



# **LOW-COST, SMALL FORM-FACTOR DAS FOR AUTONOMOUS OFFSHORE DATA ACQUISITION**

Proposal

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## Issue of Control Document

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## Summary

Sintela are pleased to provide this proposal to the Monterey Bay Aquarium Research Institute (MBARI) for the deployment of a low-cost, small form-factor Distributed Acoustic Sensing (DAS) Sensing Unit to be used to autonomously acquire offshore seabed data, based upon the Sintela ONYX™ *nano* design.

The ONYX *nano* is the latest DAS system from Sintela which is due for product release in 2024. It is designed as a low-cost, small form-factor DAS used to provide acoustic measurements on short fibers up to 10 km in length.

Sintela proposes providing a modified version of ONYX *nano* for the MBARI application.

This document provides further technical details on our proposal to fulfil your Distributed Acoustic Sensing (DAS) Interrogator Unit requirements and includes costs for the purchase, warranty of an ONYX *nano* Sensing Unit as well as the Non-Recurring Engineering cost (NRE) to modify the ONYX *nano* to fulfil MBARI's requirements.

## Our understanding of your requirements

MBARI wishes to use DAS to monitor sediment gravity flows during their first experiment, although there is also an interest in monitoring other seafloor processes with the same technology afterwards (e.g. seafloor displacement, changes in seafloor geometry due to uplift/subsidence, fluid seepage, etc.)

The fiber during the first experiment is proposed to be placed on the flank of a canyon, at almost 400 m depth, as shown in Figure 2.

The canyon will be far offshore, so a fully autonomous system is required.

First test to take place off Monterey around November 2024 with a prototype available for integration testing in the summer of 2024.

MBARI require a DAS with small dimension so that it can fit inside a 17-inch internal diameter titanium pressure sphere. It must require minimum power to operate, ideally  $\leq 30$  W using DC supplied from approximately 50 kWh capacity lithium batteries. Heat shall be dissipated through the walls of the Ti pressure sphere. The equipment is required to autonomously record DAS data from 1,000 m of fiber for approximately two months. The sphere with batteries, and the sensing fiber cable will be deployed on the seabed in a fashion similar to that shown in Figure 2.

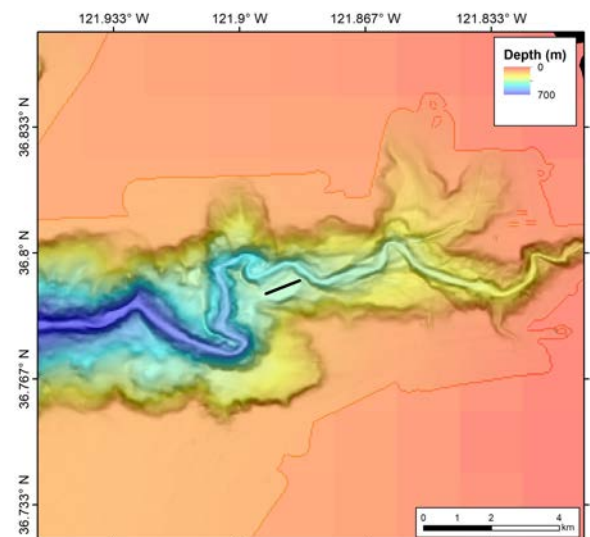


Figure 1: Intended deployment location of Marinized DAS Sensing Unit

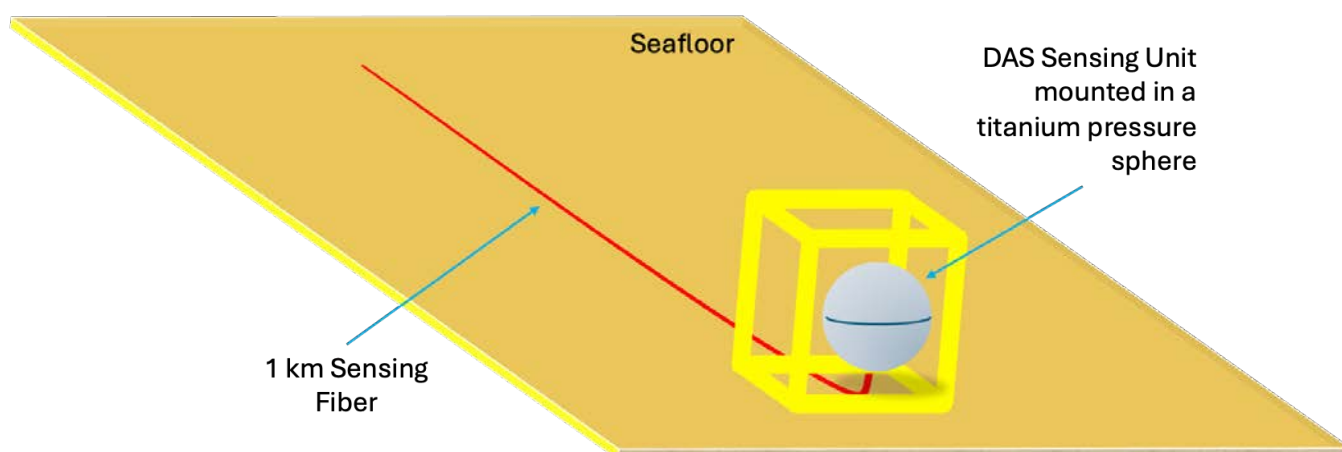


Figure 2: Schematic of the proposed deployment of DAS on the ocean seafloor

Once deployed the system will continuously monitor for seismic activity and any event over a set threshold (to be determined) will be recorded on to a Solid-State Drive (SSD). After two months all the equipment will be recovered, and the data retrieved for analysis.

## Acquisition settings

The following are the required acquisition settings:

|                    |                           |
|--------------------|---------------------------|
| Fiber length       | 1,000 m                   |
| Gauge length       | 5 m (ideally down to 1 m) |
| Sample Interval    | 5 m (Ideally down to 1 m) |
| Output sample rate | 1 kHz                     |
| Output file format | SEG-Y / HDF5              |
| Event duration     | ~30 minutes               |
| Event likelihood   | ~6 events per 100 days    |

## Our approach

Sintela proposes the use of a slightly modified ONYX *nano* to fulfil the MBARI requirements. ONYX *nano* is a low-cost small form factor fiber optic Distributed Acoustic Sensing (DAS) designed to operate on fiber up to 10 km in length. The ONYX *nano* is in the product design phase, but a preproduction version is expected to be available by the summer of 2024 and a full production version by the end of the year. A preproduction model will be made available to MBARI for integration testing in the summer and a final system suitable for use in the trial will be available by November 2024.

The design specification (subject to further change), of the ONYX *nano* is:

- Fiber Range: 10 km
- Spatial Resolution: 3 m – 10 m
- Noise floor: Approx.  $-63 \text{ dB rad.Hz}^{-1/2}$
- Acq. Sample Rates: 10, 20, 50 kHz
- O/P Sample Rate: 500 Hz, 1 kHz, 2 kHz
- Weight: c. 5 kg
- Dimensions: c. 300 x 200 x 75 mm
- Operating Temp:  $-10^\circ\text{C}$  to  $50^\circ\text{C}$
- Power: 20 V – 60 V DC, 40 W
- External I/O: 1 x 1 Gb Copper LAN
- Software ONYX standard SW  
(as provided across all other ONYX products)

## Proposal Detail

To achieve the MBARI requirements the standard ONYX *nano* requires some modification. These modifications include the ability to:

- be firmly supported within inside a 17 in sphere and dissipate heat to the sphere to ensure the system does not overheat.
  - This will require the design of a suitable mounting frame and some thermal modelling to ensure that the heat generated will be dissipated.
- start the system while inside the Ti pressure sphere
  - Achieved using a start command sent over a temporary wired connection or via a inductively coupled link
- generate a ‘heartbeat’ acoustic signal to confirm its operation
  - Possible inclusion of a an acoustic piezo electric transducer attached to the inner wall of the sphere set to generate a periodic ‘heartbeat’ signal
- continuously monitor the background activity but trigger record on an appropriate signal
  - Software chain built and tested to ensure that recordings are triggered by landslip activity and that 5 minutes of pre-trigger data and 25 minutes of post trigger data is stored on SSD’s
- record to an SSD
  - Addition of SSD to a standard ONYX *nano* and configuration for triggered recording

## ONYX™ Purchase

Prices are quoted for:

- A single channel ONYX *nano* Sensing Unit
- Non-Recurring Engineering charge to modify the standard ONYX *nano* for suitable operation as an autonomous subsea acquisition system

## Training

Online training will be provided to ensure that the users of the Onyx nano software are failure with its feature.

## Support

Sintela can provide ongoing annual support for each of the ONYX Sensing Units purchased. This support will include:

- Software updates
- Firmware updates
- Security patches
- Updates to the machine learning algorithms to provide improved detection and classification

These can be provided monthly or to a schedule determined by MBARI.

Sintela can provide remote support during the operation. For remote support ONYX Sensing Units must be connected to the internet for the VPN connection to be established back to the UK for support.

## Pricing

The following tables provide a breakdown of the prices included pricing for the various ONYX hardware options, with discounts and NRE costs.

| # | Code         | Product Description                             | Unit | Qty | Unit Price (USD) | Discount | Amount (USD) |
|---|--------------|-------------------------------------------------|------|-----|------------------|----------|--------------|
| 1 | ONX 530001 P | Single Channel<br>ONYX <i>nano</i> Sensing Unit | Each | 1   | \$75,000         | 26%      | \$55,000     |

Table 1: Price for an ONYX nano with a 26% academic discount

| # | Code | Product Description                                                                                                                                                                                                                                                                                               | Unit | Qty | Unit Price (USD) | Discount | Amount (USD) |
|---|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----|------------------|----------|--------------|
| 2 | NRE  | Non-Recurring Engineering preparing ONYX <i>nano</i> for autonomous seabed data acquisition. Tasks include:<br>- mounting frame design for Ti sphere with thermal modelling<br>- acquisition initiation scheme<br>- 'heartbeat' signal<br>- recorder triggering software setup and test<br>- Integration of SSD's | Each | 1   | \$45,000         | 0%       | \$45,000     |

*Table 2: Cost for the Non-Recurring Expenditure*

The total price proposed for the provision of an ONYX *nano* and the NRE needed to ensure it will operate as an autonomous subsea data acquisition system is **\$100,000 USD**.

In addition to the standard warranty, we also can provide extended an annual support and maintenance.

| # | Code    | Product Description                                                                                                                                                                                                                                                                     | Unit   | Qty | Unit Price (USD) | Discount | Amount (USD) |
|---|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|------------------|----------|--------------|
| 3 | Support | Extended Support and Maintenance<br><br>Includes:<br>- telephone and online support<br>- firmware and software upgrades,<br>- remote system performance check,<br>- laser power measurements,<br>- verification of the internal optical interfaces, and<br>- data storage health check. | Annual | 1   | \$2,500          | 0%       | \$2,500      |

## Manufacture – Quality control documentation

Sintela are a ISO-9001 accredited company. Each ONYX is tested to ensure its performance meets the specification required and each unit will be supplied with its quality assurance documentation when delivered.

## Items outside of Sintela's scope of supply

The following items are outside of Sintela's scope of supply:

- Project specific documentation supply.
- Hardware – except for the ONYX™ Sensing Units referenced in this document.

- Services greater than specified in this proposal. If additional services are required these can be requested at the day rates referenced in this proposal.
- Travel and expenses – all prices exclude travel and expenses these will be charged at cost plus 10%

## Delivery Terms

Prices quoted are inclusive of FCA incoterms from the Sintela facility in Pill, Bristol, U.K.

### Delivery Address:

Monterey Bay Aquarium Research Institute  
7700 Sandholdt Road,  
Moss Landing, CA 95039

### Delivery Point of Contact:

Aaron Micallef  
Senior Scientist  
P (831) 775-1747  
F (831) 775-1620

## Warranty

Pricing includes 12 months warranty from date of delivery and an option for extended maintenance and support is set out in this document.

## Payment Terms

Invoicing will be as follows:

- 50% of the NRE to be invoiced on receipt of order, payable in 30 days
- 50% of the equipment price to be invoiced on delivery of the preproduction test unit in the Summer of 2024 order which must be paid and cleared funds prior to shipment
- Balance of any equipment and NRE will be invoiced on shipment of the operational ONYX *nano* before November 2024 to be paid within 30 days of invoice date.
- Our payment terms are strictly 30 Days from date of invoice with late payment fees liable to be charged at LiBOR plus 8%

All equipment and services are supplied in accordance with Sintela's standard terms and conditions of sale.

## Annexes

- A Sintela Standard Terms and Conditions

## APPENDIX B – SINTELA STANDARD TERMS AND CONDITIONS

Rev 01.05

### Application and entire agreement

1. These Terms and Conditions (together with any Special Condition(s) set out in the quotation) will apply to the purchase of the goods detailed in our quotation (Goods) by the buyer (you) from Sintela Ltd a company registered in England and Wales under number 11015440 whose registered office is at The Distillery, The Old Brewery Park, 7- 11 Lodway, Pill, Bristol BS20 0DH (we or us).
2. These Terms and Conditions (together with any Special Condition(s) set out in the quotation) will be deemed to have been accepted by you when you accept them or the quotation or from the date of any delivery of the Goods (whichever happens earlier) and will constitute the entire agreement between us and you.
3. These Terms and Conditions and the quotation (together, the Contract) apply to the purchase and sale of any Goods between us and you, to the exclusion of any other terms that you try to impose or incorporate, or which are implied by trade, custom, practice or course of dealing. In the event of any conflict between these Terms and Conditions and any Special Condition(s) set out in the quotation, the Special Condition(s) shall take precedence.

### Interpretation

4. A "business day" means any day other than a Saturday, Sunday or bank holiday in England and Wales.
5. The headings in these Terms and Conditions are for convenience only and will not affect their interpretation.
6. Words imparting the singular number include the plural and vice-versa.

### Goods

7. The description of the Goods is set out in our sales documentation, unless expressly changed in our quotation.
8. We may make any changes to the specification of the Goods which are required to conform to any applicable safety or other statutory or regulatory requirements.

### Price

9. The price (Price) of the Goods is set out in our quotation current at the date of your order or such other price as we may agree in writing.
10. The Price is inclusive of fees for packaging and transportation / delivery.
11. The Price is exclusive of any applicable VAT and other taxes or levies which are imposed or charged by any competent authority.

### Cancellation and alteration

12. The quotation (including any non-standard price negotiated in accordance with the clause on Price (above) is valid for a period of 90 days only from the date shown in it unless expressly withdrawn by us at an earlier time.

## Payment

13. Unless specified in the quotation, Payment terms are our standard terms: 50% pre-payment on order. 50% on or at any time after shipment of the Goods. Services are charged monthly in arrears for prior month.
14. You must pay the Price within 30 days of the date of our invoice or otherwise according to any credit terms agreed between us.
16. If you do not pay within the period set out above, we may suspend any further deliveries to you and without limiting any of our other rights or remedies for statutory interest, charge you interest at the rate of 0.5% per annum above the base rate of the Bank of England from time to time on the amount outstanding until you pay in full.
17. All payments must be made in the currency indicated on the quotation unless otherwise agreed in writing between us.
18. Both parties must pay all amounts due under these Terms and Conditions in full without any deduction or withholding except as required by law and neither party is entitled to assert any credit, set-off or counterclaim against the other in order to justify withholding payment of any such amount in whole or in part.

## Delivery

18. We will arrange for the delivery of the Goods in accordance with the Incoterms specified on the quotation; to the address specified on the quotation, your order or to another location we agree in writing.
19. Delivery will be charged at cost unless otherwise specified on the quotation.
20. If you do not specify a delivery address or if we both agree, you must collect the Goods from our premises.
21. Subject to the specific terms of any special delivery service, delivery can take place at any time of the day and must be accepted at any time between 8 am to 8 pm.
22. If you do not take delivery of the Goods we may, at our discretion and without prejudice to any other rights:
  - a. store or arrange for the storage of the Goods and will charge you for all associated costs and expenses including, but not limited to, transportation, storage and insurance; and / or
  - b. make arrangements for the redelivery of the Goods and will charge you for the costs of such redelivery; and/or
  - c. after 10 business days, resell or otherwise dispose of part or all of the Goods and charge you for any shortfall below the price of the Goods.
23. If redelivery is not possible as set out above, you must collect the Goods from our premises and will be notified of this. We can charge you for all associated costs including, but not limited to, storage and insurance.
24. Any dates quoted for delivery are approximate only, and the time of delivery is not of the essence. We will not be liable for any delay in delivery of the Goods that is caused by a circumstance beyond our control or your failure to provide us with adequate delivery instructions or any other instructions that are relevant to the supply of the Goods.

## Inspection and acceptance of Goods

25. You must inspect the Goods on delivery or collection.
26. If you identify any damages or shortages, you must inform us in writing within 15 days of delivery, providing details.
27. Other than by agreement, we will only accept returned Goods if we are satisfied that those Goods are defective and if required, have carried out an inspection.
28. Subject to your compliance with this clause and/or our agreement, you may return the Goods and we will, as appropriate, repair, or replace, or refund the Goods or part of them.
29. We will be under no liability or further obligation in relation to the Goods if:
  - a. if you fail to provide notice as set above; and/or
  - b. you make any further use of such Goods after giving notice under the clause above relating to damages and shortages; and/or
  - c. the defect arises because you did not follow our oral or written instructions about the storage, commissioning, installation, use and maintenance of the Goods; and/or
  - d. the defect arises from normal wear and tear of the Goods; and/or
  - e. the defect arises from misuse or alteration of the Goods, negligence, wilful damage or any other act by you, your employees or agents or any third parties.
30. You bear the risk and cost of returning the Goods.
31. Acceptance of the Goods will be deemed to be upon inspection of them by you and in any event within 30 days after delivery.

## Risk and title

32. The risk in the Goods will pass to you on completion of delivery.
33. Title to the Goods will not pass to you until we have received payment in full (in cash or cleared funds) for:
  - (a) the Goods and/or (b) any other goods or services that we have supplied to you in respect of which payment has become due.
34. Until title to the Goods has passed to you, you must (a) hold the Goods on a fiduciary basis as our bailee; and/or (b) store the goods separately and not remove, deface or obscure any identifying mark or packaging on or relating to the Goods; and/or (c) keep the Goods in satisfactory condition and keep them insured against all risks for their full price from the date of delivery.
35. A final software licence will only be supplied when title to the Goods has passed to you irrespective of whether the Goods have been resold or incorporated into another product, until such time as title to the Goods is passed to you a temporary time limited software licence supplied which can be renewed by agreement with Us.
36. As long as the Goods have not been resold, or irreversibly incorporated into another product, and without limiting any other right or remedy we may have, we can at any time ask you to deliver up the Goods and, if you fail to do so promptly, enter any of your premises or of any third party where the Goods are stored in order to recover them.

## Termination

37. We can terminate the sale of Goods under the Contract where:
  - a. you commit a material breach of your obligations under these Terms and Conditions;
  - b. you are or become or, in our reasonable opinion, are about to become the subject of a bankruptcy order or take advantage of any other statutory provision for the relief of insolvent debtors;
  - c. you enter into a voluntary arrangement under Part 1 of the Insolvency Act 1986, or any other scheme or arrangement is made with your creditors; or

- d. you convene any meeting of your creditors, enter into voluntary or compulsory liquidation, have a receiver, manager, administrator or administrative receiver appointed in respect of your assets or undertakings or any part thereof, any documents are filed with the court for the appointment of an administrator, notice of intention to appoint an administrator is given by you or any of your directors or by a qualifying floating charge holder (as defined in para. 14 of Schedule B1 of the Insolvency Act 1986), a resolution is passed, or petition presented to any court for the winding up of your affairs or for the granting of an administration order, or any proceedings are commenced relating to your insolvency or possible insolvency.

### **Limitation of liability**

- 40. Our liability under the Contract, and in breach of statutory duty, and in tort, misrepresentation or otherwise will be limited to this clause. Subject to the clauses above on Inspection and Acceptance and Risk and Title, all warranties, conditions or other terms implied by statute or common law (save for those implied by Section 12 of the Sale of Goods Act 1979) are excluded to the fullest extent permitted by law. If we do not deliver the Goods, our liability is limited, subject to the clause below, to the costs and expenses incurred by you in obtaining replacement goods of similar description and quality in the cheapest market available, less the price of the Goods. Our total liability will not, in any circumstances, exceed the total amount of the Price payable by you.
- 41. We will not be liable (whether caused by our employees, agents or otherwise) in connection with the Goods, for:
  - a. any indirect, special or consequential loss, damage, costs, or expenses; and/or
  - b. any loss of profits; loss of anticipated profits; loss of business; loss of data; loss of reputation or goodwill; business interruption; or, other third-party claims; and/or
  - c. any failure to perform any of our obligations if such delay or failure is due to any cause beyond our reasonable control; and/or
  - d. any losses caused directly or indirectly by any failure or breach by you in relation to your obligations; and/or
  - e. any loss relating to the choice of the Goods and how they will meet your purpose or the use by you of the Goods supplied.
- 42. The exclusions of liability contained within this clause will not exclude or limit our liability for death or personal injury caused by our negligence; or for any matter for which it would be illegal for us to exclude or limit our liability; and for fraud or fraudulent misrepresentation.

### **Communications**

- 44. All notices under these Terms and Conditions must be in writing and signed by, or on behalf of, the party giving notice (or a duly authorised officer of that party).
- 45. Notices will be deemed to have been duly given:
  - a. when delivered, if delivered by courier or other messenger (including registered mail) during the normal business hours of the recipient;
  - b. when sent, if transmitted by fax or email and a successful transmission report or return receipt is generated.
- 46. All notices under these Terms and Conditions must be addressed to the most recent address, email address or fax number notified to the other party.

## Data protection

47. When providing the Goods to the Buyer, the Seller may gain access to and/or acquire the ability to transfer, store or process personal data of employees of the Buyer.
48. The parties agree that where such processing of personal data takes place, the Buyer shall be 'data controller' and the Seller shall be the 'data processor' as defined in the General Data Protection Regulation (GDPR) as may be amended, extended and/or re-enacted from time to time.
49. For the avoidance of doubt, 'Personal Data', 'Processing', 'Data Controller', 'Data Processor' and 'Data Subject' shall have the same meaning as in the GDPR.
50. The Seller shall only Process Personal Data to the extent reasonably required to enable it to provide the Goods as mentioned in these terms and conditions or as requested by and agreed with the Buyer, shall not retain any Personal Data longer than necessary for the Processing and refrain from Processing any Personal Data for its own or for any third party's purposes.
51. The Seller shall not disclose Personal Data to any third parties other than employees, directors, agents, subcontractors or advisors on a strict "need-to-know" basis and only under the same (or more extensive) conditions as set out in these terms and conditions or to the extent required by applicable legislation and/or regulations.
52. The Seller shall implement and maintain technical and organisational security measures as are required to protect Personal Data Processed by the Seller on behalf of the Buyer. Further information about the Seller's approach to data protection are specified in its Data Protection Policy, which can be found on our website. For any enquiries or complaints regarding data privacy, you can contact our Data Protection Officer at the following e-mail address: [accounts@sintela.com](mailto:accounts@sintela.com).

## Circumstances beyond the control of either party

53. Neither party shall be liable for any failure or delay in performing their obligations where such failure or delay results from any cause that is beyond the reasonable control of that party. Such causes include, but are not limited to: power failure, internet service provider failure, industrial action, civil unrest, fire, flood, storms, earthquakes, acts of terrorism, acts of war, governmental action or any other event that is beyond the control of the party in question.

## No Waiver

54. No waiver by us of any breach of these Terms and Conditions by you shall be considered as a waiver of any subsequent breach of the same or any other provision.

## Severance

55. If one or more of these Terms and Conditions is found to be unlawful, invalid or otherwise unenforceable, that / those provisions shall be deemed severed from the remainder of these Terms and Conditions (which will remain valid and enforceable).

## Law and jurisdiction

56. This Agreement shall be governed by and interpreted according to the law of England and Wales and all disputes arising under the Agreement (including non-contractual disputes or claims) shall be subject to the exclusive jurisdiction of the English and Welsh courts.