AUKUS PILLAR II MARITIME INNOVATION CHALLENGE 2025: UNDERSEA COMMUNICATIONS AND AUTONOMY

STAGE ONE SUBMISSION FORM

Section 1 – Complete the fields below with your organisation details[1]

Organisation name
Groundbreaker Solutions LLC

Business Registration number – e.g. USA – Commercial and Government Entity (CAGE) Code, UK – Companies House, AUS - Australian Business Number/Australian Company Number, or national equivalent
09Q33

Contact Name and e-mail – Enter the name and e-mail address of your point of contact
Jason L. Lind jason@groundbreaker.solutions

Organisation Registered Address (multiline entries permitted)
120 N Orchard St.
Thiensville, WI 53092

Country of Tax Residency
USA

Work Location – Indicate the expected location of the research work to be undertaken
120 N Orchard St. Thiensville, WI 53092

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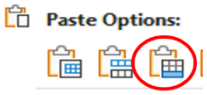
Expected subcontractors – List full organisation names of any expected subcontractors working on the project. To add a new line Select and copy the fields from the bottom row of the table, Right click and then click the 'Insert as New Rows' icon.



Subcontractor Organisation name	Arrangement Type (Select from list)	Country	Subcontractor Address
Click or tap here to enter text.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.
Click or tap here to enter text.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.

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Section 2 – Compete the fields below with outline details of your proposal

Proposal title

HydroFog: Acoustic-Aware Fog Fabric for Autonomous Undersea Communication in Contested Environments (DDIL)

Proposal Abstract – Enter a short (100 words max.) description of your innovation

HydroFog is an advanced fog computing solution specifically designed to enhance communication, control, and coordination among autonomous undersea vehicles (UVs) for AUKUS partners. Leveraging acoustic mesh networking and adaptive machine learning algorithms, HydroFog significantly improves operational efficiency by decentralizing data processing, reducing communication latency, and enhancing system resiliency. It integrates robust cybersecurity measures through Zero Trust Architecture, ensuring secure, adaptive, and reliable subsea communications. This technology uniquely addresses the challenges of underwater acoustic channels, delivering improved situational awareness, autonomous decision-making capabilities, and sustained mission effectiveness even in disrupted communication environments, ultimately providing a strategic operational advantage for allied naval forces.

Desirability – Please describe in fewer than 750 words how your innovation meets the requirements of the call. Consider factors such as

- Clearly state how your submission aligns with the Challenge Statement.
- Explain how the proposed technology is unique, how does it improve effectiveness and efficiency in relation to the Challenge Statement for AUKUS partners.
- What advantages does the proposed technology provide over available technology?
- How does it provide operational benefit

Please enter your word count to the Desirability section here. 458

Please enter your Desirability comments here

You can format text and add images to this section.

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The HydroFog innovation directly aligns with the AUKUS Challenge Statement by enhancing undersea communication, control, and coordination capabilities among autonomous undersea vehicles (UVs). It addresses key operational constraints such as limited acoustic bandwidth, signal degradation, and intermittent connectivity that are characteristic of subsea environments.

HydroFog uniquely integrates advanced fog computing with acoustic mesh networking, optimized through adaptive machine learning algorithms. Unlike traditional underwater communication systems, HydroFog decentralizes data processing, enabling autonomous decision-making and significantly reducing latency. This real-time, edge-level processing capability empowers UVs to respond swiftly to changing operational conditions without relying solely on centralized command structures, thereby enhancing operational agility and resilience.

The acoustic mesh network at the core of HydroFog leverages proven hardware such as EvoLogics S2CR and Teledyne Benthos ATM-900 acoustic modems. These modems provide robust underwater acoustic communication capabilities, known for their reliability under challenging subsea conditions. HydroFog further enhances their performance with predictive algorithms that dynamically adapt network configurations, mitigating interference and optimizing bandwidth utilization. This results in more reliable and efficient data exchanges, even in adverse communication scenarios typical of underwater operations.

Compared to current available technologies, HydroFog offers several distinct advantages. Traditional subsea communication methods often depend heavily on centralized, surface-based command structures, which introduce vulnerabilities such as single points of failure and increased latency. In contrast, HydroFog's decentralized architecture improves redundancy and operational continuity, ensuring sustained mission capabilities even if individual nodes become compromised or disconnected.

Furthermore, HydroFog incorporates Zero Trust Architecture (ZTA) principles, greatly enhancing cybersecurity and operational security in contested underwater domains. By continuously verifying identities, enforcing minimal privilege, and dynamically adjusting security policies based on real-time threat intelligence, HydroFog significantly mitigates cybersecurity risks. This advanced security framework ensures that sensitive operational data and communications among AUKUS partners remain protected, bolstering confidence in joint multi-national operations.

Operationally, HydroFog delivers substantial benefits by improving situational awareness, reaction times, and decision-making quality. Its real-time data processing capabilities enable UV fleets to independently interpret sensor data and environmental inputs, facilitating immediate, informed decisions at the edge. This reduces reliance on intermittent acoustic communication links for critical operational decisions, thus ensuring continuous and effective mission execution even during prolonged communication outages or disruptions.

The adaptive and predictive nature of HydroFog's machine learning algorithms also means the system continually improves its performance over time, automatically learning from past mission data to refine communication protocols and operational responses. This results in an increasingly

robust and efficient communication network that progressively reduces the cognitive and operational burden on human operators.

Ultimately, HydroFog significantly advances the operational effectiveness and efficiency of AUKUS undersea missions. By ensuring robust, secure, and adaptive communications, the technology not only meets but exceeds the requirements set forth in the Challenge Statement, establishing a foundation for sustained strategic advantage in subsea domains.

Current Technology Readiness Level (TRL) - TRL4 - Technology basic validation in a laboratory environment

Planned Technology Readiness Level (TRL) - TRL6 - Technology model or prototype demonstration in a relevant environment

Technical Description – Please describe in fewer than 750 words the underlying technology behind your innovation.

- Describe the underlying technology behind your innovation.
- What is the final deliverable from your project?
- Explain the rationale behind your indicated TRLs
- Please state the high level development activities that will be conducted to make the technology ready for prototype demonstration within the 12 months allocated for development and the resources (e.g. personnel, equipment, software systems, facilities)
- How long would your project last?
- How would you expect to scale up into a production ready/in-service capability?
- Outline very briefly the future work and/or integration efforts required to develop the technology beyond the timeline in the Challenge Statement (acquisition ready).

Please enter your word count to the Technical Description section here. 710

Please enter your Technical Description comments here

You can format text and add images to this section.

The underlying technology, termed HydroFog, leverages advanced fog computing principles specifically tailored for communication and coordination among undersea vehicles (UVs). HydroFog employs a decentralized computing architecture designed to move data processing directly onto UVs, significantly reducing latency, optimizing bandwidth, and enhancing system resiliency in challenging underwater environments.

HydroFog incorporates an acoustic mesh networking topology wherein each UV functions as an intelligent node, autonomously processing data and dynamically exchanging information with neighboring nodes. Communication among nodes is executed via advanced acoustic modems specifically engineered for underwater data transfer, such as the EvoLogics S2CR acoustic

modems or Teledyne Benthos ATM-900 Series modems. These hardware solutions are well-established for their robustness, reliability, and adaptability in underwater acoustic communications.

The acoustic mesh network utilizes intelligent, adaptive routing algorithms optimized to address the unique challenges of underwater acoustic channels, including limited bandwidth, multipath propagation, high latency, and interference. HydroFog employs machine learning models to predict channel conditions, proactively adjusting routing paths and modem parameters to mitigate interference and improve overall communication efficiency. This adaptive approach ensures sustained connectivity despite varying signal strengths, node mobility, and temporary outages typical in subsea environments.

Additionally, HydroFog's distributed computing capability significantly enhances mission-critical data handling by performing computations at the vehicle level. By reducing unnecessary data transmission, HydroFog maximizes available bandwidth for essential information exchanges, thereby increasing mission responsiveness and operational effectiveness.

HydroFog also incorporates principles from Zero Trust Architecture (ZTA), enhancing security through adaptive control, continuous verification, and minimal privilege enforcement. ZTA's Policy Decision Points (PDP) and Policy Enforcement Points (PEP) continuously evaluate trust based on dynamic criteria including user identity, asset conditions, and threat intelligence. By integrating ZTA principles, HydroFog ensures secure communication and robust security postures, even in contested subsea environments.

The final deliverable from the HydroFog project will be a functional, prototype-ready fog computing framework fully integrated within a small UV fleet. It will include adaptive acoustic mesh networking software, decentralized data processing algorithms, machine learning-based predictive routing modules, a Zero Trust compliant security model, and an intuitive command-and-control interface designed for operational users. Comprehensive documentation, technical manuals, and training resources will also be delivered to facilitate effective implementation and further development.

The rationale behind the indicated Technology Readiness Levels (TRLs) stems from the existing maturity of individual technological components. Acoustic communication technologies and mesh networking protocols individually achieved laboratory-scale validation at TRL 4-5. HydroFog aims to integrate these components into a unified fog-based architecture, elevating the combined system to TRL 6 by demonstrating it under realistic operational conditions.

High-level development activities planned for the 12-month development period include:

1. Detailed system architecture development, emphasizing adaptive mesh networking, decentralized data processing, and Zero Trust security integration.
2. Implementation and validation of predictive machine learning models tailored for acoustic interference mitigation.

3. Simulation-based testing of acoustic mesh networking protocols using underwater acoustic channel simulators.
4. Laboratory integration of acoustic modems (such as EvoLogics and Teledyne hardware) with fog computing hardware and Zero Trust compliant software.
5. Controlled marine environment field testing to validate system performance, robustness, scalability, and security.

Resources required include a dedicated multidisciplinary team comprising software engineers specializing in distributed networking, cybersecurity experts versed in Zero Trust principles, data scientists proficient in predictive analytics, and marine technicians experienced in subsea operations. Equipment resources will include EvoLogics and Teledyne acoustic modems, subsea simulators, computing hardware suitable for fog computing, and specialized simulation software. Facilities for laboratory integration and marine field tests will be essential to validate the technology thoroughly.

The project duration aligns precisely with the allocated 12-month timeline set by the challenge framework, ensuring timely progression and milestone achievement.

Scaling HydroFog into a production-ready capability involves incremental enhancements beyond prototype demonstrations:

- Extensive sea trials with larger UV fleets to validate scalability and security.
- Continuous optimization of machine learning algorithms and adaptive mesh networking protocols based on operational test feedback.
- Integration with existing naval command-and-control (C2) systems to ensure seamless interoperability.

Future work beyond the current challenge will include further collaboration with defense stakeholders to transition HydroFog from prototype to acquisition readiness. Critical tasks include cybersecurity enhancements aligned with Zero Trust frameworks, advanced predictive network management integration, and comprehensive validation through fleet exercises. Industry collaboration will also be pursued to ensure the technology's manufacturability, maintainability, and sustainability, supporting long-term operational deployment within naval defense applications.

Government Furnished Assets (GFX)

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- What support and/or Government furnished materials would you require to develop this technology to enable prototype demonstration within the timeframe? Consideration should be given to how you would complete your project if the requested GFX were not available.

To successfully develop and demonstrate the HydroFog technology prototype within the allocated timeframe, we request the following Government Furnished Materials (GFX) and support:

1. **Underwater Acoustic Modems:** Availability of EvoLogics S2CR or Teledyne Benthos ATM-900 acoustic modems for integration, testing, and field validation.
2. **Subsea Vehicle Platforms:** Access to autonomous undersea vehicle platforms or realistic subsea simulators to enable practical integration and operational testing in controlled and relevant marine environments.
3. **Testing Facilities:** Access to suitable marine testing facilities or ranges for controlled underwater acoustic communication and mesh networking trials. We intend to conduct field testing on Lake Michigan, leveraging proximity to and potential facility access at the Great Lakes Naval Base in Illinois.
4. **Technical Expertise:** Subject matter expertise, particularly in underwater acoustics and naval operational procedures, to provide critical insights and validation during development phases.

Should these GFX not be fully available, alternative approaches will involve utilizing commercially available acoustic modems, virtual subsea simulators, and collaborating with industry partners for joint access to relevant marine environments and platforms.

Rough order of magnitude cost – Please enter a Rough Order of Magnitude for your project exclusive of tax. (e.g. VAT, GST) Do not include costs for final demonstration at the multinational maritime exercise at this time.

Australian $	**GB £**	**US $**
$ 0	£ 0	$ 1,100,000

Section 3 – Company Background

Please use this section to provide background information on your company (max 750 words). Images of Powerpoint slides (or similar) can be used. A maximum of 6 images is permitted. Please ensure that the images are of a suitable resolution to be legible

- Company size
- Turnover
- Employees

Company Background (Approx. 420 words)

Groundbreaker Solutions is a micro-consultancy and technology advisement firm committed to helping organizations unlock innovative solutions and gain strategic advantages in rapidly evolving markets. Founded on the belief that small teams can deliver big impacts, we pride ourselves on combining deep expertise with agile methodologies to address the specific needs of our clients.

Our company is composed of three dedicated professionals who bring together a range of complementary skill sets, from business strategy and project management to software development and data analytics. This lean structure allows us to offer flexible, personalized services that larger consultancies often struggle to match. Each team member is driven by the desire to spark impactful changes in organizations—regardless of their size, stage, or sector.

Although Groundbreaker Solutions is a young company, we have already contributed to successful digital transformations in sectors such as financial services, healthcare, and non-profits. Our focus extends beyond just delivering immediate value; we also work to build a culture of continuous improvement for our clients. This approach enables them to remain competitive, resilient, and future-ready in an environment where customer needs and market conditions can shift rapidly.

We maintain strong alliances with a network of specialist partners. These strategic relationships ensure we can scale our capabilities to handle more complex or large-scale projects without losing the personal touch and attentiveness that comes from having a small, dedicated core team.

Despite our ongoing collaborations and projects, our turnover is currently recorded as zero (we do not publicly disclose revenue figures). We reinvest our earnings in talent development, technological exploration, and forging meaningful partnerships. This reinvestment strategy ensures our services remain at the cutting edge of evolving industry trends and that our clients always receive top-tier guidance.

Above all, Groundbreaker Solutions is about creative problem-solving. Our ethos is to “break new ground” for our clients by questioning assumptions, experimenting with novel ideas, and

delivering tangible outcomes that exceed expectations. By continually evolving our service offerings and staying attuned to emerging technologies, we aim to remain a trusted innovation partner for organizations looking to thrive in a rapidly changing world.

Acceptance of Terms and Conditions

By submitting this form I accept the terms and conditions of the submission

Nb please save the form as a pdf file and attach the completed pdf form to your submission.

[1] COMPANY attributional/proprietary information" means information that identifies the COMPANY(s), whether directly or indirectly, by the grouping of information that can be traced back to the COMPANY(s) (e.g., program description, facility locations), personally identifiable information, as well as trade secrets, commercial or financial information, or other commercially sensitive information that is not customarily shared outside of the company. The US Government shall protect against the unauthorized use or release of information obtained from the COMPANY (or derived from information obtained from the COMPANY) under this clause that includes COMPANY attributional/proprietary information. To the maximum extent practicable, the COMPANY shall identify and mark attributional/proprietary information. In making an authorized release of such information, the Government will implement appropriate procedures to minimize the COMPANY attributional/proprietary information that is included in such authorized release, seeking to include only that information that is necessary for the authorized purpose(s) for which the information is being released.