Dorado Bioacoustics Concept

901807 NEXT GEN BIOACOUSTICS ON DORADO MBARI 2018

Statement of Problem (Kelly)

2018 Goals (Kelly)

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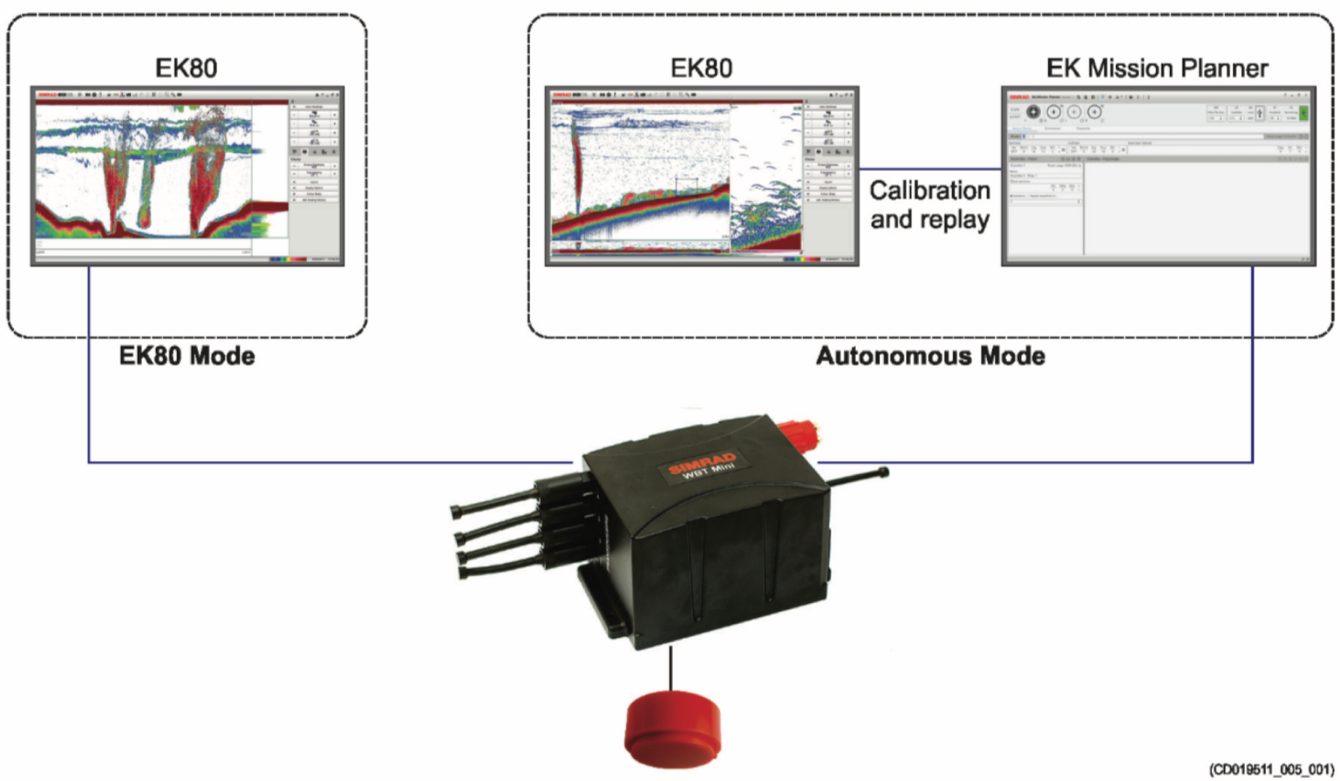
Simrad Mini-WBT

- Compact version of the Wide Band Transceiver (WBT)
- 12-16 VDC input, Max 6W



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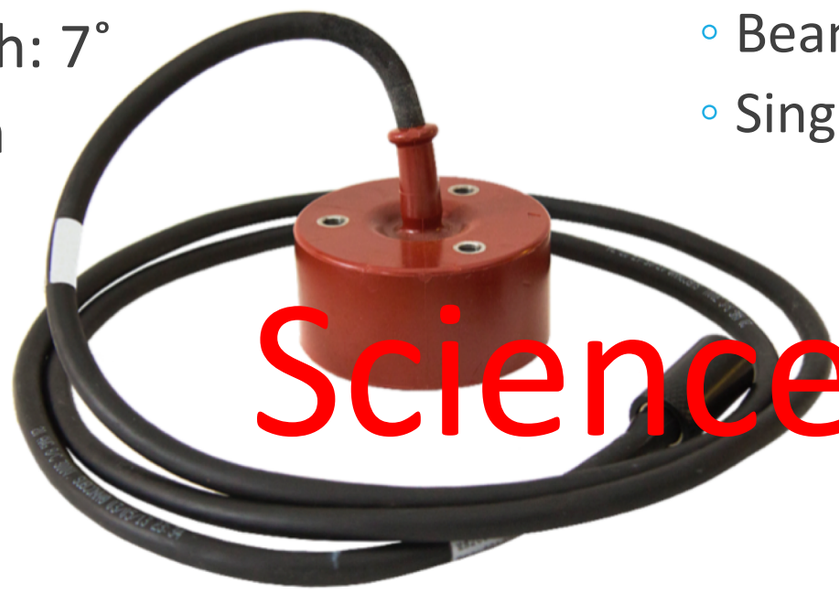
Transducers

ES200-7CDK Split

- Nominal Frequency: 200-kHz
- Frequency Range: 185 to 255 kHz
- Beamwidth: 7˚
- Split Beam



ES333-7CDK Split

- Nominal Frequency: 333-kHz
- Frequency Range: 270 to 445 kHz
- Beamwidth: 7˚
- Single Beam

Science reason?

Previous Integrations (Chad/Paul?)

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Functional Requirements

1. All components must be contained within the I2Map Payload area.
2. The system must facilitate deck configuration and remote start/stop operation.
3. Time, depth, and position data from the vehicle must be incorporated in the recorded data.
4. The system must survive the depth rating of the overall payload.
5. Transducers cannot impact the video data.
6. The forward-oriented transducers' field of view must overlap with the field of view of the camera from within the focal range of the camera.
7. I2Map must remain deployable without the acoustic payload and during development
8. **Science Requirements: ping rate/ping power/detail**
9. Cannot impact existing surveys in duration or depth capability.
10. Conduct continuous data collection.
11. Cannot impact other acoustic systems, and vice-versa.
12. Data must be available post-dive.
13. Data download must occur in time less than a recharge of the vehicle's batteries.
14. System needs to deployed without the AUV for tank testing purposes
15. There must be a dedicated Windows-based processor to operate the software.

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Derived Requirements

System:

- Depth rated to 1500-m
- No obstruction for transducers to 7 degrees
- No video obstruction
- Transducers mounting must easily be installed/removed.
- Neutrally buoyant
- Vehicle shall remain in stable flight at existing I2MAP normal through-water speeds (1 knot).

Interface:

- Self-powered (12-17VDC) and auv-host connection (18-36VDC), existing electronics require a clean 12-17VDC input.
- Isolated Trigger Input
- GPS/Depth/MRU serial data to sonar software
- Configuration interface (ethernet/remote desktop)
- CPU must accommodate simrad and echoview software
- Accommodate data storage at rate 25-GB/hr.
- Disciplined time input (ntp or 1-PPS)
- Download interface must facilitate a maximum 5-hour download time.
- Minimum 6 hour run time.
- Must respect normal AUV health monitoring standards.

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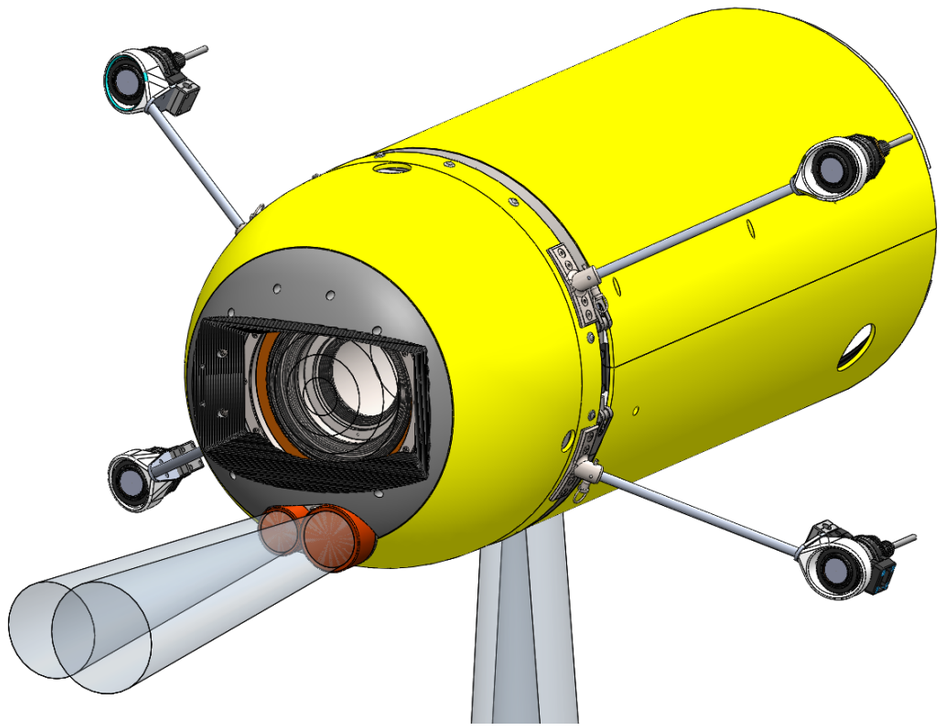
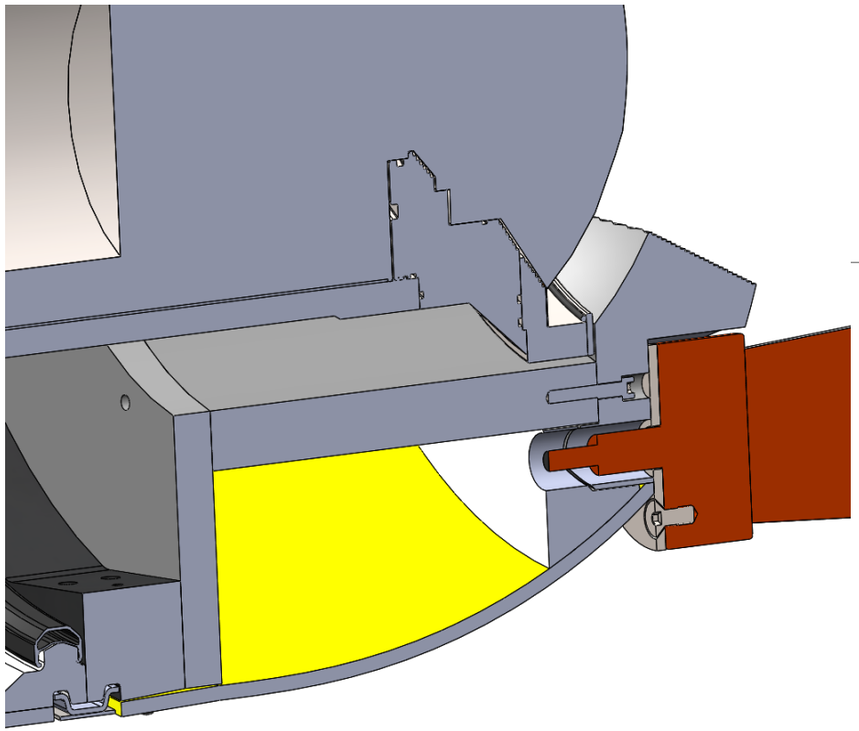
System Concept

Forward Mounting Transducers

Transducers are embedded in the Delrin piece below the camera:

- Lower drag
- Somewhat out of harm's way
- Closer to camera
- No cables outside of fairing
- Requires taking apart nose cone and machining plastic components.
- No interference with light beams.

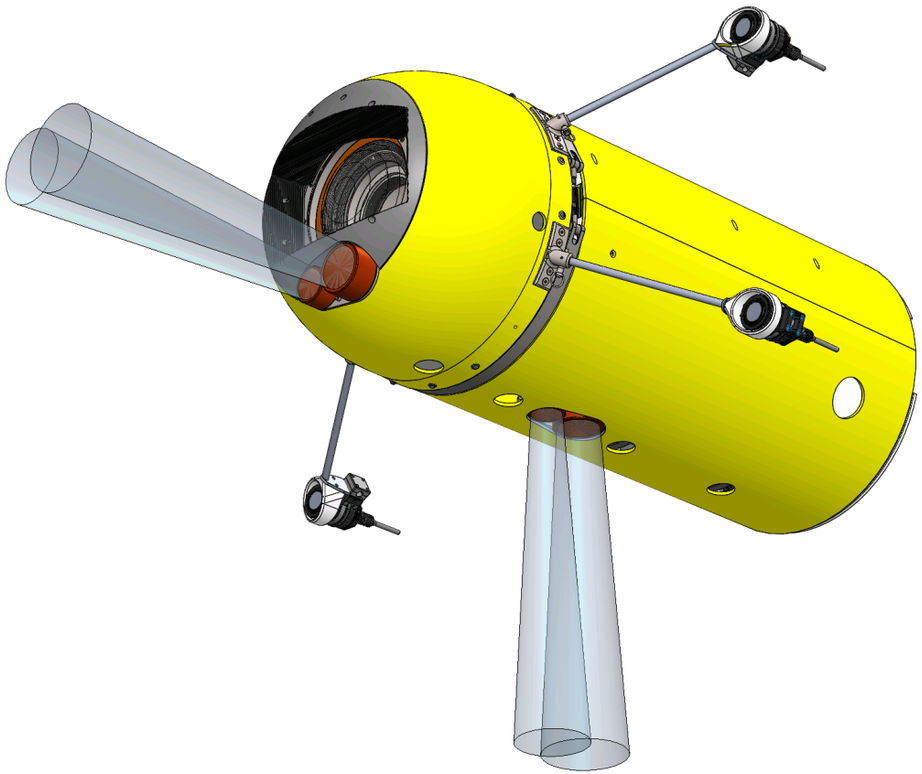


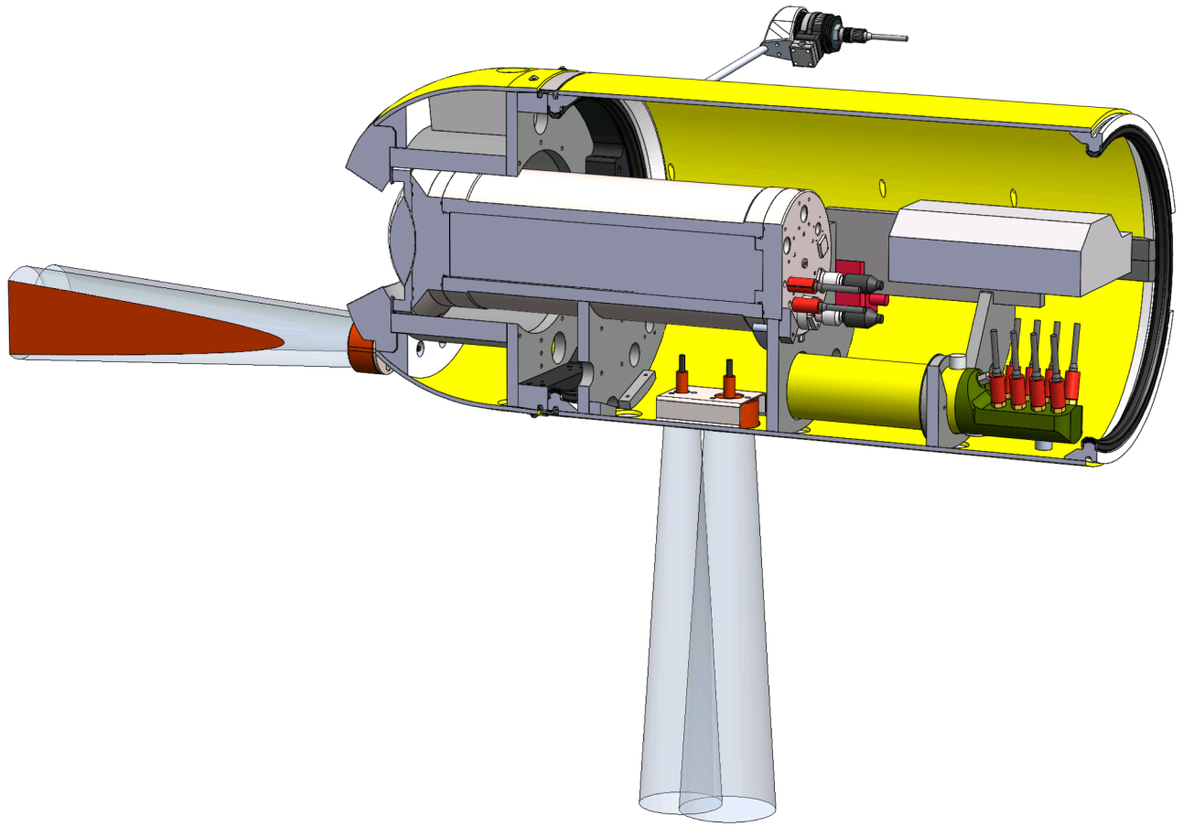


The cross section view above is offset from the center plane by 1.5”.
The transducers are mounted on a 3/16” metal plate. The metal plate is screwed to the plastic ring from the front using two ¼-20 screws. The cables are easily routed to the back of the AUV.

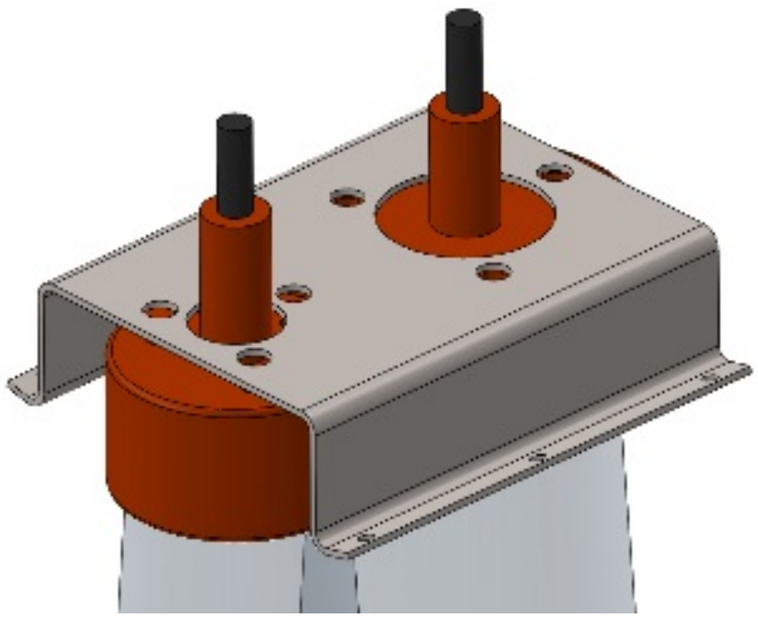
View without the transducers.

Placement of Downward Transducers in AUV



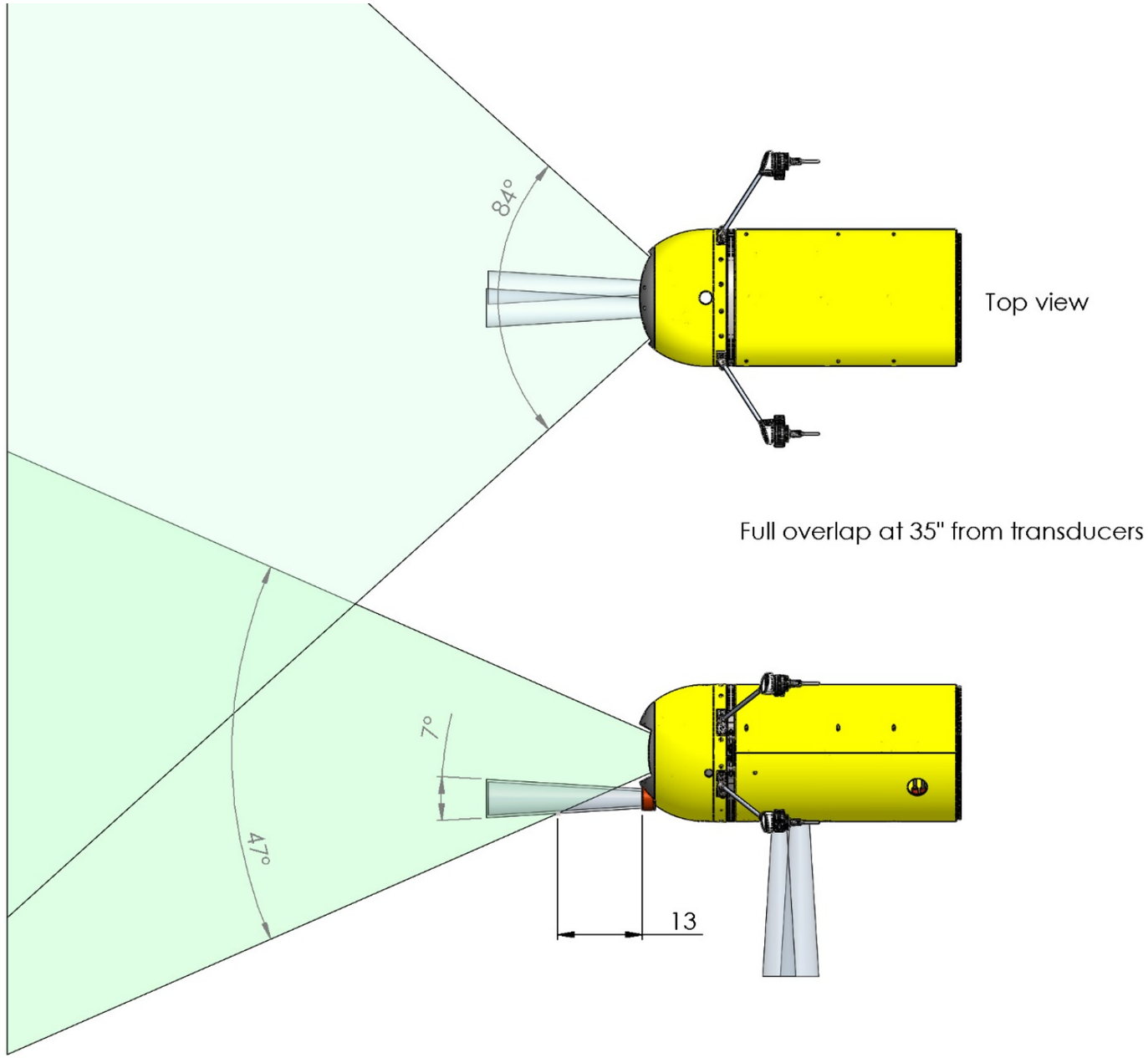


Downward facing transducer bracket



- Gauge 14 stainless steel bracket
- Gets screwed to bottom fairing
- Transducers can we accessed without removing the camera housing (there is enough space on the sides for an operator to reach the fasteners)

Comparison of camera field of view and transducer beams: Low bracket



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Electronics Packaging: The Sphere Solution

Concept

Since the system has been notoriously difficult in integrations, let's choose a solution that provides initial flexibility and reduces design time and risk.

- Replace a 5-kWhr sphere with a similar 17" sphere with Simrad and support electronics in its place.
- Capable because of short i2Map mission duration limitation (recording 5 hours)
- Enough room for key components, and space for a dedicated battery pack to run the acoustics and processor
- Extra room allows for better EMI rejection
- Removes need for new section
- Current wet-connector count dictates a large housing regardless.
- This solution will likely reduce need for much floatation.

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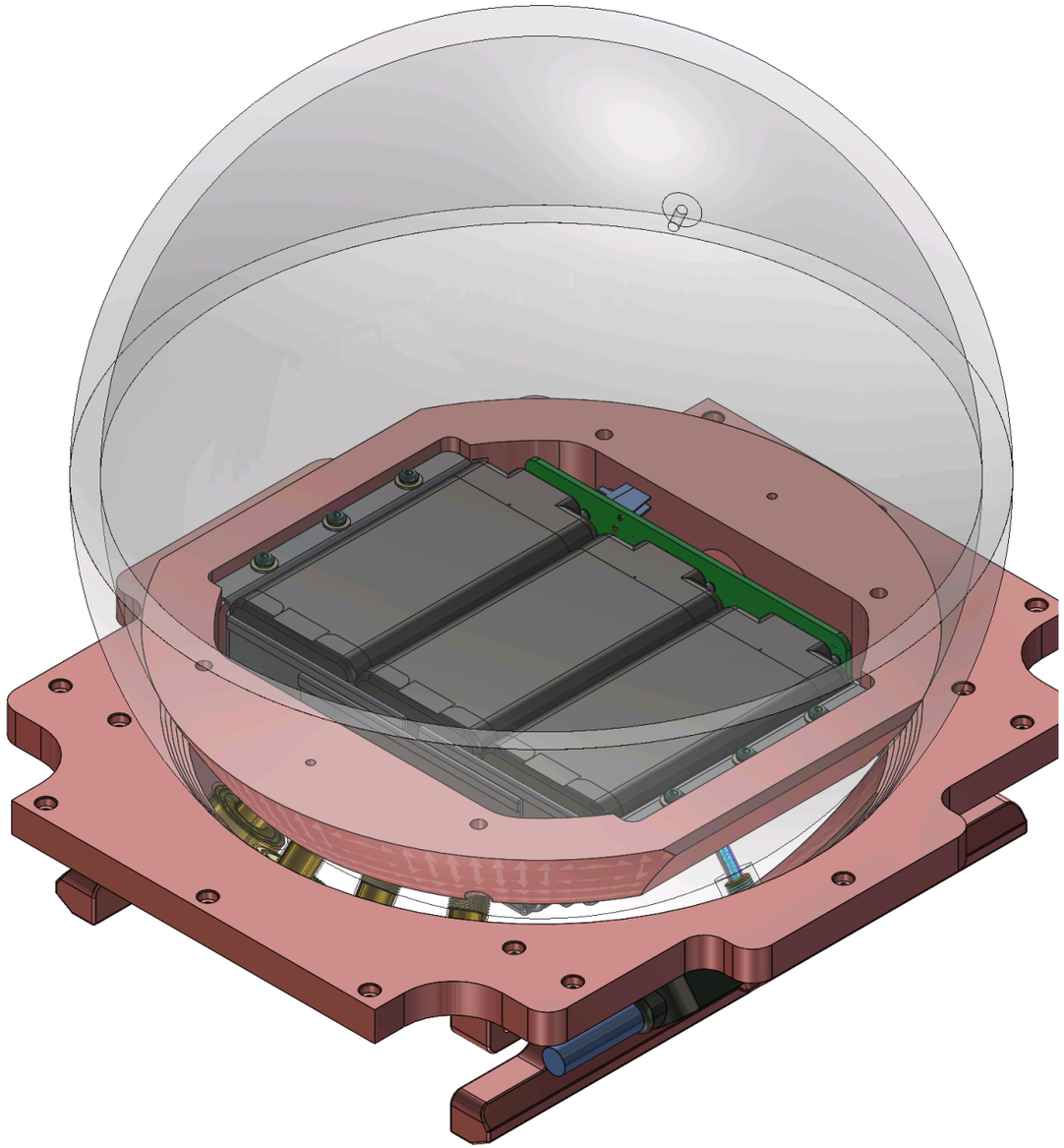
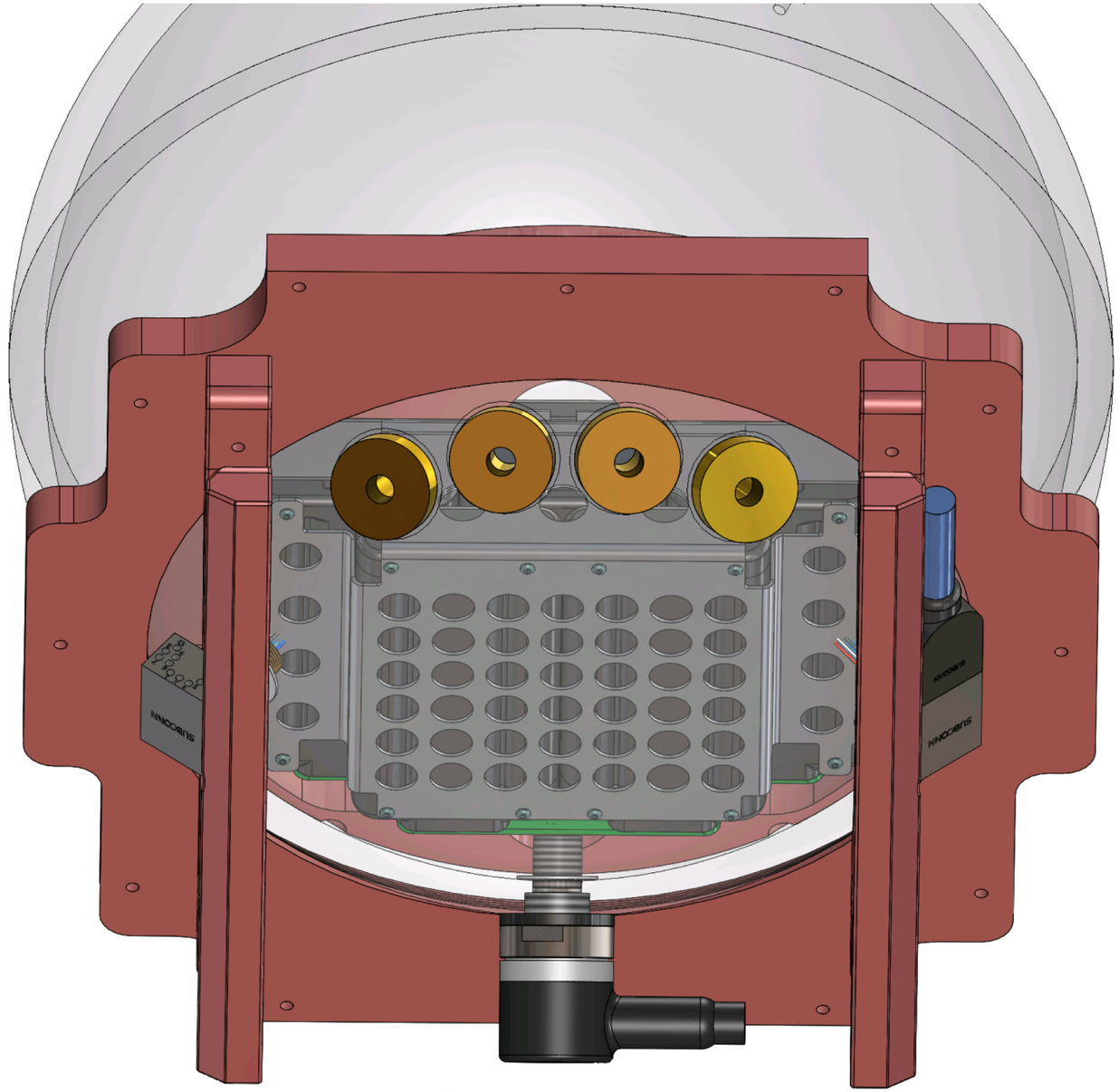
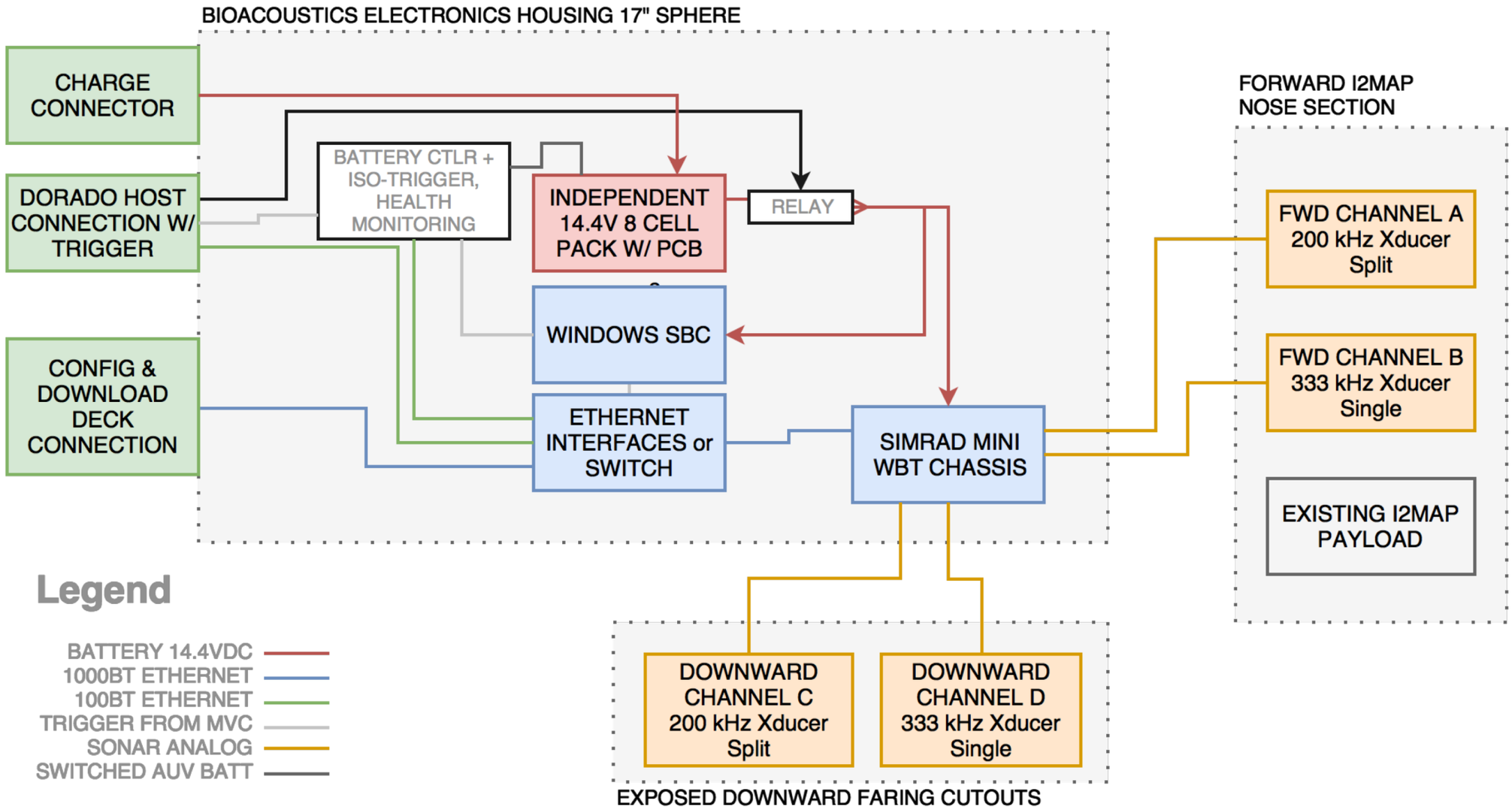




From Below, Connector View

Notional Wiring Concept



Custom Electronics: Battery Controller

Current Battery: PH2054HD34

PART NUMBERS:	PH2054HD31 = 6.2Ah / PH2054HD34 = 6.8Ah Hi capacity
CHEMISTRY / CELL ARRAY:	8 Li-Ion 18650 cells / 4S2P array
CAPACITY / ENERGY:	6.2Ah / 89Wh 6.8Ah,/ 98Wh
VOLTAGE:	Vmax=16.8V Vnom=14.4 V Vcutoff=10.0V
EQ. LI CONTENT:	6.9g
MAX CONTINUOUS DISCHARGE	8A
MAX CONT DISCHARGE TO CUTOFF VOLTAGE	80W

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Features:

- Incorporate the LPC1769 using micromint SOM and firmware from dorado
- Leverage existing circuits from 41-Cell pb
- Leverage existing filter circuit from the glider.=
- Controls battery charge/discharge [CONTING ON INSPIRED ATM]
- Trigger/Signal isolation
- Fusing
- Health Monitoring (humidity, pressure, leak)
- Potential Voltage regulation for SBC, MiniWBT

Alternatively

- We could skip some of this board, and since the charge will last for currently estimated 33 hours on 8 cells, you could avoid smart charging.

Preliminary Power Budget

Batteries

Hotel Battery Energy	4.6	kWhr	Single Sphere
Sonar Battery Energy	0.744	kWhr	8x PH2054HD34

Payload

i2MAP Payload Hotel	97.6	watts	Instruments, Micro, Fan, Switch, Camera
i2MAP Payload Lamps	364	watts	LSL-2050 Sealite
AUV Hotel Payload	157	watts	
Propulsion Speed	0.5	knots	
Propulsion Power	0.66	watts	Based on propulsion budget from M. Chaffey
Total AUV Battery Load	619.26	watts	

Duration

Duration All Items On	7.43	hours	
Recording On Percentage	30	%	
Duration On Percentage	12.62	hours	

BioAcoustics Payload

Transceiver Hotel	10	watts	
SBC	12	watts	
Duration Two Cells	8.45	hours	Minimum Required
Duration 8 Cells	33.82	hours	Well exceeds an estimate for opportunistic lamp usage.

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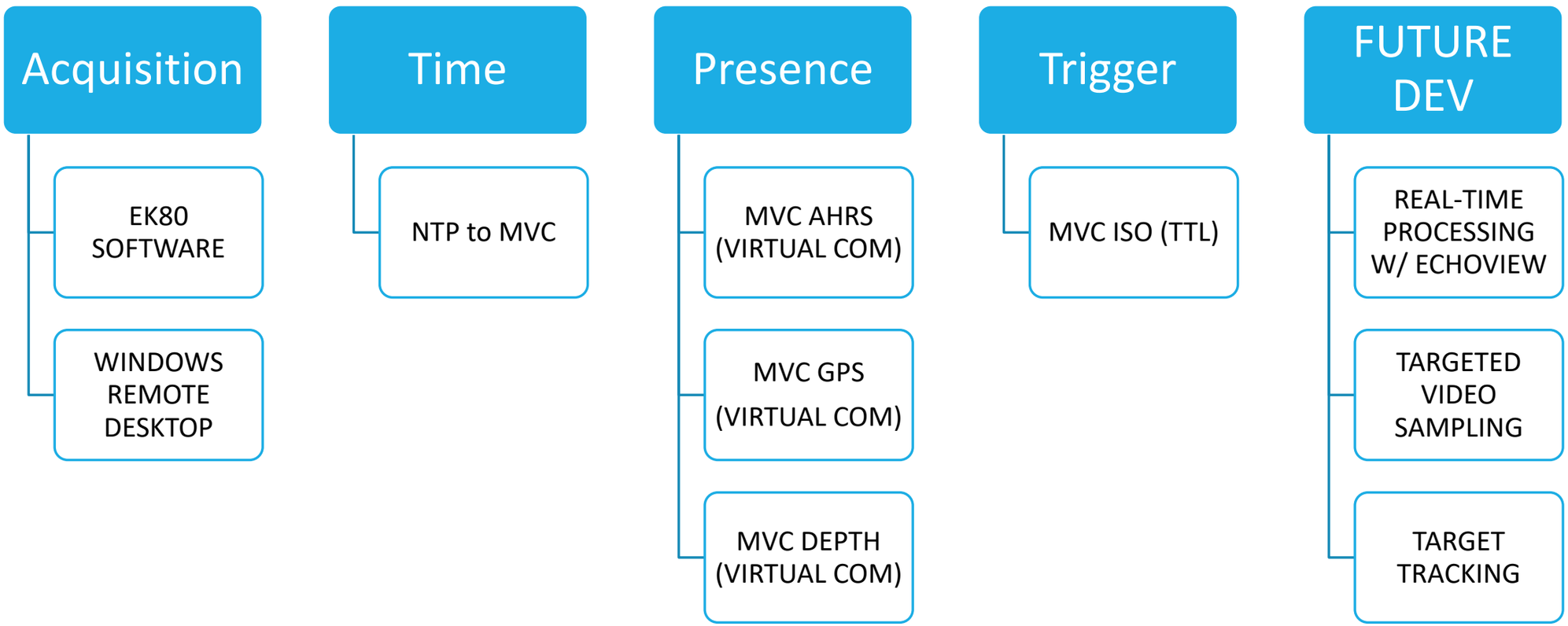
Software Architecture (Windows SBC)



Preliminary Cost Estimates

- Padding in budget from likely unnecessary foam and fairing line items.

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Subsea Housing

Item	Quantity	Unit	Extended
17" Nautilus Sphere	1	$ 1,300.00	$ 1,300.00
Lincoln60e	1	$ 100.00	$ 100.00
Housing Manager Board	1	$ 2,000.00	$ 2,000.00
8 Cell Plastic Sphere Adaptor	1		$ -
8 Cell Bent Aluminum Chassis	1		$ -
Sphere Exterior Mounting Fixture	1		$ -
SBC	2	$ 2,700.00	$ 5,400.00
SBC Accessories	2	$ 151.20	$ 302.40
SBC Heat Pipe Plate	1	$ 58.00	$ 58.00
8 Cell Battery PCB	1	$ -	$ -
Batteries PH2054HD34 14.4V	8	$ 168.04	$ 1,344.32

Category Total:	$	10,504.72
Budgeted Amount:		$11,968.00
Shortfall/Surplus:	$	1,463.28

Wet Connectors

Item	Quantity	Unit	Extended
Download GigE Bulkhead (NETG)	1	$ 265.00	$ 265.00
Download GigE Cable	1	$ 600.00	$ 600.00
Download Bench Cable	1	$ 900.00	$ 900.00
Download GigE Dummy	2	$ 200.00	$ 400.00
AUV Host Bulkhead ()	1	$ 1,100.00	$ 1,100.00
AUV Host Cable	1	$ 2,200.00	$ 2,200.00
AUV Host Bench Cable	1	$ 1,100.00	$ 1,100.00
AUV Host Dummy	2	$ 400.00	$ 800.00
Transducer {A:D} Bulkhead	4	$ 330.44	$ 1,321.76
Transducer {A:D} Cable	4	$ 445.50	$ 1,782.00
Transducer {A:D} Dummy	8	$ 44.00	$ 352.00

Category Total:	$	10,820.76
Budgeted Amount:		$10,820.76
Shortfall/Surplus:	$	-

Note: Need to get quotes for many of these.

Dorado Mechanical

Item	Quantity	Unit	Extended
Transducer Forward Mounts	1	$ -	$ -
Transducer Downward Mounts	1	$ -	$ -
Foam Modifications	1	$ -	$ -
Weight	1	$ -	$ -
Floatation	1	$ -	$ -

Category Total:	$	-
Budgeted Amount:		$8,690.00
Shortfall/Surplus:	$	8,690.00

Risk Elements

1. The Simrad MiniWBT has notorious noise susceptibility from a broad array of electrical and mechanical sources as seen in previous integrations (glider and Ventana)
   - **Approach:**
     - Leverage sphere space for EM enclosures other solutions
     - Dedicated battery pack
     - Leverage previously designed filters.
     - Isolated connections
     - Design room for mechanical isolation of transducers.
2. Acoustic interference from AUV subsystems, DVL & CTD Pump
   - **Approach:** Characterize problem as early as possible.
3. The transducers are mechanically sensitive devices and must have unimpeded exposure to the environment.
   - **Approach:** Transducers have been brought as close into vehicle as possible, there is room for more proctection if necessary.

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Performance Stack-Up

Category	Requirement	Design Concept
Functionality	Preserve current functionality and capabilities.	• No obstructions • Small change in drag profile • Transducers easily removed
Depth Rating	1500	7000
Mission Duration	6	7.5 (for AUV w/ 1 battery and package on its own)
Data Storage	6*25GB/hr = 150-GB	TBD - Commonly Available
Data Offloading	5 hour	20 min at Gig-E
Mounting	2FWD/2DWN Focal range	2FWD/2DWN 1.3-m

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Test Plan

- April Tank testing:
  - Identifying noise sources as soon as possible by running against i2Map section
  - Waiting on transducers & software fixes
- April/May:
  - Purchase COTS components and test against the hardware in May
  - Assess final processor requirement.
- May/June: PCB Design CDR
- July/August: Package assembly and testing
- At Sea Testing: 10/26, 10/29, 12/6

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Team

- Kelly Benoit-Bird: PI, Simrad POC
- Eric Martin: PM, Wiring, Board Design
- Bruce Robison: Investigator, I2MAP POC
- Kim Reisenbechler: I2MAP POC, collaborator
- François Cazenave: Brackets, EMI Enclosures, Chassis Design
- Hans Thomas: Sphere Housing, Wiring, Board Design
- Paul McGill: Noise Isolation
- Chad Waluk: Sonar software, SBC configuration

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Questions

Additional Slides

SBC Requirements

- Celeron or better x86/x64
- 10-16.8V Input range desired
- 2x Gig-Ethernet & 2 100BT-Ethernet
- Serial port or dig IO for trigger
- Runs windows 7 or better
- HDD SIZE BASED ON REQ

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