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Technical Note

WBMS DFD External

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4 Terms and Abbreviations

The following table describes terms and acronyms used throughout this document.

Term/Acronym	Description
DFD	Data Format Definition
WBMS	Wideband Multibeam Sonar
WHI	WBMS Hydrographers Interface
TCP	Transmission Control Protocol
IP	Internet Protocol
Beam	The sonar array is comprised of beams of various angles
SoS	Speed of Sound
VGA	Variable gain amplifier
TGC	Time gain compensation
WC	Water column

Term/Acronym	Description
SS	Side scan
SP	Snippets
uint8	Unsigned 8 bit integer (byte)
uint16	Unsigned 16 bit integer (unsigned short)
uint32	Unsigned 32 bit integer (unsigned int)
int16	Signed 16 bit integer (short)
int32	Signed 32 bit integer (int)
float32	32 bit float value (IEEE 754)
float64	64 bit float value (IEEE 754)

5 Preface

This document describes the WHI communication interface used on the bathymetric version of the WBMS.

This Data Format Definition (DFD) document describes how the WHI communication interface is used to:

- Read and apply configuration settings to the WBMS
- Read data packet streams from the WBMS

6 Overview

This document describes the network protocol needed for WHI communication. The WHI is run on the TCP/IP over a 100Mb/s Ethernet. Connections can be established from a PC (or equivalent) to 4 ports on the sonar:

- Port **2209** opens the command link on the WBMS. It is used for configuring and querying the status of the WBMS.

- Port **2210** opens the bathymetric data stream link from the WBMS. It sends the data to all recipients when a ping is ready. Connecting to this port designates a subscription to this type of data stream. It is not possible to query a single ping data record.

- Port **2211** opens the water column data stream link from the WBMS. It sends the data to all recipients when a ping is ready. Connecting to this port designates a subscription to this type of data stream. It is not possible to query a single ping data record.

- Port **2212** opens the snippet data stream link from the WBMS. It sends the data to all recipients when a ping is ready. Connecting to this port designates a subscription to this type of data stream. It is not possible to query a single ping data record.

The interface allows for multiple users to access the data ports simultaneously, however it is important that a user either closes the port or reads/flushes it continuously to avoid stalling data for any other users. Additionally, the configuration applied by one user to port 2209 will not be rendered to other users that have established a connection to that port.

Protocols for each communication link is described in the following sections.

7 Command and control

Port 2209 is at the moment the only interface for changing parameters in the sonar.
It is primarily designed as a terminal interface for direct use by a human operator, and is subject to change.
It takes in text strings as commands in the form of one command followed by a number of arguments separated by white-space:
COMMAND ARG1 ARG2 ARG3 etc...
And returns a text string to confirm the command has been executed.
Ex.
depth_range 0.5 30
Sets the sonar depth range from 0.5 to 30.0 meters, and replies with:
Bottom detect gates set: 0.5 to 30.0 m
To check the currently set values without modifying them, the user can send the command without argument:
depth_range
Returns:
Bottom detect gates set: X to Y m
Where X and Y are currently set values.

Table 1 shows the most useful commands

The command link communication is performed with text based requests over TCP/IP. A socket connection to the WBMS must be established before issuing/querying commands.
The TCP/IP connection is established to port **2209** on the WBMS' IP.

7.1 Issuing Commands and Requesting WBMS State

To configure the WBMS, the client must issue commands via the socket connection.
The following text is written to the socket in order to send a specific command to the WBMS:

```
command <arg1> <arg2> … <argN>
```

where the arguments, which are separated by white space, are of the following type:

Type	Description
int32	int is used as a parameter
float32	float is used as a parameter

Likewise, in order to query for a specific state of the WBMS, the following text is written to the socket:

```
command
```

No parameters are sent in this case.

In both cases the reply is of the form:

```
command <arg1> <arg2> … <argN> # comments
```

where the arguments are of the form as described above and designates the parameters used by the WBMS. Everything after the (and including) **#** character should be discarded.
A single request results in a single reply from the WBMS. The WBMS does not—asynchronously—send a command state to the recipients.
Some commands might take a little while to process. The client should wait for the reply, indicating that the command has been processed, before sending next command.

Table 1 lists commands that can be utilized to configure the WBMS.

Close the 2209 socket connection to cease communication with the WBMS.

7.2 Example

Suppose the following command is issued:

```
set_range
```

The WBMS might reply with:

```
set_range 0.5 20.0 # in meter
```

Here, the reply is broken down into the following parts:

Item	Description
set_range	The reference to the command issued earlier
0.5	A float32 value designating the start range
20.0	A float32 value designating the end range
# in meter	A comment, only for human interpretation

Command	Arguments	Range[1]	Default[2]	Queryable	Description
MODE CONTROL					
set_mode	MODE	0-7	1	YES	Operation mode 0=Forward 1=Bathy, 2=Bathy amp, 4=BF pass-through, 5=Edge enhance, 6=Super res, 7=Multi detect
set_sidescan_mode	MODE	0-9	1	YES	Sidescan / snippet mode 0=Snippets 1=Sidescan, 9=Croped sidescan
set_flip	FLIP	0-1	1 (bathy) 0 (FLS)	YES	Sets mounting direction of sonar. Defining direction angles. For bathy system, default is 1, assuming sonar mounted with projector pointing towards stern. Increasing receive angles from port to starboard. Increasing transmit angles from aft to forward. For FLS system, default is 0, assuming sonar mounted with projector pointing upwards. Increasing receive angles from port to starboard. Increasing transmit angles down to up.
set_default		-	-	NO	set all config to startup defaults
RANGE, RESOLUTION, DIRECTIONS					
set_gate_mode	MODE	0-2	1	YES	set gate mode 0=Gate by range 1=Gate by depth 2=Gate by range and depth
set_gate_tilt	TILT	-45 - 45	0	YES	set gate tilt in degrees
set_range[3]	START, STOP	0-600	0, 50	YES	Set range for gate mode 0 and 1. Start and stop range / depth in meters
set_range	R0, R1, D0, D1	0-600	0, 50, 0, 50	YES	Set range for gate mode 2. Start and stop range (R0 – R1) and Start and stop depth (D0 -D1) Figure 1
set_direction	DIR	-90 – 90	0	YES	Sets center direction in degrees
set_opening_angle	OPEN	0-360	140	YÈS	Sets opening angle in degrees.
set_resolution	VRES, HRES	64-2048, 64-512	256, 128	YES	Set resolution of water-column data. First number, vertical resolution is an approximate value. Exact value will depend on range is decimated down by a integer factor. Second number, horizontal resolution needs to be a power of 2 (64-128-256,512).
set_tx_direction	DIR	-90 - 90	0	YES	Sets center direction in degrees for STX
set_tx_opening_angle	OPEN	0-90	0	YES	Set opening angle for STX scan.
set_tx_beam_number	BEAM	1-64	1	YES	Sets number of beams for STX scan sequence.
set_mf_decimation	DEC	1-16	1	YES	Set decimation factor before Match filter. Enables longer pulses by reducing sample rate.
TX, GAIN, TRIGGERING					
set_tx	FREQ, BW, AMP, LEN	80-1000, 0-80, 0-15, 10-819	400, 80,15, 500	YES	Sets tx-pulse FREQ=freq in kHz, BW=bandwidth in kHz, AMP=[0-15], LEN=length in us
set_rate	HZ	-1 60		YES	Sets max allowable ping rate of the sonar. Set to -1 to calculate automatically.
set_RESERVED_rate	HZ	-1 - 60	5	YES	Sets WC output rate

1 Range will depend on settings. Values here is typical values only.
2 Default values will depend on sonar partno. Typical values for bathymetric sonars given here.
3 Other obsolete commands for setting range also exist (including range, depth, set_depth, start_range, stop_range…). These are depreciated and replaced by the 2 and 4 parameter “set_range” command listed here.

set_snippet_rate	HZ	-1 - 60	18	YES	Sets snippet output rate
set_trigger_mode	MODE	0-5	3	YES	0:Fixed rate, 1:Fixed rate (time sync), 2:Full range (max allowed by set range), 3:Adaptive (max allowed by measured range), 4:Ext. trig. (rising edge), 5: Ext. trig. (falling edge)
ENVIRONMENT, STATUS					
sound_velocity	C			YES	Set sound velocity to fixed value, -1 to use velocity probe on serial port
set_time_source	SOURCE		0	YES	0: IRIG-B 1:NTP 2: IRIG-B (inverted) 3: NTP+PPS(pos) 4: NTP+PPS(neg) 5: ZDA+PPS(pos) 6:ZDA+PPS(neg) 7:ZDA 8:Free run (time since startup)
set_ntp_server	IP			NO	Ip-address for ntp server
temperature				YES	Read out internal temperature sensor
revision				YES	Running FW revision for FPGA and DSP
serial				YES	Return sonar serial number
partno				YES	Return sonar partno
bit_log				YES	Return all logged info messages
ntp_log				YES	Return logged messages from NTP sub-system
ADVANCED GATES AND SNIPPET CONTROL					
set_autogate_preset	MODE	0-3	2	YES	Sets the adaptive gate mode: 0 – off, 1 – Wide, 2 – Normal, 3 - Narrow
OTHER					
set_power[4]	ON	0-1	0	YES	Turn on pinging and receiver 1:On 0:Off
exit				NO	Say goodbye and disconnect from sonar WHI shell

Table 1: Control commands

4 set_power was previously controlled by the “on” and “off” command. These still exist but were not queryable and has been replaced by this command.

8 WBMS Data Stream

A socket connection to the WBMS must be established before reading data packet streams from the sonar. The TCP/IP connection is established to the following ports on the WBMS' IP:

- Port **2210** opens the bathymetric data stream link from the WBMS. It sends the data to all recipients when a ping is ready. Connecting to this port designates a subscription to this type of data stream. It is not possible to query a single ping data record.
- Port **2211** opens the water column data stream link from the WBMS. It sends the data to all recipients when a ping is ready. Connecting to this port designates a subscription to this type of data stream. It is not possible to query a single ping data record.
- Port **2212** opens the snippet data stream link from the WBMS. It sends the data to all recipients when a ping is ready. Connecting to this port designates a subscription to this type of data stream. It is not possible to query a single ping data record.

Each port streams binary data to recipients represented in little endian byte order. The stream consists of bathymetric packets (2210), water column packets (2211) or snippet packets (2212). Each packet is designated with a *preamble* of 4 bytes which is set to **0xDEADBEEF**.

Protocols for each communication link is described in the following subsections.

8.1 Bathymetric Data

The sonar will keep sending all available bathymetric data to any client connected to port 2210 Bathymetric data is a binary format in the following form:

Byte Offset	Type	Name	Description
0	uint32	preamble	0xDEADBEEF
4	uint32	type	Set to 1 for bathymetric data
8	uint32	size	Size of entire package in bytes
12	uint32	version	4
16	uint32	RESERVED	
20	uint32	crc	CRC32 of the size-24 bytes following the header (crc32, zlib-style SEED=0x00000000, POLY=0xEDB88320)
24	float32	snd_velocity	Sound velocity in m/s
28	float32	sample_rate	Sampling rate in Hz
32	uint32	N	Number of beams
36	uint32	ping_number	Sequence number of ping
40	float64	time	Ping timestamp, unix time at TX
48	float64	time_net	Timestamp Unix time as fract (send on network time)
56	float32	ping_rate	In Hz
60	uint16	type	Bathy data type (4)
62	uint8 * 8	beam_dist_mode	1:512EA 2:256EA
63	uint8	sonar_mode	0:FLS 1:Bathy 2:Bathy amp, 3:TBD 4:bf pass-through 5:Bathy edge enhance 6: Super res bathy

64	float32	RESERVED	TBD
68	uint16	RESERVED	RESERVED
70	uint16	RESERVED	RESERVED
72	float32	tx_angle	Tx elevation steering in radians
76	float32	gain	Intensity value gain
80	float32	tx_freq	Tx frequency in Hz
84	float32	tx_bw	Tx bandwidth in Hz
88	float32	tx_len	Tx pulse length in sec
92	float32	RESERVED	RESERVED
96	float32	tx_voltage	Tx peak-voltage over elements, NaN on non-STX sonars.
100	float32	swath_dir	Center pointing direction of swath, in radians
104	float32	swath_open	Opening angle of swath, in radians
108	float32	gate_tilt	Gate tilt in radians, for depth gates
112	uint32	sample_number #1	Sample number for first beam
116	float32	angle #1	Angle in radians for first beam
120	uint16	upper_gate #1	Sample number for upper adaptive gate
122	uint16	lower_gate #1	Sample number for lower adaptive gate
124	float32	intensity #1	Intensity for first beam
128	uint16	flags #1	Info flags for first beam
130	uint8	quality_flag #1	Quality flags for first beam
131	uint8	quality_val #1	Quality value for first beam
:	:	:	:
92+N*20	uint32	sample_number #N	Sample number for last beam
96+N*20	float	angle #N	Angle in radians for last beam
100+N*20	uint16	upper_gate #N	Sample number for upper adaptive gate
102+N*20	uint16	lower_gate #N	Sample number for lower adaptive gate
104+N*20	float	intensity #N	Intensity for last beam
108+N*20	uint16	flags #N	Info flags for last beam (Not in use)
110+N*20	uint8	quality_flag #N	Quality flags for last beam
111+N*20	uint8	quality_val #N	Quality value for last beam

8.1.1 Notes about members

Extra spatial information about selected members in previous table:

Member	**Description**
sample_number	Distance in **m** is obtained with **sample_number** * **snd_velocity** / (2.0 * **sample_rate**)
angle	Direction of the detection point w.r.t. nadir.
intensity	Backscatter intensity value for detection point. Compensated for internal gain and TVG
quality_flag	Bit 0: SNr test for sounding. 1=pass 0=fail Bit 1: Colinearity test for sounding (flyer detect). 1=pass 0=fail Bit 2-7: Not in use

<table>
<tr><th>Member</th><th>Description</th></tr>
<tr><td>quality_val</td><td>Quality value. (Added in FW version 10.2)
8-bit unsigned value, giving a indication of sounding quality based on the combined amp/phase processing signal.
Compares the combined signal with noise level next to detection and calculates a 8-bit value equal to √(16*sig/noise)
<table>
<tr><td>SNr</td><td>-12dB</td><td>-6dB</td><td>0dB</td><td>6dB</td><td>12dB</td><td>20dB</td></tr>
<tr><td>Value</td><td>2</td><td>3</td><td>4</td><td>6</td><td>8</td><td>13</td></tr>
</table>
</td></tr>
<tr><td></td><td></td></tr>
</table>

8.2 Water column data

The sonar will keep sending all available water column data to any client connected to port 2211. Water column data is a binary format in the following form:

Byte Offset	Type	Name	Description
0	uint32	preamble	0xDEADBEEF
4	uint32	type	Set to 2 for water column data
8	uint32	size	Size of entire package in bytes
12	uint32	version	4
16	uint32	RESERVED	
20	uint32	crc	CRC32 of the size-24 bytes following the header (crc32, zlib-style SEED=0x00000000, POLY=0xEDB88320)
24	float32	snd_velocity	Sound velocity in m/s
28	float32	sample_rate	Samping rate in Hz
32	uint32	N	Number of beams
36	uint32	M	Number of samples in each beam
40	float64	Time	Ping timestamp, unix time at TX
48	uint32	dtype	0:uint8 1:int8 2:uint16 3:int16 4:uint32 5:int32 6:uint64 7:int64 0x15:float32 0x17:float64
52	int32	t0	Sample number of first sample in data
56	float32	gain	Total processing gain
60	uint32	RESERVED	RESERVED
64	float32	swath_dir	Swath center direction in radians
68	float32	swath_open	Swath opening angle in radians
72	float32	tx_freq	Tx frequency in kHz
76	float32	tx_bw	Tx Bandwidth in kHz
80	float32	tx_len	Tx pulse length in sec
84	unit32	tx_amp	Tx amplitude 0-15
88	uint16	RESERVED	RESERVED
90	uint16	RESERVED	RESERVED
92	float32	RESERVED	RESERVED
96	float32	RESERVED	RESERVED
100	float32	ping_rate	In Hz
104	float32	RESERVED	RESERVED
108	uint32	ping_number	Sequence number of ping
112	float64	time_net	Timestamp Unix time as fract (send on network time)
120	uint32	beams	Total number of beams in beamformer (before decimation)
124	int32	vga_t1	Sample number for first vga value
128	float32	vga_g1	vga gain in dB for first vga value
132	int32	vga_t2	Sample number for second vga value

136	float32	vga_g2	vga gain in dB for second vga value
140	uint16	RESERVED	RESERVED
142	uint16	RESERVED	RESERVED
144	float32	tx_angle	Tx elevation steering in radians
148	float32	tx_voltage	Tx voltage - peak-voltage signal over ceramics. NaN for sonars without measurement
152	uint8	beam_dist_mode	1:512EA 2:256EA 3:256ED, 4:512EAx, 5:256EAx
153	uint8	sonar_mode	0:FLS 1:Bathy 2:Bathy amp, 3:TBD 4:bf pass-through 5:Bathy edge enhance 6: Super res bathy
154	uint16	RESERVED	
156	float32	gate_tilt	Gate tilt in radians, for depth gates
160	float32	RESERVED	TBD
164	uint8*28	RESERVED	
192	dtype*M*N	Water column pixel data	
192 + M*N*sizeof(dtype)	float32*N	Watercolumn beam directions in radians	

8.2.1 Notes about members

Extra information about selected members in previous table:

Member	Description
t0	Distance in **m** is obtained with **((t0 + sample_number) * snd_velocity)/ (2 * sample_rate)**
vga_t1, vga_g1, vga_t2, vga_g2	These four parameters describes the applied VGA / TGC (time gain compensation). The two values t1 and t2 is the two sample numbers where respectively g1 and g2 is applied (gain values in dB). For samples before t1, the VGA has a fixed gain og g1, between t1 and t2, a linear slope (in dB) is applied, and after t2 a fixed gain of g2 is applied.
payload	The total size of the packet is 1048768

The following layout is of the scan and beam directions within the **payload** (starting from offset 192 from the start in the packet). Here, *payload* is comprised of a single scan of size M*N and N directions (one for each beam). The total size of the payload is at most 1048576 bytes.

```
|------+-----+------+-----+-----+-----+------+-----+------+-----+-----+-----|
| P_11 | ... | P_1N | ... | ... | ... | P_M1 | ... | P_MN | B_1 | ... | B_N |
|------+-----+------+-----+-----+-----+------+-----+------+-----+-----+-----|
```

Where each scan is an intensity image like:

```
|------+-----+------|
| P_11 | ... | P_1N |
|------+-----+------|
| ...  | ... | ...  |
|------+-----+------|
| P_M1 |     | P_MN |
|------+-----+------|
```

Each P_xx can be up to 8 bytes in size and each B_x is a 4 byte *float32*.

8.3 Snippet data

The sonar will keep sending all available snippet data to any client connected to port 2212 if sonar is configured in snippet mode.
Snippet data is is a binary format in the following form:

Byte Offset	Type	Name	Description
0	uint32	preamble	0xDEADBEEF
4	uint32	type	4
8	uint32	size	Size of entire package in bytes
12	uint32	version	4
16	uint32[2]	RESERVED	
24	float32	snd_velocity	Sound velocity in m/s
28	float32	sample_rate	Samping rate in Hz
32	uint32	N	Number of beams
36	uint32	M	Number of samples in each beam
40	float64	Time	Ping timestamp, unix time at TX
48	uint32	dtype	0:uint8 1:int8 2:uint16 3:int16 4:uint32 5:int32 6:uint64 7:int64 0x15:float32 0x17:float64
52	int32	t0	Sample number of first sample in data
56	float32	gain	Total processing gain
60	uint32	RESERVED	RESERVED
64	float32	swath_dir	Swath center dir in radians
68	float32	swath_open	Swat opening angle in radians
72	float32	tx_freq	Tx frequency in kHz
76	float32	tx_bw	Tx Bandwidth in kHz
80	float32	tx_len	Tx pulse length in sec
84	unit32	tx_amp	Tx amplitude 0-15
88	uint16	RESERVED	RESERVED
90	uint16	RESERVED	RESERVED
92	float32	RESERVED	RESERVED
96	float32	RESERVED	RESERVED
100	float32	ping_rate	In Hz
104	float32	RESERVED	RESERVED
108	uint32	ping_number	Sequence number of ping
112	float64	time_net	Timestamp Unix time as fract (send on network time)
120	uint32	beams	Total number of beams in beamformer (before decimation)
124	int32	vga_t1	Sample number for first vga value
128	float32	vga_g1	vga gain in dB for first vga value
132	int32	vga_t2	Sample number for second vga value
136	float32	vga_g2	vga gain in dB for second vga value

140	uint16	RESERVED	RESERVED
142	uint16	RESERVED	RESERVED
144	float32	tx_angle	Tx elevation steering in radians
148	float32	tx_voltage	Tx voltage - peak-voltage signal over ceramics. NaN for sonars without measurement
152	uint8	beam_dist_mode	1:512EA 2:256EA 3:256ED, 4:512EAx, 5:256EAx
153	uint8	sonar_mode	0:FLS 1:Bathy 2:Bathy amp, 3:TBD 4:bf pass-through 5:Bathy edge enhance 6: Super res bathy
154	uint16	RESERVED	
156	float32	gate_tilt	Gate tilt in radians, for depth gates
160	float32	RESERVED	TBD
164	uint8*28	RESERVED	
192	dtype[MxN]	Snippet pixel data	
192+M*N*sizeof(dtype)	float[N]	Snippet beam directions in radians	
192+M*N*sizeof(dtype)+4*N	uint16[N]	Snippet start sample	
192+M*N*sizeof(dtype)+6*N	unit16[N]	Bottom detection sample	

8.4 Sidescan data

The sonar will keep sending all available sidescan data to any client connected to port 2212 if sonar is configured in sidescan mode.
Sidescan data is is a binary format in the following form:

Byte Offset	Type	Name	Description
0	uint32	preamble	0xDEADBEEF
4	uint32	type	5
8	uint32	size	Size of entire package in bytes
12	uint32	version	4
16	uint32[2]	RESERVED	
24	float32	snd_velocity	Sound velocity in m/s
28	float32	sample_rate	Samping rate in Hz
32	uint32	N	Number of beams (always 2 for sidescan)
36	uint32	M	Number of samples in each beam
40	float64	Time	Ping timestamp, unix time at TX
48	uint32	dtype	0:uint8 1:int8 2:uint16 3:int16 4:uint32 5:int32 6:uint64 7:int64 0x15:float32 0x17:float64
52	int32	t0	Sample number of first sample in data
56	float32	gain	Total processing gain
60	uint32	RESERVED	RESERVED
64	float32	swath_dir	Swath center dir in radians
68	float32	swath_open	Swat opening angle in radians
72	float32	tx_freq	Tx frequency in kHz
76	float32	tx_bw	Tx Bandwidth in kHz
80	float32	tx_len	Tx pulse length in sec
84	unit32	tx_amp	Tx amplitude 0-15
88	uint16	RESERVED	RESERVED
90	uint16	RESERVED	RESERVED
92	float32	RESERVED	RESERVED
96	float32	RESERVED	RESERVED
100	float32	ping_rate	In Hz
104	float32	RESERVED	RESERVED
108	uint32	ping_number	Sequence number of ping
112	float64	time_net	Timestamp Unix time as fract (send on network time)
120	uint32	beams	Total number of beams in beamformer (before decimation)
124	int32	vga_t1	Sample number for first vga value
128	float32	vga_g1	vga gain in dB for first vga value
132	int32	vga_t2	Sample number for second vga value
136	float32	vga_g2	vga gain in dB for second vga value

140	uint16	RESERVED	RESERVED
142	uint16	RESERVED	RESERVED
144	float32	tx_angle	Tx elevation steering in radians
148	float32	tx_voltage	Tx voltage - peak-voltage signal over ceramics. NaN for sonars without measurement
152	uint8	beam_dist_mode	1:512EA 2:256EA 3:256ED, 4:512EAx, 5:256EAx
153	uint8	sonar_mode	0:FLS 1:Bathy 2:Bathy amp, 3:TBD 4:bf pass-through 5:Bathy edge enhance 6: Super res bathy
154	uint16	RESERVED	
156	float32	gate_tilt	Gate tilt in radians, for depth gates
160	float32	RESERVED	TBD
164	uint8*28	RESERVED	
192	dtype[Mx2]	Sidescan pixel data	Interleaved left /right intensity data: Intensity left Intensity right

9 Comments:

9.1 Gain settings

The systems adjustable gain consists of an analog gain (VGA variable gain amplifier) in the front end (40dB dynamic range), and several digital gain settings in the following processing chain.
The analog gain is by default used for time-gain-compensation (TGC), where the amplifier starts at 0dB gain and then ramps up with a fixed slope (dB/km two-way range), until it reaches max gain. This slope is adjustable with the set_vga command.
To get full manual control over the analog gain with set_gain vga should be set to 0.
Analog gain is reported in water-column, sidescan and snippet headers, with the vga_t1, vga_t2, vga_g1 and vga_g2 parameters. For bathy data, which reports back-scatter intensity as floating point numbers, gain is corrected for.

The digital gain, is numerical scaling of the data in the processing chain.
It is adjustable in steps of 6dB, and is by default done automatically (autogain 1) meaning that the sonar will monitor the peak signal in every step of the signal processing and adjust digital gains up and down accordingly.
The applied digital gain is reported in the gain field in all packet headers.

The difference between autogain 2 and autogain 0,
in mode 2, gain is set fixed to assumed sane values, just based on tx and filter settings.
in mode 0, gain is locked to whatever value it has. E.g. you can run in autogain mode to adjust the gain, and then lock it so the gain wont change if some strong reflector enters the field of view.

9.2 Resolution setting

Water column resolution is controlled with the set_resolution command.
This takes in two parameters, vertical and horizontal resolution
vertical resolution is a requested number of samples in vertical (time) direction, but be aware that you wont get the exact number of samples that you require, but instead the closest approximation that can be done with the following constraints.
- Sample rate needs to be 78.125kS/s (~1cm) or a integer decimation of this (1cm, 2cm, 3cm etc.)
- Maximum number of lines is limited to 32768
- Total number of samples per image is 512k (will be increased in the coming release)

horizontal resolution is one of 64, 128, 256 and 512

10 Figures

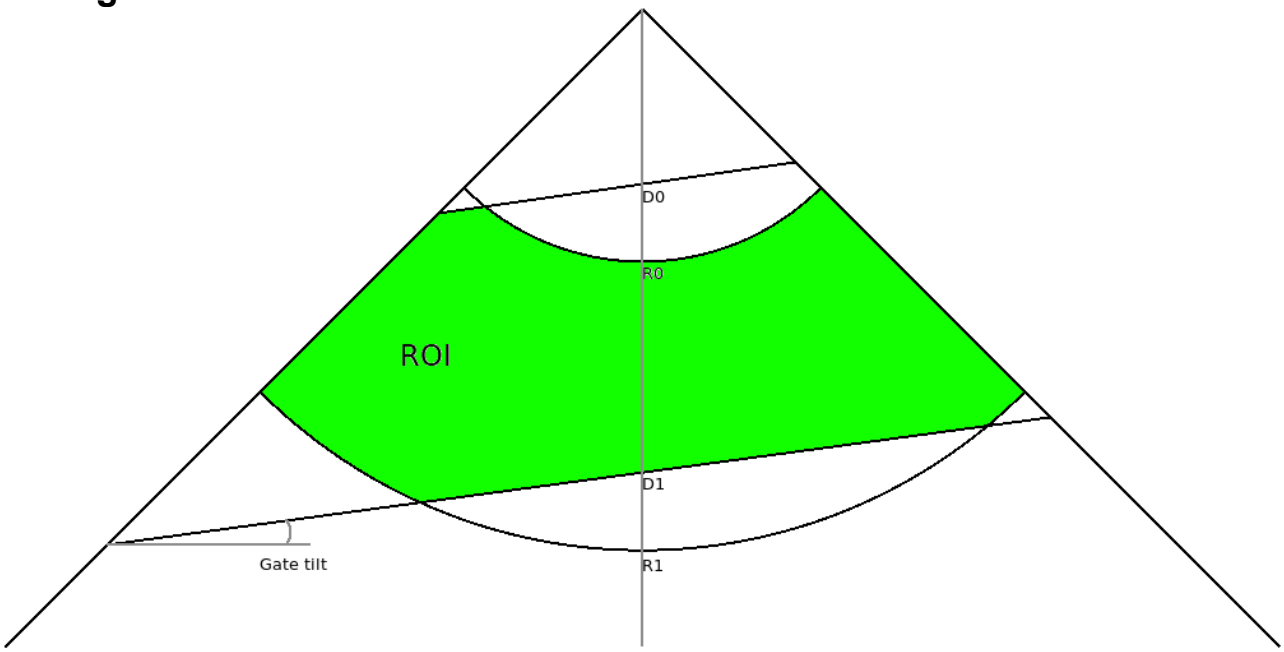

Figure 1: Region of interest defined by gate tilt and depth / range gates