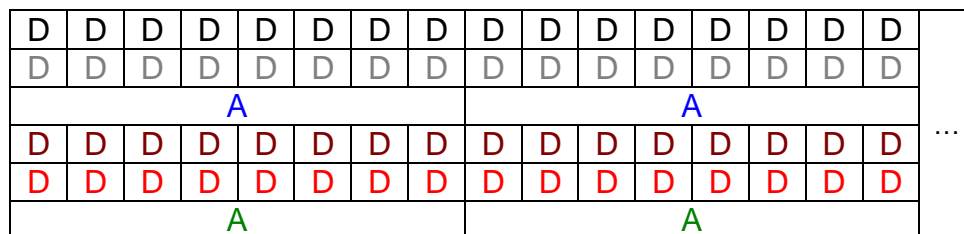
Time axis →

2. bit-packed, close times together

Channel 1 Id		4	ulong	N/A	Channel 1 identifier
Channel 2 Id		4	ulong	N/A	Channel 2 identifier
Digital States Samples 0, 1	1		uchar	N/A	Bit 0: Ch 1, "A", smpl. 0/2/4/6 Bit 1: Ch 1, "B", smpl. 0/2/4/6
Digital States Samples 2, 3	1		uchar	N/A	Bit 2: Ch 2, "A", smpl. 0/2/4/6 Bit 3: Ch 2, "B", smpl. 0/2/4/6
Digital States Samples 4, 5	1	D/8	uchar	N/A	Bit 4: Ch 1, "A", smpl. 1/3/5/7 Bit 5: Ch 1, "B", smpl. 1/3/5/7
Digital States Samples 6, 7	1		uchar	N/A	Bit 6: Ch 2, "A", smpl. 1/3/5/7 Bit 7: Ch 2, "B", smpl. 1/3/5/7
Channel 1 Current	2		ushort	A	Channel 1 current
Channel 2 Current	2		ushort	A	Channel 2 current
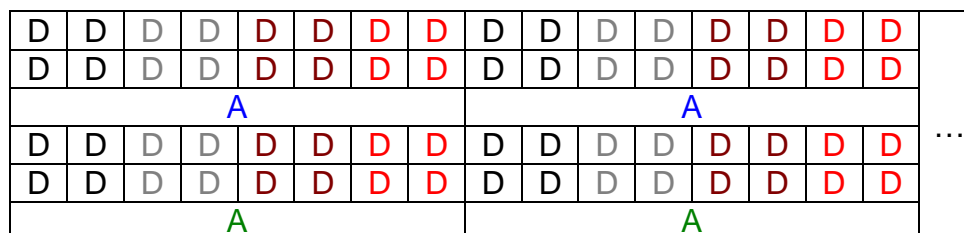
Time axis →

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	14+N	bytes	between Byte Count & Group End
Id	4	ulong	48	N/A	Transmitter Test Result Group
Test Id	1	uchar	0 1 2 3 4 5 255	VME bus acknowledge Register read/write TCB memory Interrupts Accuracy timing crystal Power amplifiers Tests completed	Identifier of run test
Result	1	uchar	0 1 2	failed passed working	Test result
Message Length	4	ulong	N	N/A	Message text length
Message Text	N	char		chars	Message text
Progress	4	float	0.0 - 100.0	percentage	Percentage completed
End	4	ulong	#HSG	N/A	End Group

Figure 157: Transmitter Test Result Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	29+2*H*S	bytes	between Byte Count & Group End
Id	4	ulong	49	N/A	Raw Data Group
Ping	4	ulong		N/A	Ping number
Transducer	1	uchar		N/A	Transducer identificator
Angle	4	float	Starbd: < 0 Port: > 0	radian	Hydrophone mounting angle
Hydrophones	4	ulong	H	N/A	Number of hydrophones
First Slice	4	ulong		N/A	First slice index
Slices S	4	ulong	S	N/A	Number of slices
Data	2 S*H	short		N/A	Hydrophone data, ordered by hydrophone (all slices hydrophone 0, …, all slices hydrophone H-1)
End	4	ulong	#HSG	N/A	End Group

Figure 158: Raw Data Group

The Properties Group (Id 1) of the corresponding ping must be sent together with the Raw Data Group.

Furthermore, we propose to extend the State field of the Collect Group:

State	4	ulong	0	off	Collect raw hydrophone data and send it to UI
			1	send to UI	
			2	send to Raw Data PC	
			3	send to UI and Raw Data PC	

1.4.14   Message Groups

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	Warning Group
Id Number	4	ulong			Error Id
Text	4+N	string			Error String
End	4	ulong	#HSG	N/A	End Group

Figure 159: Error Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Message Group
Id Number	4	ulong			Warning Id
Text	4+N	string			Warning String
End	4	ulong	#HSG	N/A	End Group

Figure 160: Warning Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Error Group
Id Number	4	ulong			Info Id
Text	4+N	string			Info String
End	4	ulong	#HSG	N/A	End Group

Figure 161: Info Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Error Group
Id Number	4	ulong			Debug Id
Text	4+N	string			Debug String
End	4	ulong	#HSG	N/A	End Group

Figure 162: Debug Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Error Group
Id Number	4	ulong			Exception Id
Text	4+N	string			Exception String
End	4	ulong	#HSG	N/A	End Group

Figure 163: Exception Group

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	12+N	bytes	between Byte Count & Group End
Id	4	ulong	3	N/A	Error Group
Id Number	4	ulong			Annotation Id
Text	4+N	string			Annotation String
End	4	ulong	#HSG	N/A	End Group

Figure 164: Annotation Group

1.5 Example

1.5.1 Example One: Navigation and Single Beam Frames

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Start Frame
Byte Count	4	ulong	60+5	bytes	between Byte Count & Frame End
Id	4	ulong	1	N/A	Navigation Frame
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*N/A*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*	*N/A*	*usec*	*micro seconds of seconds*
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	28+5	bytes	between Byte Count & Group End
Id	4	ulong	2	N/A	Position Group
N	4	ulong	5	N/A	Name length
Description	N	char	WGS84	chars	Geodetic Description
X	8	double		radian	Longitude
Y	8	double		radian	Latitude
Z	8	double		m	Ellipsoidal Height
End	4	ulong	#HSG	N/A	End Group
End	4	ulong	#HSF	N/A	End Frame

Figure 165: Specialized Navigation Frame (WGS84 Position only)

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Start Frame
Byte Count	4	ulong	72	bytes	between Byte Count & Frame End
Id	4	ulong	7	N/A	Single beam Frame
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*N/A*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*	*N/A*	*usec*	*micro seconds of seconds*
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	40	bytes	between Byte Count & Group End
Id	4	ulong	1	N/A	
Frequency	4	ulong		kHz	30/200 kHz transducer
Quality	4	ulong		N/A	0/1 invalid/valid
Traveltime	8	double		sec	not used (NaN)
Sound	8	double		m/s	used sound velocity
Depth	8	double		m	calculated depth
Amplitude	8	double		dB	not used (NaN)
End	4	ulong	#HSG	N/A	End Group
End	4	ulong	#HSF	N/A	End Frame

Figure 166: Single beam Frame (Echosounder data)

2 Client/Server Communication

2.1 Handle Data Connection
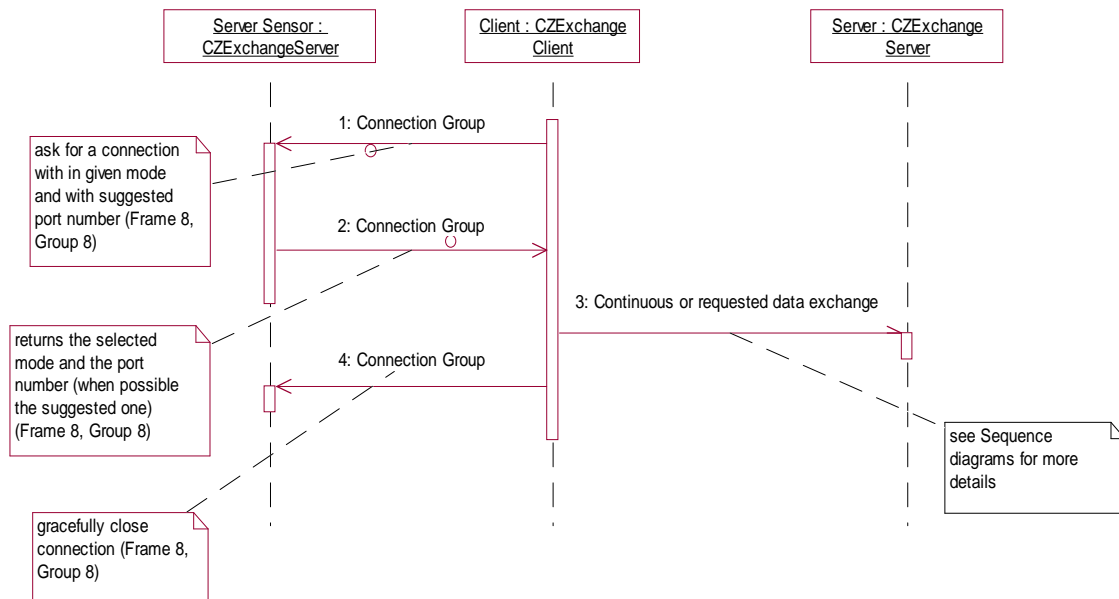
Figure 167: Create and shutdown connection to Exchange Server

To establish a new connection you have to send a request connection control command to the exchange server. The services supplied by the exchange server can be reached under port number 3400. As shown in Figure 167 send a control frame containing a connection group (frame 8, group 8) and a identity group (frame 8, group 10) to the server port 3400. To summarize you send the following bytes to the server with the given port number above:

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Frame Start
Byte Count	4	ulong	74+N	Bytes	between Byte Count & Frame End
Id	4	ulong	8	N/A	see Figure 12
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*time item*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*		*usec*	*micro seconds of seconds*
Transaction	4	ulong	1	N/A	Client transaction number
Address	4	ulong	19.16.84.21	N/A	e.g. sender IP address

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+6	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Connection Group
Port	2	short	1530		Requested port number
Command	4	ulong	1: open	bit	Request to open connection
End	4	ulong	#HSG	N/A	End Group
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	16+N	bytes	between Byte Count & Group End
Id	4	ulong	10	N/A	Identity Group
Server	4	ulong	99	number	Identity number of HydroStar client (example)
Version	4	ulong	1	number	version of client
Name	4+N	string	HydroStar Client	string	name of client
End	4	ulong	#HSG	N/A	End Group
End	4	ulong	#HSF	N/A	Frame End

As an reply (sequence 2 in Figure 167) to this request the servers answers with:

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Frame Start
Byte Count	4	ulong	70	Bytes	between Byte Count & Frame End
Id	4	ulong	8	N/A	see Figure 12
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*time item*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*		*usec*	*micro seconds of seconds*
Transaction	4	ulong	1234	N/A	Server transaction number
Address	4	ulong	19.16.84.20	N/A	e.g. server IP address
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+6	bytes	between Byte Count & Group End
Id	4	ulong	8	N/A	Reply Group
Port	2	short	3401		Requested port number is not available. Reply with given port number
Command	4	ulong	1: open	bit	Open connection
End	4	ulong	#HSG	N/A	End Group
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+N	bytes	between Byte Count & Group End
Id	4	ulong	9	N/A	Reply Group
Transaction	4	ulong	1		transaction number to which this reply corresponds
Status	4	ulong	2	bit	accepted request (connection group valid)
End	4	ulong	#HSG	N/A	End Group
End	4	ulong	#HSF	N/A	Frame End

We are dealing with a one-shot protocol so we can handle one or more clients connected to the server software. As a result from a one-shot protocol close the connection after the client receives the reply with the port number. The figure below uses the port number 3401 as an example. Now the server is ready to open a connection on port 3401. However, a waiting period of 500 ms is required between the reply with the port number and the first use of the connection. Communication in both directions takes place between the server with port number 3401 and the client. (sequence 3 in Figure 167). To shutdown the connection send a control frame with the

close connection group to the server (port number 3400). This is represented as sequence 4 in Figure 167.
The connection which was established for future use between the client and server is used to exchange data and control commands in an bi-directional way.

2.2 Continuous Data Exchange

Which frames and groups are used in continuous data exchange is determined by the identity group, which was send within the control frame during the login phase.

2.3 On Request Data Exchange (not implemented)

If the client side is interesting in data on request, a request group within the control frame is send to the server. The server answers this request immediately. The reply group is used when data is not available or the request could not be understand by the server (e.g. asking for undefined frames or groups). Let's assume that the client side is interested in knowing the sound velocity profile, which is currently used for processing. By sending the following byte (sequence 1 in Figure 168) to the server the client asks for the currently used sound velocity profile:

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Frame Start
Byte Count	4	ulong	N/A	Bytes	between Byte Count & Frame End
Id	4	ulong	8	N/A	see Figure 12
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*N/A*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*	*N/A*	*usec*	*micro seconds of seconds*
Transaction	4	ulong	2	N/A	Transaction number
Address	4	ulong	19.16.84.20	N/A	e.g. server IP address
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+16	bytes	between Byte Count & Group End
Id	4	Ulong	6	N/A	Request Group
Frame	4	ulong	2		frame id
Count	4	ulong	2		Number of groups to enable or disable for continuous data exchange
Group	4	ulong	2		depth group id
Group	4	ulong	3		velocity group id
End	4	ulong	#HSG	N/A	End Group
End	4	ulong	#HSF	N/A	Frame End

To answer the request the server sends the following bytes (sequence 2 in Figure 168) to the client (assuming that a current sound velocity profile is available):

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSF	N/A	Frame Start
Byte Count	4	ulong	N/A	bytes	between Byte Count and Frame End
Id	4	ulong	N/A	N/A	see Figure 12
Source	4	ulong	N/A	N/A	id (e.g. sensor id)
Seconds	*4*	*ulong*	*N/A*	*sec*	*seconds since 00:00 1.1.1901 UTC*
Micro	*4*	*ulong*	*N/A*	*usec*	*micro seconds of seconds*

Item	Bytes	Format	Value	Units	Description
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count and Group End
Id	4	ulong	2	N/A	Depth Group
N	4	ulong	2	N/A	The sound velocity profile holds only two entries (values)
Depth	8	double	0.0	meter	first depth value
Depth	8	double	3.0	meter	second depth value
End	4	ulong	#HSG	N/A	End Group
Start	4	ulong	$HSG	N/A	Start Group
Byte Count	4	ulong	8+8*N	bytes	between Byte Count and Group End
Id	4	ulong	3	N/A	Velocity Group
N	4	ulong	2	N/A	Two velocity values follow
Velocity	8	double	1420.0	m/s	First velocity value
Velocity	8	double	1430.0	m/s	Second velocity value
End	4	ulong	#HSG	N/A	End Group
End	4	ulong	#HSF	N/A	Frame End
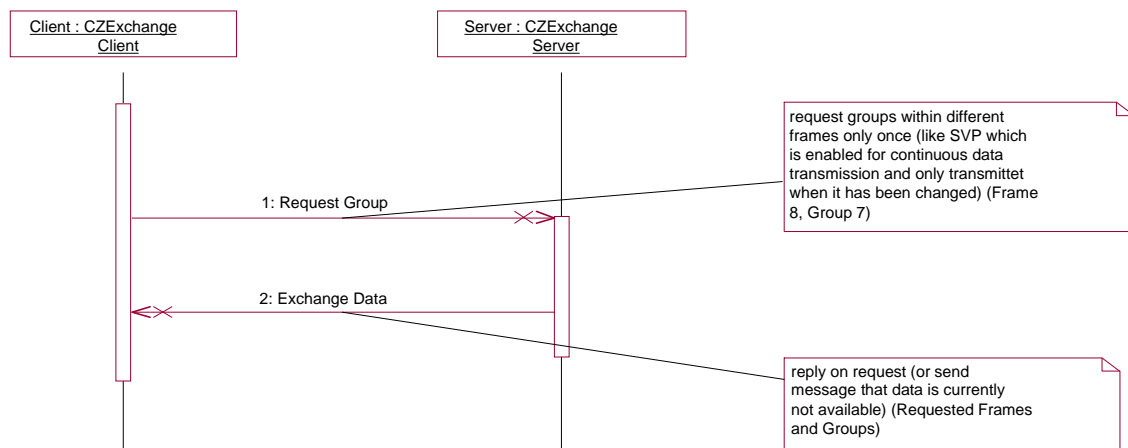
Figure 168: Sequence diagram

3 Frequently Asked Questions

Q: The navigation group indicates that storage could be northing/easting, or latitude/longitude. It does not say, however, how the 2 modes are differentiated.
A: The point group contains values for X, Y, Z and a geodetic description (a so called Geodetic Point Item). The geodetic description how to interpret the X, Y, Z values. If the geodetic description is WGS84 then the X, Y should be handled as longitude, latitude. Z is in this case a geodetic height.

Q: The heading seems to be stored in the navigation group, but our data files do not have the heading group within the navigation group. Can you tell me where we can get reliable heading information?
A: There are more than one place where heading information can be stored. One place is the Heading group, a second one in the navigation frame is the Motion Through Water group. Which group is used depends on the configuration of HydroStar, e.g. which sensors are connected to HydroStar Software.

Q: Heave/roll/pitch seems to be stored in both the navigation and multibeam groups. Why?
A: The heave, roll and pitch values stored in the multibeam group, are sampled/read by the multibeam sensor and than send to HydroStar Software. These values should be used when processing the multibeam data. The heave/roll/pitch stored in the navigation frame is read over the network or a serial line direct from the motion (HRP) sensor. The update rate of the two sources differs in normal operation. Whereas the update rate of the multibeam depends on the water depth, the update rate of the motion sensor should be constant in normal operation.

Q: The navigation group can contain a HeaveRollPitch group, as well as separate Heave, Roll and Pitch groups. Not all of these groups are present in our data files. Can you tell us which groups are always present and should be used?
A: Which groups are present depends on the configuration in which HydroStar Software is running. If there is a motion sensor which measures heave/roll/pitch at the same time (e.g. TSS DMS05) the HeaveRollPitch group is used. If the motion sensor measures only heave the Heave group is used.

Q: The documentation does not say the convention used for the sign of the heave/pitch/roll.
A: Positive roll is port up, positive pitch is stern up, positive heave is ship up.

Q: How are the offset convention in the XSE protokoll.

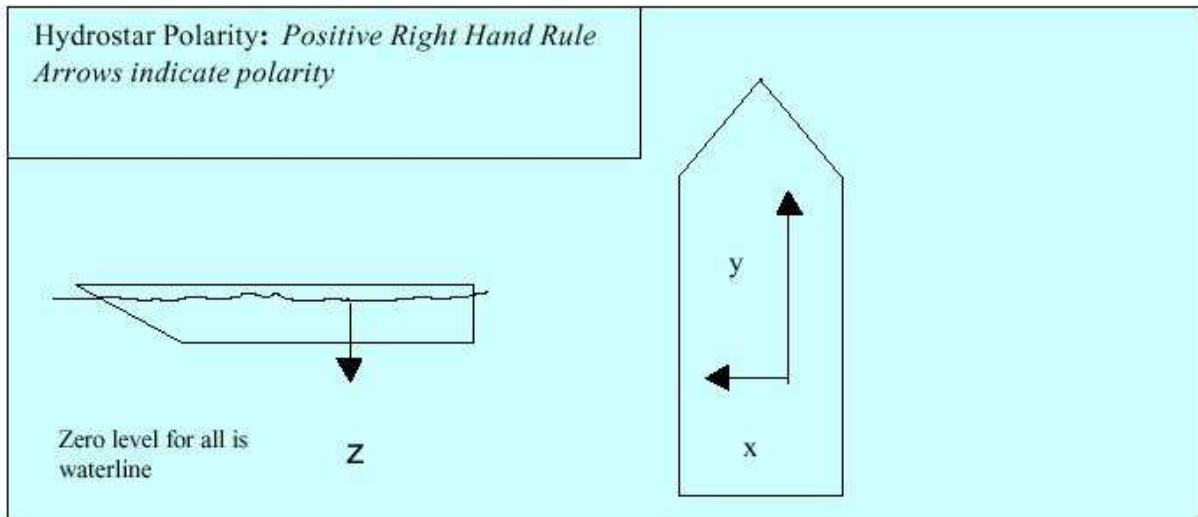A: The convention is the positive right hand rule (See the picture)

Hydrostar Polarity: *Positive Right Hand Rule*
Arrows indicate polarity

y

z

x

Zero level for all is waterline

Figure 1. Elac Sign Convention

Q: In the multibeam group, data can be stored as raw slant range (angle/traveltime), as well as computed (across/along/depth). In the data files that we have, I only see the slant range data. Can you tell me what data is always present? If we are going to use slant range, can you tell me what sound velocity should I be using to compute the initial set of across/along/depth?

A: For sure the traveltime is always be present, because this is a value which is measured by the multibeam sonar. The across/along/depth is calculated using a sound velocity profile the user has to select in post-processing. The sound velocity profile which was used during the data recording will be (but is probably not in your sample file) inserted at the beginning of the file or when the sound velocity profile will change (due to user interaction or using a tow fish).

Q: In the side scan group, data can be stored in raw (amplitude vs. time), or corrected (amplitude vs. distance). However, the documentation does not go into specific details about the values. For example, what does "Time Offset" mean? How are port and starboard values stored? The data files that we have store side scan data in the corrected mode, but the "Bin size" and "Lateral Offset" are zero, meaning we can't decode the range of imagery. I think a more thorough explanation of the values within the group is necessary. We also need to know how many of the 16 bits for each side scan amplitude is actually used to store data.

A: Up to now the amplitude vs. lateral distance in the side scan frame is implemented (and the General group). The "Bin size" means the grid size in lateral direction. If there is a gap between the port and starboard side (e.g. the side scan data of the innermost beams are omitted) the "Lateral Offset" holds this gap in direction of the lateral distance.

Q: Why does the server immediately close the port that has been negotiated during setup?

A: It may take some time for the server to setup, start and initialize the connection. The connection must not be used within 500 ms after negotiation of the port.

Q: Should the length and value of the string fields (i.e. "Name" field in the identity group) include the zero termination character which normally part of C-type strings?

A: No. The string item is defined on page 5/57 (Figure 7) and the text doesn't include the zero termination character.

Q: When should we send the "Ships Groups". By this I mean the "Ship-General" group, the "Ship-Sensors" group, "Ship-NavigationAndMotion" group and the "Ships-Transducer" group. May we send them immediately after receiving the Port number or should we send them after the "Continuous" group?

A: Send the "Ship" and "Soundvelocity" Frames on the data connection after the "Continuous" group and when the operator changes these values.

Q: Our software is interfaced with the HRP sensor and will capable of determining Roll/Pitch/Heave at any moment in time. However the following groups do not make sense to me: "Multibeam-Roll", "Multibeam-Pitch" and "Multibeam-Heave".

A: The values Roll, Pitch and Heave group are stored by the SeaBeam 1000, 2100 or 3000. The accuracy between measurement and timestamp correlation is higher.

Q: If we want the HydroStar software to output both data from the Multibeam group and the Sidescan group on the same socket do we need to send 2 Continuous groups (as defined in figure 85 of the 1.8.5 beta documentation) or is it possible to combine the two types of data in one group?

A: HydroStar sends all information (frames) on one socket. If you want, you can open two sockets, one socket for multibeam data and another for the sidescan data. If you don't send the continuous group, HydroStar sends all existent groups (i.e. Sidescan frame group 1,2,9).
If you don't need all groups, you send the continuous group to control this. Send one continuous group per frame.

Q: Which groups are sended by HydroStar Online?

A: Which groups exist, depend of the kind of sensors, which are connected to HydroStar Online. You can choose with the continuous groups a set of the existent groups.

Q: Are the multibeam angles roll corrected?

A: Yes, but without the roll offset from the motion sensor.

Q: What is the time relation of multibeam data to the time in the frame header, what is the info contained in the delay group ?

A: The time of the multibeam frame header plus the delay value is the transmit time of the beam.

Q: Our software receive the multibeam and sidescan data of the Seabeam 1000 by the XSE interface. Which frames need HydroStar Online by our software?

A: HydroStar Online need the Navigation frame (Group 2 and 4), the Sound Velocity frame (Group 1, 2 and 3, the surface sound velocity value is important) and the Ship frame