FULMEN AMETHYSTINUM

MARE NEXUS

Pacific Clean Energy, Compute, Communications & Resilience Infrastructure

Version 1 — New Zealand

Onyx Horizon Systems Ltd

Fulmen Amethystinum

Officina Fulminis — Consulting

Domus Gubernaculi — Project Management & Stewardship

Connect what should be connected. Keep independent what should remain independent. Build resilience into the relationships between them.

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Executive Summary

Mare Nexus is a modular coastal and maritime infrastructure concept designed around a simple systems question:

What if essential infrastructure were designed to strengthen the wider ecosystem around it rather than operating as a collection of isolated assets?

Modern communities depend upon energy, communications, digital infrastructure, water, logistics, emergency capability, and healthy surrounding environments at the same time.

Yet these systems are often planned separately.

A power facility produces electricity.

A port moves freight.

A communications network carries information.

A compute facility processes data.

Emergency infrastructure waits for emergencies.

Environmental restoration is frequently treated as a separate programme again.

Mare Nexus explores whether selected coastal and maritime sites could instead function as multi-purpose resilience nodes where complementary systems are intentionally designed to support one another.

Depending upon location and feasibility, a Mare Nexus node could combine elements of:

- clean and resilient energy generation;
- energy storage and local distribution;
- resilient communications;
- digital and compute capability;
- port and maritime infrastructure;
- emergency power and logistics;
- water and essential-service resilience;
- research and environmental monitoring;
- marine restoration;
- technical training;
- repair and maintenance capability;
- and supporting local economic activity.

Mare Nexus is not a predetermined engineering design.

It is a Version 1 originating architecture intended to establish a direction of inquiry and provide a framework from which engineers, scientists, communities, iwi and hapū, institutions, industry, government, and other specialists can determine what is practical and responsible.

The first version is framed for New Zealand, with future Pacific adaptations developed only in partnership with the countries and communities that would use them.

1. Origin of the Concept

Mare Nexus began with an observation about infrastructure fragmentation.

Many systems essential to human life are treated as though they are separate problems even though they rely upon the same underlying environment.

Energy requires infrastructure. Digital systems require energy. Communications require both. Ports require energy, communications, logistics, maintenance, and water. Emergency response requires all of them to remain available when ordinary systems are under pressure.

Marine environments surrounding coastal infrastructure also affect food systems, biodiversity, storm resilience, culture, tourism, and long-term economic health.

The project therefore began not with a particular technology, but with a design question:

Can infrastructure be built as an ecosystem?

Mare Nexus proposes that some coastal locations may benefit from being treated as integrated infrastructure environments rather than collections of unrelated facilities.

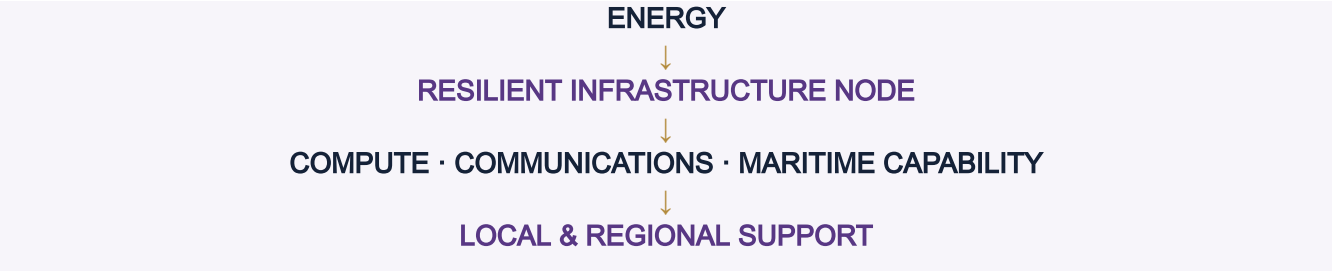
The project does not assume that integration is always better. It proposes that integration should be tested.

2. The Core Architecture

Mare Nexus is best understood as a platform architecture.

It is not one fixed facility.

It is a library of interoperable infrastructure modules that can be assembled differently according to local requirements.



Another node may contain only: ENERGY + WATER + EMERGENCY COMMUNICATIONS.

Another may emphasize: PORT + REPAIR + LOGISTICS + RESEARCH.

Another may focus primarily upon: COMPUTE + ENERGY + COMMUNICATIONS.

The architecture is therefore configurable rather than prescriptive.

That allows Mare Nexus to scale from larger strategic infrastructure sites to smaller regional or island applications where only a few modules are appropriate.

3. Why Coastal and Maritime Sites?

New Zealand's relationship with the sea is not peripheral. It is structural.

New Zealand depends upon maritime trade, coastal settlements, ports, fisheries, marine ecosystems, international communications, tourism, research, and regional Pacific relationships.

Coastal sites can also provide unique opportunities for:

- port access;

- renewable-energy integration;
- subsea and satellite communications;
- research activity;
- vessel support;
- emergency staging;
- marine monitoring;
- logistics;
- and future infrastructure technologies.

The sea should therefore not be treated merely as the boundary surrounding New Zealand. It is part of New Zealand's infrastructure environment.

4. Design Principle: Multiple Functions, One Ecosystem

Mare Nexus is not simply a proposal to place many technologies beside each other.

Co-location alone does not create a system.

The intention is to identify useful relationships between components.

- local energy generation supporting communications resilience;
- stored energy supporting emergency operations;
- port infrastructure supporting repair and logistics;
- communications systems supporting maritime safety;
- compute facilities supporting environmental monitoring;
- research facilities providing data for restoration programmes;
- infrastructure maintenance creating local technical employment;
- water systems serving both ordinary operations and emergencies;
- and waste streams from one component potentially becoming usable inputs elsewhere where technically appropriate.

Every relationship would require technical validation.

Integration should create measurable value, not complexity for its own sake.

5. Energy & Emergency Resilience

Energy is one of the foundational layers of Mare Nexus.

A resilient node could potentially incorporate appropriate combinations of:

- renewable generation;
- energy storage;
- microgrid capability;
- shore power;
- backup generation;
- distributed energy systems;

- and future energy technologies as they become technically and commercially viable.

The emergency role is particularly important.

During earthquakes, storms, tsunami events, volcanic disruption, grid failures, or other emergencies, energy failure can quickly cascade into failures of communications, water, logistics, healthcare support, refrigeration, digital services, and emergency coordination.

Mare Nexus therefore explores whether selected nodes could maintain limited islanded emergency capability when surrounding infrastructure is disrupted.

The objective is not indefinite self-sufficiency. It is to create strategically placed infrastructure capable of preserving critical functions long enough for wider systems to recover.

6. Communications & Digital Resilience

Communications are now essential infrastructure.

Potential Mare Nexus communications modules may include:

- terrestrial fibre;
- satellite connectivity;
- maritime communications;
- emergency radio;
- network redundancy;
- backup power for communications systems;
- and resilient local digital infrastructure.

A Mare Nexus site should avoid dependence upon one communications pathway where practical.

The system should be designed around the assumption that during a serious disruption, one or more ordinary channels may fail.

7. Compute Infrastructure

Compute capability is increasingly important to research, public services, infrastructure management, environmental modelling, logistics, emergency coordination, and modern economic activity.

A Mare Nexus node could potentially support:

- edge computing;
- research computing;
- environmental data processing;
- secure institutional computing;
- AI-related workloads;
- distributed data services;
- and, where feasible, larger compute facilities.

However, compute should not be treated as automatically beneficial.

Any substantial compute installation would need assessment of energy demand, cooling requirements, water use, environmental impacts, grid effects, security, economic value, and long-term maintainability.

Mare Nexus therefore treats compute as an optional infrastructure module, not the purpose of the project itself.

8. Marine Restoration as Infrastructure

Mare Nexus treats environmental health as part of infrastructure resilience.

Coastal ecosystems can contribute to biodiversity, fisheries, water quality, shoreline stability, storm protection, cultural practices, tourism, recreation, and community wellbeing.

Where coastal infrastructure is developed, Mare Nexus proposes that environmental monitoring and restoration opportunities should be considered from the beginning rather than added only after environmental harm occurs.

Potential applications could include:

- habitat restoration;
- shellfish or reef restoration where ecologically appropriate;
- seagrass or coastal vegetation recovery;
- water-quality monitoring;
- pollution detection;
- marine debris response;
- biodiversity monitoring;
- habitat enhancement around suitable structures;
- and collaboration with existing restoration programmes.

The principle is not that infrastructure automatically restores nature.

Infrastructure should be designed with the surrounding ecosystem in mind from the beginning.

A Mare Nexus site should leave its surrounding environment healthier where feasible, or at minimum avoid creating avoidable degradation.

9. The Mare Nexus Port

One of the clearest applications of the architecture is the Mare Nexus Port.

A traditional port is primarily understood as transport infrastructure.

A Mare Nexus Port explores whether an existing or future port could also become a regional resilience platform.

The port could therefore operate normally as commercial infrastructure while retaining additional capabilities that become particularly valuable during disruption.

Potential applications may include:

- shore power;
- resilient communications;
- emergency-energy storage;
- supply warehousing;
- maintenance facilities;
- vessel repair;
- emergency staging;
- research-vessel support;
- marine monitoring;
- and distributed digital infrastructure.

The Mare Nexus Port is not a separate project. It is a major application of the broader Mare Nexus architecture.

10. Economic & Workforce Layer

Infrastructure should create more than physical assets.

Where possible, Mare Nexus should contribute to durable local capability.

Potential workforce and economic effects may include:

- engineering and technical employment;
- marine trades;
- electrical work;
- communications installation;
- maintenance and repair;
- environmental monitoring;
- research employment;
- data and digital roles;
- apprenticeships;
- port services;
- logistics;
- manufacturing and fabrication;
- and supporting local businesses.

A node that requires all specialist knowledge to be continuously imported from elsewhere is less resilient than one that gradually develops local competence.

Training and maintainability should therefore be considered alongside construction.

11. Research & Living-Laboratory Potential

Mare Nexus sites may also provide valuable environments for applied research.

Potential partners could include universities, Crown research institutions, engineering organisations, marine scientists, energy researchers, telecommunications specialists, environmental groups, and technology companies.

Where appropriate, a site could function as a living laboratory for testing infrastructure integration under real-world conditions.

Possible research areas include:

- microgrids;
- storage;
- maritime energy;
- resilient communications;
- coastal monitoring;
- environmental restoration;
- distributed computing;
- water systems;
- infrastructure durability;
- and emergency-response systems.

Research partnerships should support, rather than interfere with, the primary infrastructure purpose of the site.

12. New Zealand Version 1

New Zealand is proposed as the starting environment for Mare Nexus because of its island geography, extensive coastline, dependence upon maritime trade, significant renewable-energy capability, existing scientific and engineering expertise, exposure to natural hazards, dispersed communities, need for resilient communications, strong maritime traditions, and relationships throughout the Pacific.

Version 1 intentionally does not nominate a specific site.

Choosing a location before understanding the system requirements risks forcing the architecture to fit the site.

Need → Feasibility → Module Selection → Site Selection

Potential sites should ultimately be evaluated against existing infrastructure, energy resources, grid access, maritime access, telecommunications, hazard exposure, land requirements, ecological sensitivity, freshwater availability, transport links, community needs, local workforce capability, consenting, economics, and long-term maintainability.

13. Emergency & National Resilience Role

A network of Mare Nexus nodes could eventually provide another layer of national resilience.

Rather than relying upon one enormous facility, distributed nodes could potentially support different parts of the country.

During ordinary conditions, they would perform productive infrastructure functions.

During emergencies, selected nodes could assist with communications, power, water, storage, logistics, vessel support, emergency coordination, and supply movement.

This dual-use resilience model may improve the economics of emergency infrastructure because assets do not need to remain largely idle while waiting for disasters.

Their everyday function helps justify their existence.

14. Pacific Version 2

The Pacific application must begin with a different assumption:

New Zealand's version is not the Pacific's version.

Pacific Island countries differ in geography, population, existing infrastructure, energy resources, economic conditions, culture, law, shipping access, environmental vulnerability, and community priorities.

A future Mare Nexus Pacific Version 2 should therefore be co-designed with participating nations.

Potential Pacific configurations may place greater emphasis upon:

- water security;
- renewable microgrids;
- communications redundancy;
- emergency energy;
- port capability;
- refrigeration and food storage;
- local repair;
- distributed compute;
- cyclone resilience;
- maritime logistics;
- and environmental monitoring.

Some nations may need only two or three modules. Others may develop larger nodes.

Local people should have meaningful authority over adaptation because they live with the consequences.

Onyx supplies the starting architecture. Local stewards know the terrain.

15. Relationship to Pons Oceani

Mare Nexus and Pons Oceani — Bridge of the Ocean are designed as complementary systems.

Mare Nexus strengthens places.

Pons Oceani strengthens movement between places.

Mare Nexus focuses upon infrastructure nodes. Pons Oceani focuses upon trade, logistics, infrastructure support, supply chains, and regional movement.

In a mature Pacific ecosystem, a Pons Oceani trade corridor could potentially connect multiple ports or communities that incorporate elements of Mare Nexus.

Neither project depends upon the other. The systems should remain useful independently.

16. Future Possibilities

Version 1 deliberately leaves some ideas outside the core architecture until greater technical evidence exists.

Possible future investigations may include:

- advanced maritime energy systems;
- alternative cooling systems;
- low-water or water-independent compute cooling;
- marine-based energy storage;
- floating infrastructure;
- cruise or passenger-service integration;
- advanced desalination;
- circular material systems;
- autonomous monitoring;
- additional marine restoration technologies;
- and other emerging technologies.

These should remain future capability areas, not assumptions built into Version 1.

Mare Nexus should not depend upon speculative technology in order to be useful.

17. What Mare Nexus Is Not

Mare Nexus is not:

- a finished engineering design;
- a commitment to build a port;
- a proposal to replace existing utilities;
- a compulsory national infrastructure model;
- an environmental consent;
- a specific technology purchase;
- a completed financial model;
- or a claim that every module belongs at every site.

It is an originating architecture designed to help ask better infrastructure questions.

18. Feasibility Questions

Before any development decision, Mare Nexus should be tested against questions including:

1. Does integration create measurable benefit over conventional separated infrastructure?
2. Which modules provide the strongest value in New Zealand?
3. Which modules create unnecessary complexity?
4. Can emergency resilience be added economically to productive everyday infrastructure?
5. Which sites, if any, are appropriate?

6. What environmental effects would occur?
7. How could surrounding ecosystems be protected or restored?
8. What infrastructure already exists and should be strengthened rather than duplicated?
9. What are the likely capital and operating costs?
10. Who should own and govern the infrastructure?
11. What public-private models are appropriate?
12. What Māori rights, interests, knowledge, and relationships need to shape development?
13. What local workforce capability would be required?
14. Which components should remain public infrastructure?
15. Which could be commercial?
16. What security and data-governance risks exist?
17. What are the failure modes?
18. Under what circumstances should a Mare Nexus proposal be rejected?

The final question is essential.

> **A responsible feasibility process must be capable of concluding: Do not build it here.**

19. Development Pathway

This prevents the project from becoming committed to construction before the central assumptions have been tested.

20. Fulmen Amethystinum's Role

Mare Nexus originates within Fulmen Amethystinum, the government and institutional systems-origination division of Onyx Horizon Systems Ltd.

Fulmen Amethystinum originates the architecture, documents the intent, and places the concept before appropriate institutions.

Where further work is requested:

Officina Fulminis may provide institutional consulting and systems-analysis support.

Domus Gubernaculi — House of the Helm may provide project management and stewardship through feasibility, coordination, milestones, dependencies, institutional continuity, and handover.

Qualified specialists retain technical authority within their disciplines.

The architect draws the destination. Specialists build the vessel. Domus Gubernaculi holds the helm.

21. Closing Position

Mare Nexus begins with a straightforward proposition:

Critical infrastructure may become stronger when relationships between systems are designed intentionally rather than left to chance.

New Zealand already possesses many of the individual ingredients: energy capability, ports, marine knowledge, research institutions, communications infrastructure, engineering expertise, local communities, environmental knowledge, and a strategic position within the Pacific.

Mare Nexus does not propose that these assets be absorbed into one enormous institution.

It proposes something simpler:

Connect what should be connected. Keep independent what should remain independent. Build resilience into the relationships between them.

The project is offered as a Version 1 starting architecture for determining where those connections may be useful.

Project Identity

Project	MARE NEXUS
Subtitle	Pacific Clean Energy, Compute, Communications & Resilience Infrastructure
Version	Version 1 — New Zealand
Originator	Onyx Horizon Systems Ltd
Division	Fulmen Amethystinum
Supporting Houses	Officina Fulminis · Domus Gubernaculi
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Document Status

Version 1 — Approved

This document presents an originating systems concept. Technical feasibility, engineering, legal requirements, environmental effects, economics, governance, consultation, consenting, and implementation require assessment by appropriately qualified specialists and institutions.

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