

From: Kent Headley headley@mbari.org
Subject: Fwd: Geosense preliminary design review
Date: May 9, 2024 at 11:14 AM
To: Alana Sherman alana@mbari.org



Hey Alana - thanks for a great review - well run and thorough; I always learn a ton!
Here are my notes, fwiw.

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Begin forwarded message:

From: Kent Headley <headley@mbari.org>
Subject: Geosense preliminary design review
Date: May 9, 2024 at 11:09:48 AM PDT
To: Kent Headley <headley@mbari.org>

sherman, paull, klimov, martin, micalef, schnitger, mcgill, hamilton, gwiazda, schaefer, tucker

Remote: henthorn, David Hill, Steve Jabobs (Sintela)

CDR/PDR but some is already done and won't change
Basically, this is the DR for the project.
Pressure housings done

Sediment flows, seepage,
Optical means of acoustic signals
Very fine resolution
Sensitive over large areas
Currently used on shore cables (large (3U 19 inch), high power (100W)

Sintela, Onyx Nano
For perimiter monitoring (prison e.g.)
Autonomous
40 W, book sized
Can trigger measurement
10 km range

Interrogator, power, storage, 1000m cable, weight

Winter 2024-25 experiment already scheduled (Paull)
Many seismometers and shore side DAS on MARS
Opportunity to ground truth vs other instruments

So, aggressive schedule

Deployment/Recovery
From RV Packard

Requirements
1-2 month deployment
1000 m depth
Distance?
Cable well coupled to seafloor
Visible for inspection
Must be able to fly over for inspection
Ti sphere for instruments
Glass spheres for batteries,
Any orientation wrt earth gravity
24-32 V
Graceful shutdown when batteries depleted
Batteries non-rechargeable

Cable density acoustic properties matter too, not lay flat only
Cable more dense than h2o
Mud 1.8, sand 2.2
Reduce hydrodynamic drag, min rattling from currents
Coupling is variable
Have had cable design review

Software on instrument itself
Software on DAS
Must connect
Use Deep sea connect for status, upload some data
Redundant drives?
All Sintela software (in DAS device), zero MBARI software
If there's power present, it will power up...it can zombie cycle

System Block Diagram

Black hole terminator
DAS instrument Ti sphere
3 glass spheres , 10 kWh batteries each
DeepseaConnect toaster

FO penetrator cable to DAS sphere

Electrical design

DAS onyx nano specs
ONYX software, strip out to lower power consumption

Log segments can be sized, via user interface
System start re-recording automatically
Usually deployed in remote areas,
WDTs? Have ability to do that (don't currently) instances where it has to feed to internet, so network WDT can reboot,
But typically don't need to do.

Power budget

Using primary batteries for max power density
DAS runs from 28V, < 40W
Using waste heat to warm laser (exactly 25C required, tight control)
30 kWh Li Primary
31d @ 40w, 42d @ 30W
DAS ok to 20V

200 Hz sampling
Cost/power/risk of second SSD trade TBD

Sample 24/7 for now (we're energy limited not storage limited)

Typical continuous operation for years
Only reboots on power cycle - very infrequent
(So prob no memory leak issues)

What happens to temp mgmt sys if batteries decrease?
Once batteries dead, that's it
Can test on bench about what happens

Priorities for this deployment:
- On time
- As low power as possible in time available

Are there humidity/pressure sensors? Can we check env
TH Internally monitored, pressure not monitored
Put it on system

How does data storage and power scale with sample frequency (non linear)

Sample size: 500 channels (size per channel, 32 bit?) - This is 2kb/sample @ 32 bits 34 GB/day
How close to nyquist can you

Deeps connect separately powered

DAS and battery spheres are reused from coordinated canyon experiment
Each sphere fused
Shorting plug required to power DAS (installed at deployment time)
Need to reduce connectors to minimize reflections that reduce S/N ratio

Is there a way to have connectivity during deployment to monitor cable health?

Maybe not required for this deployment.

If cable breaks can still get some data, but maybe degraded

FO connectors

Oil may get up into cable interstices....

Compensator volume is important

Let it sit for a while before deployment

If cable jacket breaks, will leak over time...can run out of oil

Mechanical Design

Sintela is handling thermal design, laser heating, etc.

May put insulation

Need cooling on deck? May need to shade, cool with water

But can monitor temp on deck

Can get hot quickly, advise to shade on deck

Geosense frame

Galvanized steel

Strain relief

~129 in long

Min heave load, cable tension

Peak load 1000lb 4:1 safety margin

What happens thermally if sphere in sediment

Will be shrouded so it won't plow

Keep nose up

How will it land - can it be oriented

Where to put deepsea connect (DSC)

How much can cable rotate?

Where to put lead?

300 lb in air? Water?

Cable permanently attached

How to load on boat

Has to go w/ winch

What are structural pick points

There will be eyes

Cable selection

Status

DAS eta Fall 2024

Permits OK?

Assuming not ship days 2024

Software test using docking (docker?) image

How flat will cable lay?

Better to unspool?

Test deployment?

Could unspooling be done on Carson?

Can check w/ Falmat person

Do test deploy

risk items

Delays: DAS, cable, termination

Cable lay flat

New deployment scheme, new ship

Ship availability

Cable snap at deployment, sea state

Design for before top weight in water, and after

tension....how straight does it have to be?
OK (better) if slightly curved horizontally
Don't want telephone cord
4DNAV may have guidance help
Acoustic beacons to monitor how it's laying
Maybe put some on cable — would have to add after shiv

ROV visual inspection required on deployment
Need visibility (should be ok just after deploy)

Is laser eye safe? Yes, class I eye safe laser

DAS PCB expected avail for test this month
Going well so far

Cable design: standard or engineered
Depends on delivery time

Cable selection TBD

MOBB frame deployment video
Lobos to film + Flyer
900m depth
Pretty calm conditions
Still lots of heave
Pumping water that stirs up dust cloud
Then drop it: beat it or long drop
Slack could hockle
Watch tension and

Chasing a dropped caisson: happy ending

Proposed Location?
121.9, 36.8 on a terrace above canyon
No rocks (rougher to south)
390m depth
Line spool elevator

Software questions

What hardware does software run on? Jetson Orin

Operating system?

File system?

Where is the software being developed?
What language?

What processes are running when deployed?
Multi-threading?
(How) do they communicate?

Are there WDTs?
How is they implemented (SW/HW)?

What is the data rate?
Ace sample 10, 20 50 kHz
200 Hz

What is the data format?

What is the sample/record size?
(appears to be ~1kb, since they estimate 17 GB/day)
 $200 * 86400 = 17\,280\,000$ (16.5 MB, 17.3 Mb)

Disk write rate:
 $200 * \text{<sample size> bytes/S}$

17.3 GB/day - assumes 1kb/sample : confirm this assumption
707 GB/day

12/ 50/42 u

Is recording 24/7?

If not, what is response time?

Is data log segmented? Size?

Are there any data write delays that scale with log size?

How/when is data downloaded?

Is there hold up mechanism to shut down file system on power loss?

Is there any storage redundancy? (Required/desirable)

How does software handle unscheduled power cycle?

What is the data format?

Is the data tolerant of corrupt records?

Is there a data buffering scheme or is it written directly to storage?

(How) is it processed before storage?

How much data is buffered?

Is there any dynamically allocated memory?

How are you testing for memory leaks?

Is there a way to quickly check data integrity and system function? (Deck mode required), ethernet connection (how, if not cabled)

How/when is the data processed?

Is any processing done in situ?

