bluewireless

Life on the **wavelengths**

How LTE/5G fits into a best-of-breed solution for maritime broadband

Introduction

Business is back in all five oceans.

Trade routes are busy. And from passengers to professionals, from entertainment to IoT, people and devices are hungry for megabits. But there's more than one way to answer their needs. And making the wrong choice can turn flowing cash into red ink.

Inside this paper, broadband provider Blue Wireless sets out the differences between the various maritime connectivity choices today – and why some work better than others depending on your use case.

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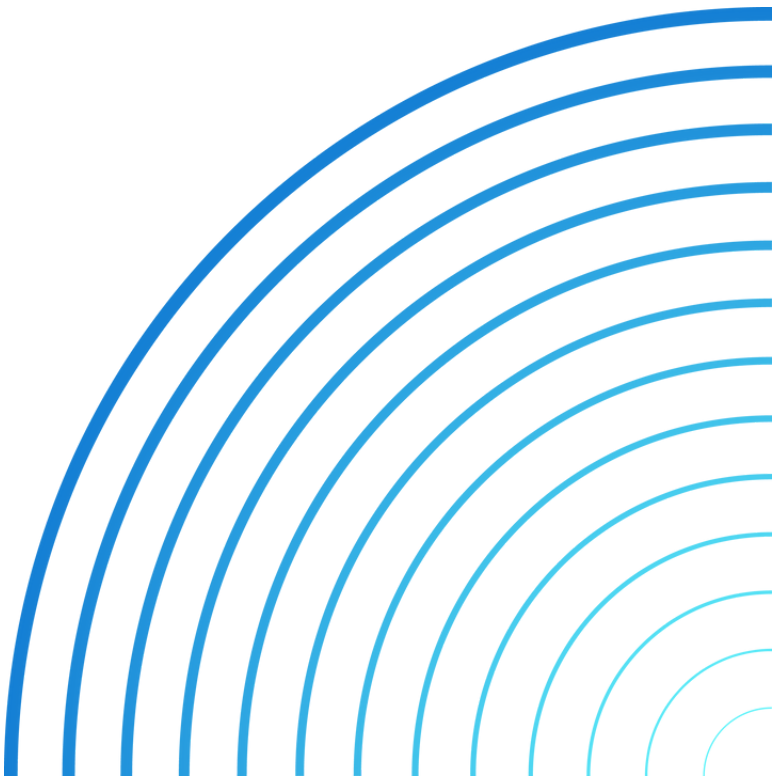


About Blue Wireless

Blue Wireless is the first and leading global provider of LTE/5G wireless connectivity for the enterprise. Our mission is to help customers along their wireless journeys by delivering worry-free connectivity solutions where other traditional networks struggle: remote locations, distributed branches, construction sites, IoT, and maritime vessels. Our secret? The right combination of LTE/5G technologies, access to multiple networks, and the best talent to design, procure, deliver, and manage network solutions for any use case.

Since being founded in 2015, Blue Wireless has expanded its global operations to offices across APAC, Europe, and the Americas. Today, we are a global team of more than 70 hands-on professionals, dedicated to the service and support of wireless solutions for more than 200 customers worldwide, including several maritime and logistics businesses navigating across all seven seas.

"With a clear technological pathway and billions in new investment yearly, terrestrial cellular networks are a great option for maritime connectivity – even if your vessels operate tens of kilometres from shore. Of course, satellites have a place in the mix – but many ocean operators are finding LTE/5G cost-effective for a rising number of use cases."

Ivan Landen, CEO, Blue Wireless

CHAPTER 1

Maritime connectivity: an overview

In times past, connectivity at sea wasn't so much best-case as least-bad. For millennia, line-of-sight was the golden rule, with everything from flags to fireworks used to exchange information. Over-the-horizon meant out-of-contact. The first ship-to-shore radio message wasn't sent until 1899; ships didn't start tapping out Morse to each other until the 20th century, and it was 1910 before vessels were obliged to carry radios onboard.

And data took far longer. Inmarsat, the first satellite telephony provider for the oceans, launched in 1979 with voice and navigation in mind, not bits. While Iridium's late-90s technology needed far more investment than there were customers to pay for it.

On dry land, of course, the story has been vastly different. If we only talk about wireless, there are over 15bn mobile devices worldwide, with 5bn individuals using them for data; each EU citizen consumes around 2.4Gb monthly. And with bandwidth increasing from the 40Kbps of 2G to the 20Gbps potential of 5G in barely two decades, voice has become minor compared to data: consumers are streaming 4K video while workers expect to communicate and collaborate on enterprise apps and cloud services, wherever they are.

But many offshore businesses – and even some nearshore ones, from aquaculture to energy – don't see cellular telephony, whatever the G number, as a viable solution for anything away from land. And – with coverage, capacity, and availability issues common – it's with good reason. But as always, there are answers.

Let's start this paper with a round-up of the different technologies offering broadband-capable connectivity to businesses calling the oceans home.

Wired broadband: the motherboard of Mother Earth

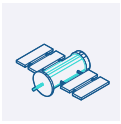
Even a mobile device in a densely connected city will see its megabytes riding on cable before hitting the airwaves. Over 550 submarine cables connect countries and territories, ranging from a short 131km span between Britain and Ireland to the 20,000km Asia America Gateway, with all modern installations using bundles of optic fibre no thicker than a hosepipe; and some of the biggest investors aren't telcos, but content providers (Google, Amazon, Microsoft, and Facebook.) These cables carry most of the world's data traffic, and connect to final customers via a "last mile" of copper wire, fibre to the kerb, or wireless network.

Obviously, no ship at sea can use a wired connection. But many maritime businesses are fixed in position: aquaculture, energy, remote but bandwidth-hungry sites like datacentres, and even shoreside operations like ports and docks. For larger businesses, a private line to an IXP (Internet Connection Point) can make sense – but if it's a remote location, that still means building physical infrastructure, which takes time and money.

Packet radio: still going, still useful

Since Hawaii's ALOHAnet in the 1970s, many offshore locations have used plain-vanilla radio transceivers to connect to packetised data services – everything from weather reports to navigation charts. It still covers some of the world's most remote regions in the Southern Hemisphere and the South Pacific. Operating in VHF bands (156-174Mhz), the advantage: it's often free.

But low-cost also means low-bandwidth: let's just say no mariner is watching Netflix in the radio room using it. And low-range: 100km is the practical limit. Making marine VHF for data sparse and functional: short messages in low volumes.



Satellites: the split between GEO and LEO

Ask most people how ships get their connectivity, and they'll say satellites. But the birds above come in two distinct species: GEO and LEO. (There's a MEO, too – Medium Earth Orbit – but for telecommunication services, LEO and MEO behave very similarly to the end user. So this paper looks principally at LEO.) Each has its advantages … and drawbacks.

Geostationary Earth Orbit: the glamour of GEO

There's a GEO satellite 35,786km above your head – if you're standing in the right place. GEOs stay in a fixed position relative to the Earth's surface, and the only place to do that is above our planet's imaginary waistline, orbiting with the Earth, once a day.

Being so high above the planet means a few satellites can cover the whole planet – just 3. And using high frequencies (the Ku and Ka bands run to 18 and 40GHz) translates to decent bandwidth: hundreds Mbps is possible (at a cost). And being so far out creates other issues: Signal strength needs to be greater, and receiving antennas, bigger. There's also poor connectivity furthest from the equator, at the Poles. Distance to the satellite means high latency: the time it takes for a packet of data to travel back and forth. Also, prices are high.

For dynamic business applications like cloud services, conferencing, or gaming, GEO satellites won't be anyone's first choice.

Low Earth Orbit: millions and millions served

In contrast to GEOs few, big satellites, is LEO: Low Earth Orbit satellite constellations. They're a lot closer to home – occupying altitudes below 2,000km, even below 750 – and don't stay in a fixed position but race around Earth at up to 30,000km/h, in orbits plotted to provide coverage everywhere. LEO constellations are also larger: Iridium's NEXT has 66 satellites, and Starlink, an approximately 5,000, with more planned. They're smaller, lower-powered, and offer far lower latency than GEO satellites.

But even LEO isn't perfect. It's a busy sky up there – both the ISS and the Hubble telescope occupy LEO orbits – meaning slots are becoming scarcer. But with greater coverage, lower latency, and higher bandwidth for less cost, LEO is giving more and more maritime operators a business case for adoption.

LTE/5G: Maritime wireless with terrestrial networks

GEO and LEO are why, looking up at the choices overhead, many maritime businesses don't see "normal" wireless networks – the 3G/4G/5G options of terrestrial mobile telephony around population centres, with their roof-mounted cell towers and limited coverage areas – as worth exploring. Yet two technologies are helping to make Earthbound wireless networks a real advantage for offshore and nearshore industries.
First, cellular routers, which provide business-grade bandwidth without fuss, letting workers connect to a wireless internet source no differently than with a wired one. Second, durable and compact antennas are bringing wireless coverage to areas far beyond city limits – drawing in connectivity up to 50km from an onshore cell tower.

That matters, because many ocean-based businesses – like cruise or cargo ships – hug the shoreline much of their lives, spending days at a time in port and many nights just a few miles away (usually 3 or 12 nautical miles). And many more "maritime" businesses never hit blue-water at all. Wind power, fish farms, and oil platforms cluster near the shoreline – well within reach of a cellular network with the right equipment.

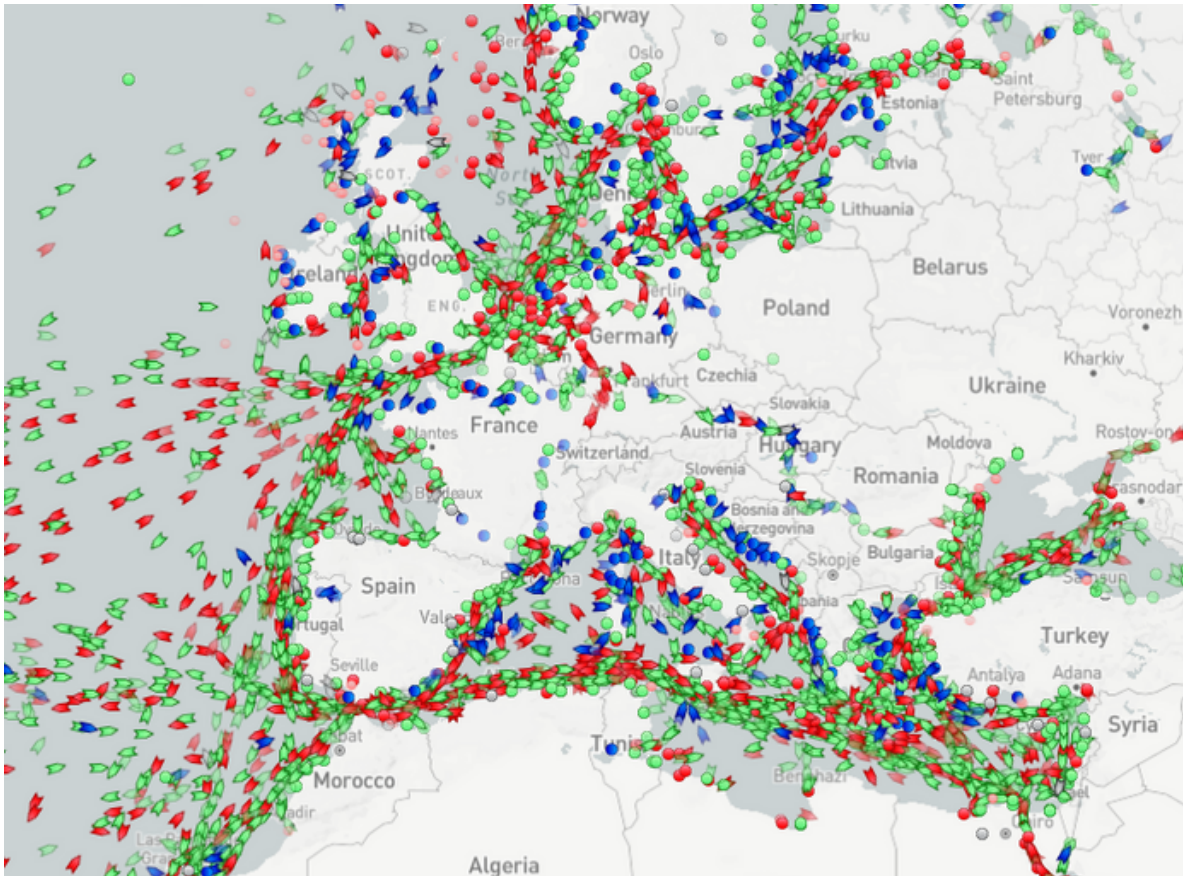


Figure 1 - Tankers, Passenger and Cargo Vessels View - Marinetraffic.com

The maritime options: the mix matters

It's clear that no single option is best for all maritime businesses in all circumstances. But the technological choices are only half the story. The other half is the use case for your business – and in many ways getting the right match for your situation is more important than the technology vendor per see.

In Part 2, let's review some typical – and not-so-typical – maritime business models and their individual challenges.

CHAPTER 2

Oceans apart: comparing use cases for maritime wireless

Maritime is more than ships – and even within shipping, the customer base is fragmented and segmented.

To illustrate the different challenges within the maritime connectivity sector, we've divided them into six areas: the **overall bandwidth requirement** at a facility (a small yacht and cruise ship will differ hugely), the **usage profile** (for example, whether always-on is a must-have or nice-to-have), the **number of connected users and/or devices**, its type of **operating environment** (such as nearshore, offshore, or blue-water), the **size of the fleet**, and the **patterns of movement** of individual vessels (such as a cargo route).

Here are the factors explained and how we've scored for each:

01 Overall bandwidth

Total bandwidth consumption is among the most important factors in wireless (or any) broadband – but far from the only one.

A large cruise ship's demand may be high but "seasonal", like typical consumer traffic, with thousands of passengers downloading masses of media in the evening only. While a cargo vessel of the same size may have a crew of just 12, and far lower bandwidth demands. In our scoring estimate in the charts below, the higher the score, the greater the total bandwidth requirement.

02 Usage profile

Usage profiles tell us how a service will be used. For an oil platform tied into safety and other systems, availability of service will be non-negotiable, but the actual traffic transmitted is mostly low, with odd peaks and bursts.

End users connecting to a service tend to have asymmetric usage profiles, meaning they download more than they upload; these users may require more bandwidth in a “day shift” versus the quiet hours. While an offshore wind farm may have a steady flow of traffic 24 hours a day, meaning lower headline speeds are required, but reliability of the service is key. Usage profiles help define the right mix of hardware and service to meet the customer's needs.

03 Users/devices per location

An important part of the usage profile is the number of users, so our model separates it out for added insight.

The number of simultaneous connections affects network performance massively: a mass of cruise passengers needs a huge number of available connections, but peaks and troughs are fairly predictable. While resource extraction or cargo vessels have a much lower, but consistent, number of connected users. This greatly affects hardware and service selection.

04 Type of environment

Where equipment is placed has a huge effect on performance. A seaborne vessel may have plenty of open space, but also plenty of hazards for equipment – weather conditions, exhaust gases, blocking masses like bulkheads.

A higher score here means higher complexity of the environment, hence the need for fit-for-purpose equipment.

05 Size of fleet

What's right for one vessel doesn't necessarily provide a model for other vessels in the same fleet: a modern shipping operator may have dozens or hundreds of assets, each in a different role.

While it's possible to design standardised solutions – see the case study further below – the best solution may also differ from asset to asset. So a higher score here means a larger number of vessels to serve.

06 Patterns of movement

Maritime traffic uses many strategies to answer its business goals. Many yachts are not oceangoing; most cargo traffic follows well-established sea lanes; a cruise liner may spend days at a time in sight of land. Vessels regularly crossing between nearshore, blue water, and in-port locations will benefit from a mixture of connectivity solutions.

Once factors are understood, it is useful to add numbers to see the differences in these factors for various use cases. For an intuitive sense of how the use cases differ, in the next pages, we've given each of our use cases a "score" from 0 to 10 representing how important each factor is for that case.

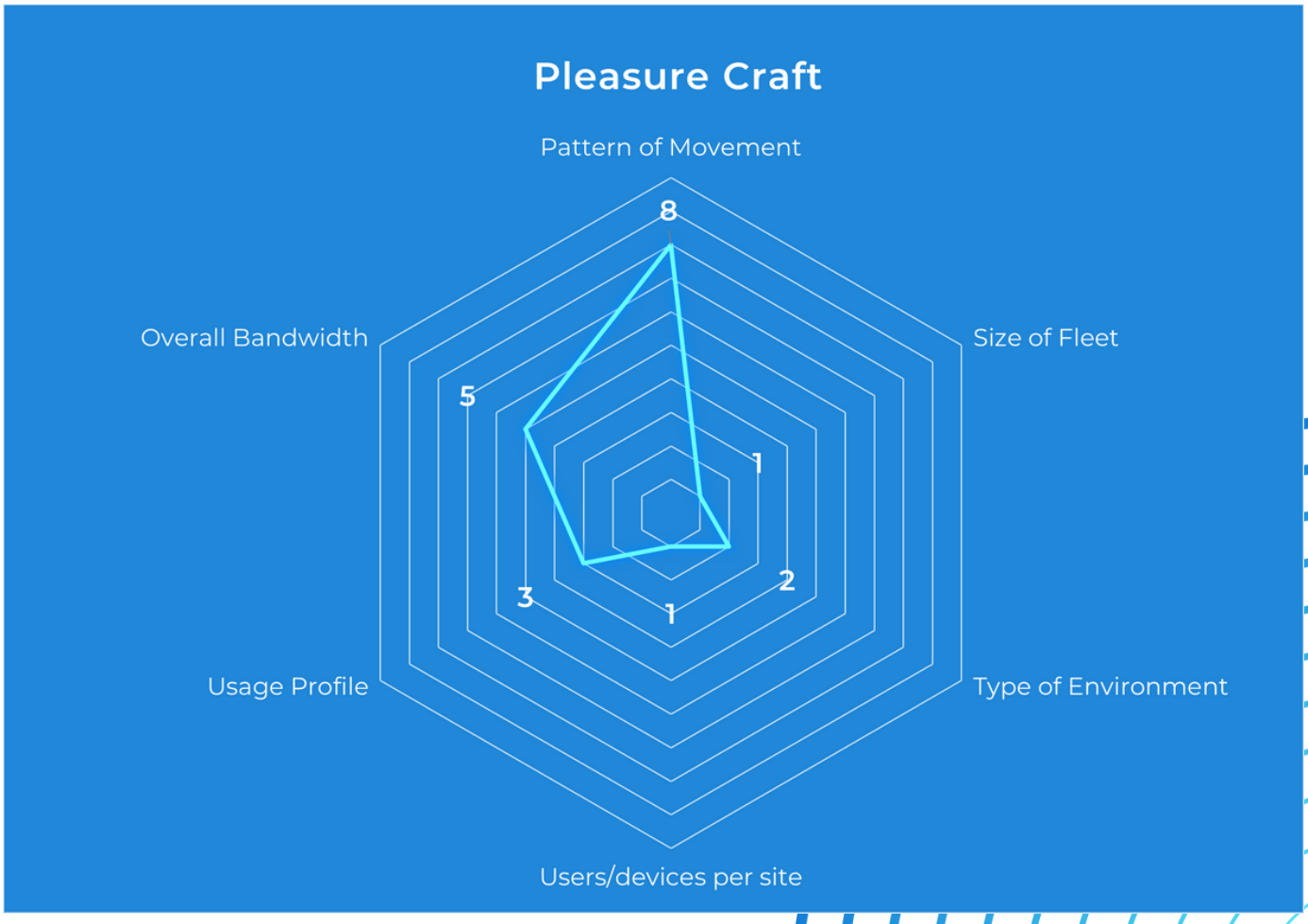
Scoring mobile vessels: shipping

Our factors affect seaborne vessels to different degrees – from the smallest pleasure yacht to the busiest UltraMax. While there are far more ship types than listed here, with equally different use cases, this report simplifies them into four broad types for readability: **pleasure craft, cruise ships, public transport, and cargo vessels.**

Pleasure Craft

While big in sales figures (only an “average” yacht will cost US$4m), it’s a small market by volume, with fewer than 300 units exchanged annually. Patterns of movement, however, differ wildly at the owner’s pleasure: yachts follow no fixed routes and a Caribbean or European itinerary can span 20+ countries in a matter of weeks.

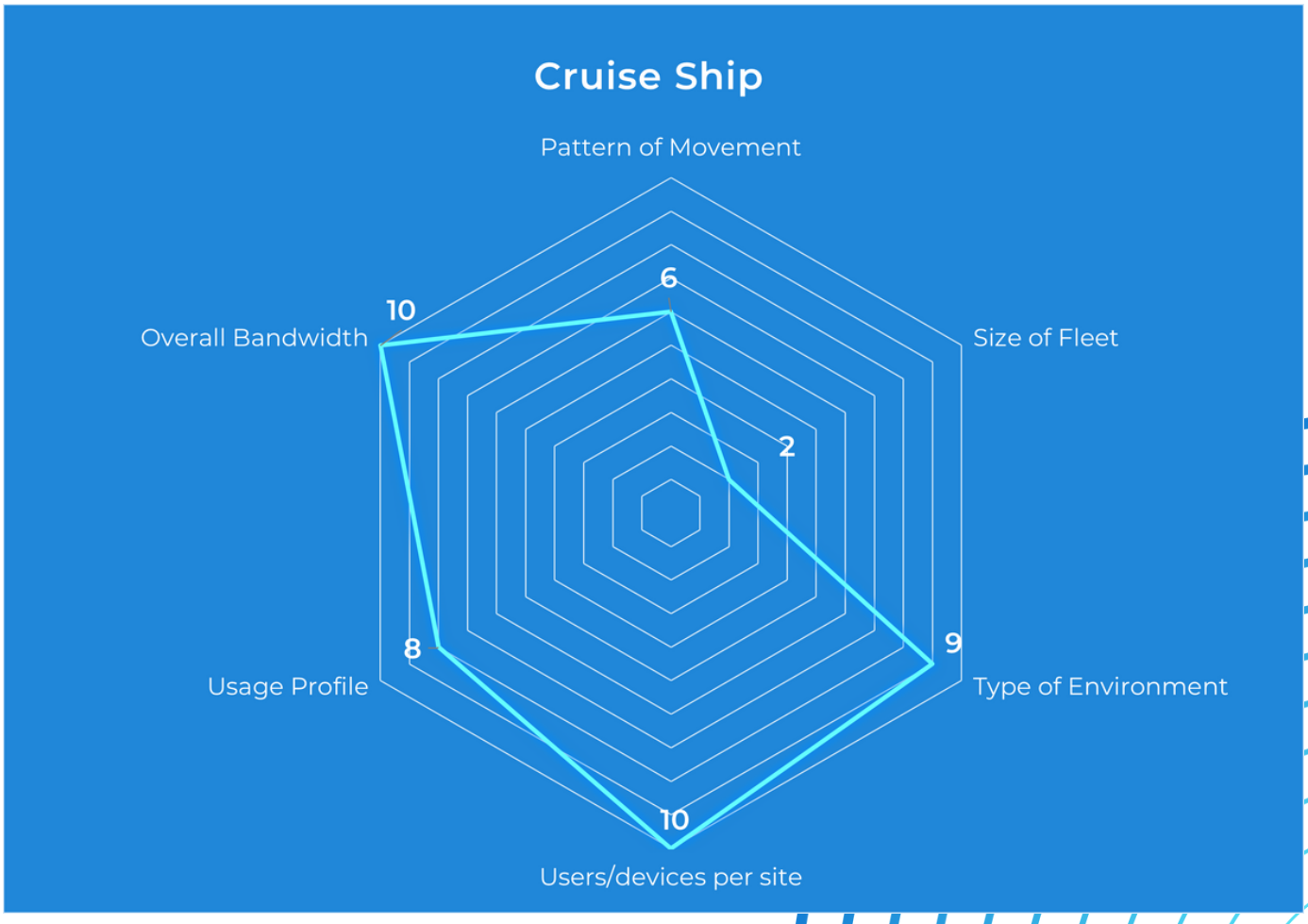
But yachts need few simultaneous connections (the crew, owner and guests, and some equipment) and most are non-mission-critical. Yachts spend most of their time close to land or in port, and often the whole of Winter in one place, meaning satellite connectivity isn’t always the only (or best) choice. Making pleasure crafts a relatively simple use case, with downstream bandwidth (movies and media) the biggest draw.



Cruise ships

Today's largest cruise vessels carry nearly 7,000 passengers, with the heavy machinery needed to power and service them taking up entire decks. This makes the modern cruise experience a complex use case for wireless internet.

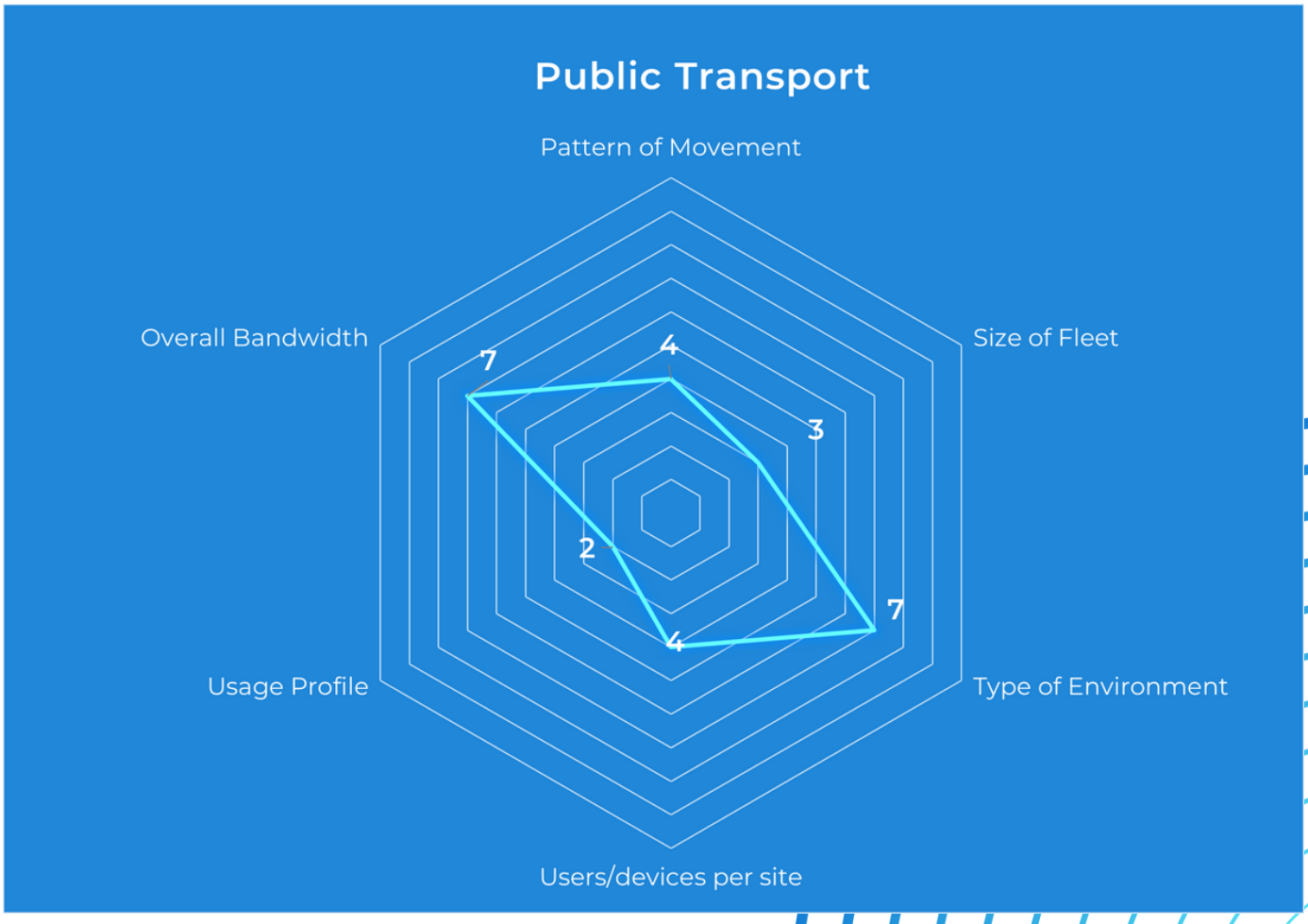
The user "nodes" are constantly walking between buffet, casino, and pool; cabins are stacked several floors deep, with multiple walls between hubs. And all such ships are blue-water-capable, with a transatlantic crossing meaning 6-8 days on the High Seas, making satellite an essential part of the solution. However, many such ships ply coastal routes, spending 5-9 hours a day (on average) in port; the point of cruising, after all, is not sailing but sightseeing and shopping. So a surprising volume of cruise ship time is within 50km of land, making it a viable case for terrestrial wireless broadband too.



Public transport

Ferries and other public transport are seagoing workhorses, providing vital links between neighbouring countries (like Britain and France) or coastal ports (as in the Eastern USA). In transit, many never even lose mobile phone reception; many even stay within the 12-nautical mile limit of most national jurisdictions known as “territorial waters”.

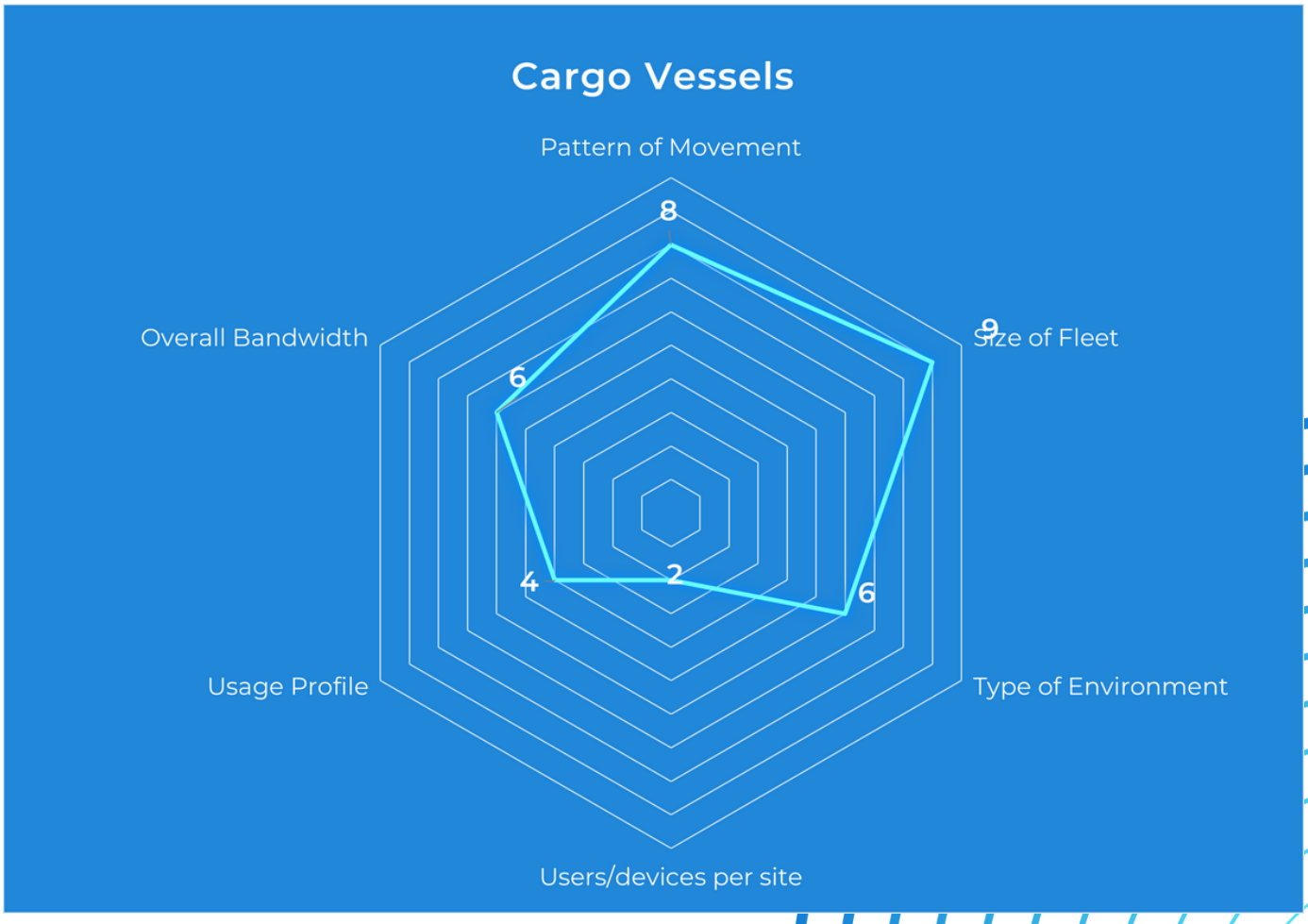
This means satellite networks are rarely needed – although maritime law often mandates at least GEO connectivity for many vessels. And with passenger numbers moderate and consistent, bandwidth demands are predictable. This means that in many cases, LTE/5G connectivity may be the best option.



Cargo Vessels

A post-Panamax bulk cargo ship's capacity is up to 110,000dwt; Evergreen's beautiful Ever Ace takes nearly 24,000 20-ft containers. But even the largest cargo ships have something in common with small HandyMaxes: a small number of humans on board.

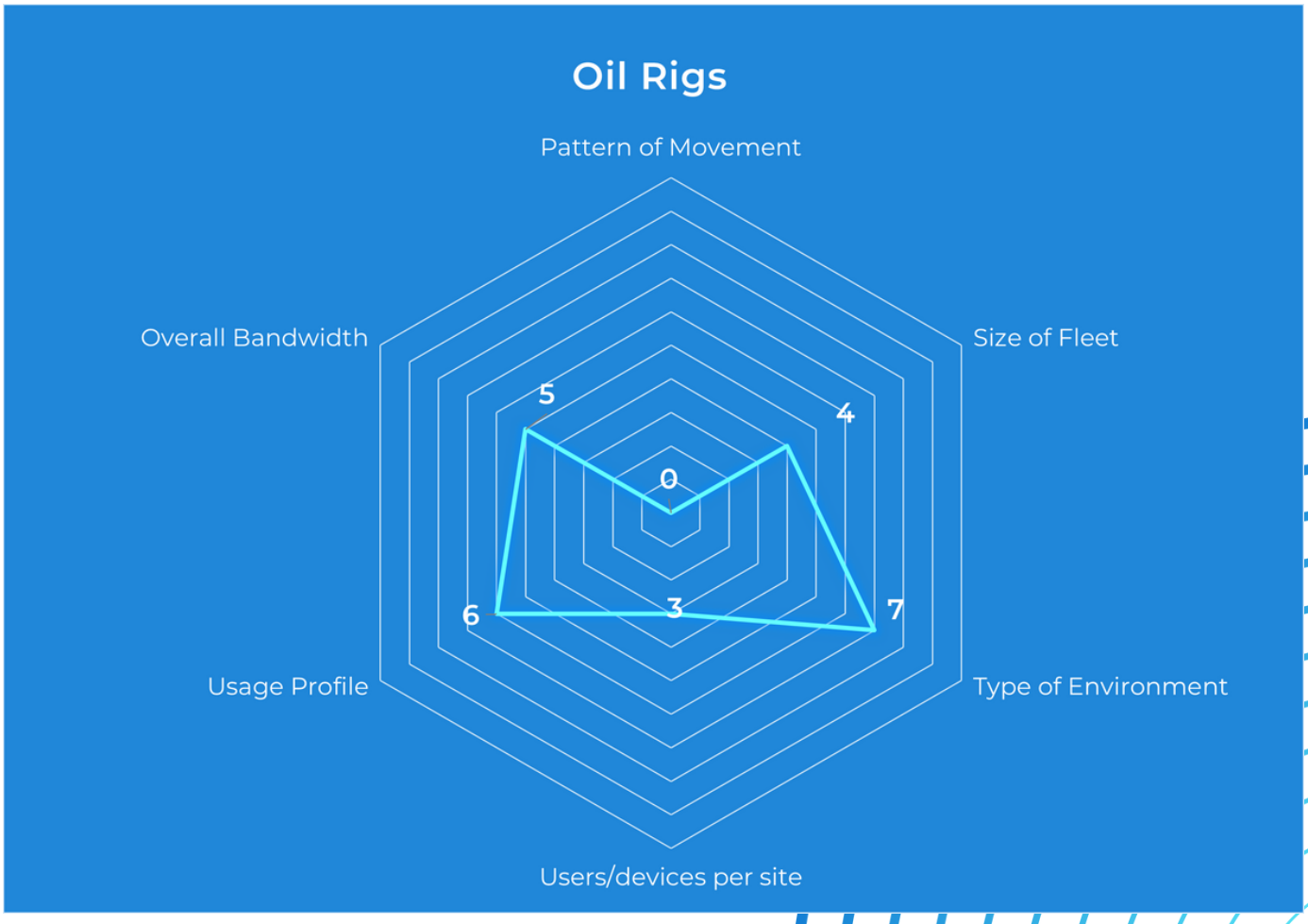
Boats also follow strict routes, often the same one for their entire existence – although, across the industry, these routes are very diverse. And since time is money, dwell time in port has been falling over the last 20 years, with crews often remaining on board without shore leave. This makes cargo vessels another use case shared between satellite and terrestrial broadband options. Overall bandwidth needs may not be huge, lowering the costs of the required satellite connection, and with significant time spent near land, terrestrial connections can provide desired bandwidth augmentation for office tasks and crew welfare.

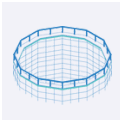


Scoring seaborn platforms: oil rigs

Despite the typical picture of an oil platform in the North Sea, offshore oil rigs are a small proportion of the total – around 200 worldwide compared to 1,300 on land. And the furthest-flung are 380km+ out, with just a single platform in Britain's North Sea within the 12-mile limit of territorial waters.

Of greater interest, however, is the industry that services them. Tender vessels, worker transport, and bulk tonnage carriers connect platforms to land, with these vessels all needing internet access – and having many more choices than just satellite. So, while rigs themselves are complex and rule-bound environments, the maritime sector surrounding them often has a case for using terrestrial 3/4/5G networks.

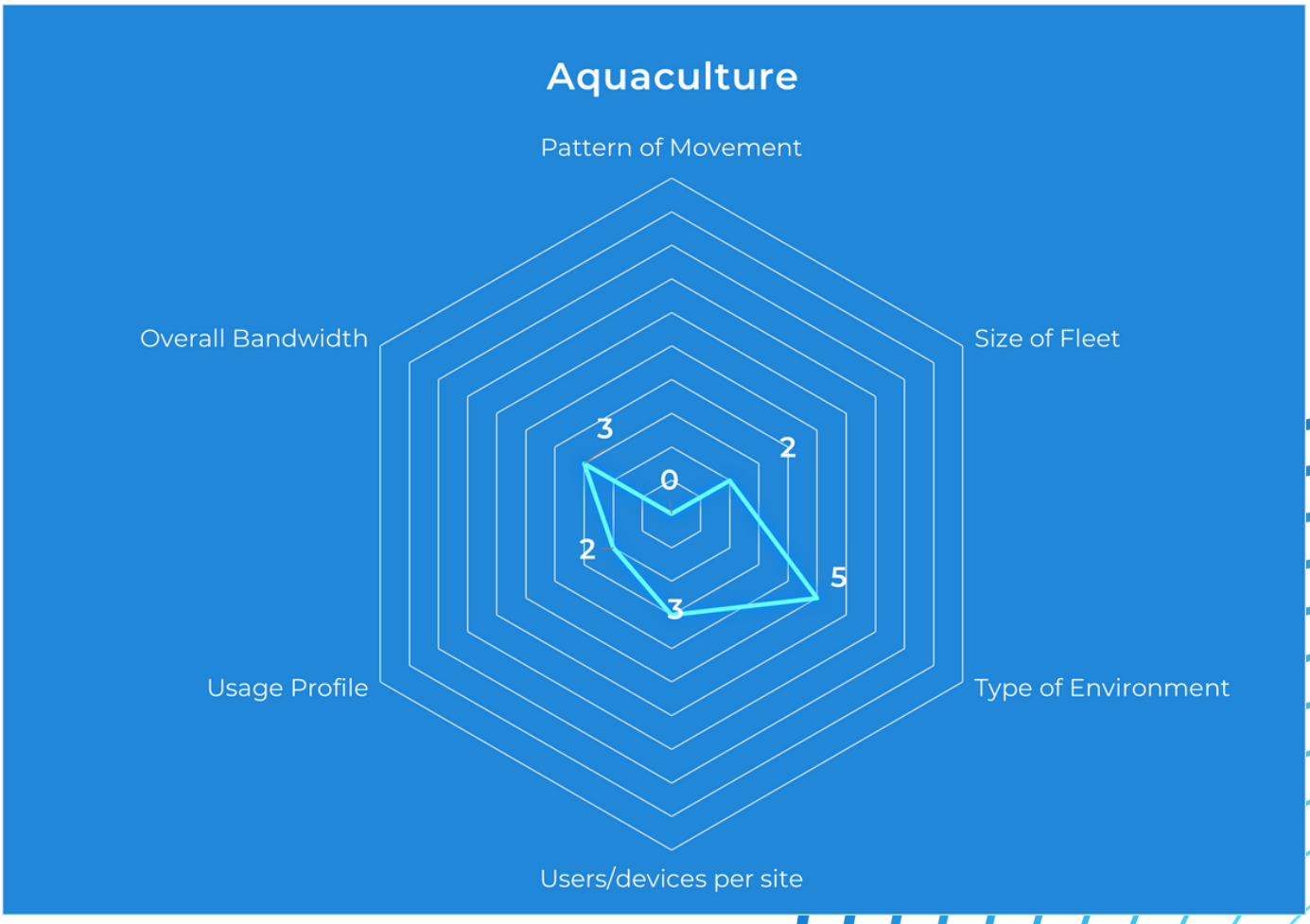




Scoring nearshore businesses: aquaculture

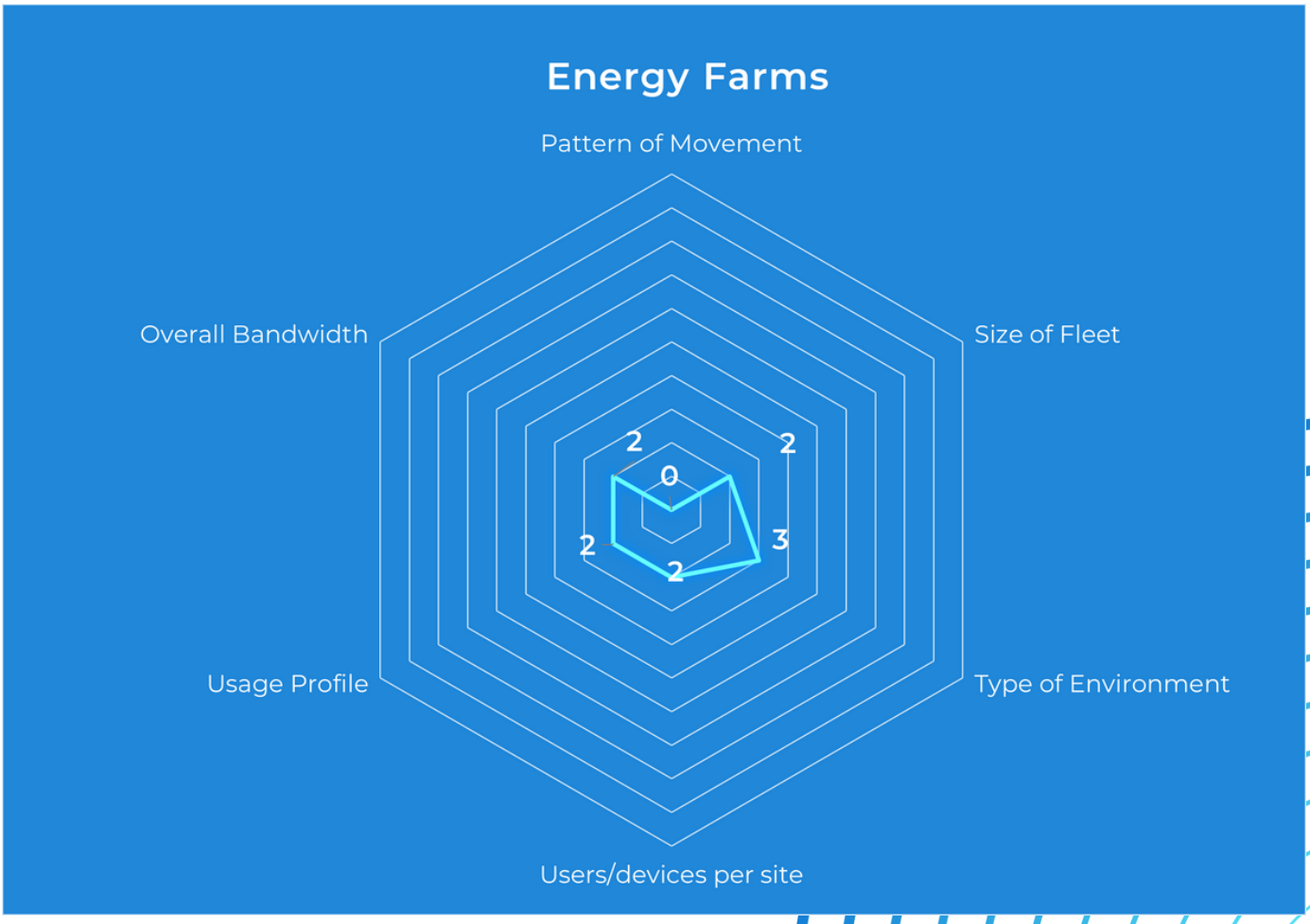
Offshore farming, everything from salmon to seaweed, is increasingly technological, relying on broadband networks to connect sensors and mechanisms to data sources like weather, tides, and feed scheduling. While they can be complex environments of dense IoT in changeable conditions, it's no surprise the installations themselves stay in one location – and it's almost always close to land, even connected by ramps and roads.

This makes aquaculture an excellent case for cellular connectivity solutions. Even a remote farm will be within range of a cell tower or two.



Scoring unmanned infrastructure: energy farms

Offshore wind and floating solar share characteristics with aquaculture: they're fixed in place, run on data, and make use of the IoT. The difference: they're further from land. Of the 15 installations financed by Denmark's Eifo government agency – the leading investor in offshore wind farms worldwide, with investments as far afield as Australia – all are within 32km of shore, with 11 within 20. This makes offshore renewables (everything from wind and solar to tidal) near-ideal cases for connectivity via cellular networks: most are in range of coastal cellular coverage, and many operate without staff onsite, needing always-on but cost-effective connectivity for sensors and telemetry. It's definitely a growth area for LTE/5G.

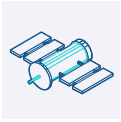


CHAPTER 3

Terrestrial versus spaceborne: what's best for the sea?

It's becoming clear that the competitive map for maritime will largely shift from an only-GEO dependency in the past decades to LEO satellites and LTE/5G solutions, covering a huge proportion of the global population.

But thinking one technology is the solution is either/or is missing the point. The real issue is about finding the right balance that delivers most effectively for a given maritime business – and seeing where each fits in best. In this section, we'll see what to consider.

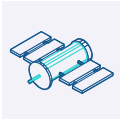


GEO vs LEO: a priority contest

While GEO remains in service for many applications – and is a legal obligation for some – LEO is growing fast for everyday connectivity. Especially with GEO's long latency times and limited bandwidth in many areas, the medal for satellite broadband to the mass market goes to Low Earth Orbit.

But for businesses, it is not that simple. While LEOs offers higher headline speeds with (mostly) global coverage, plus significantly cheaper costs per bit than traditional GEO services, so far, they are largely unable to provide guarantees on bandwidth or service quality in the same way as a GEO based service. With zero compatibility between providers, there are fewer failover options – at present, another satellite provider (there are few) means more equipment. This means relying on LEO-only for all your maritime connectivity would carry some risk.

It is, however, an exciting technology that we expect to take a huge share of the market (did you know there's a new announcement involving new LEO partners or deployments almost daily?)



Comparing LEO and LTE/5G

The next job is to take a critical look at market realities – and what these two technologies can do for your maritime business today.

Technology maturity and outlook

First consideration: as a new technology, LEO broadband providers are struggling to serve an expectant market. Starlink is kicking off with a growing list of prospects, OneWeb has only just completed its constellation, and the product sets of both are yet to mature fully.

By contrast, maritime broadband via LTE/5G is here today – and its infrastructure is not only functional, but long-established, with multiple providers offering services (with interoperable equipment) and a published upgrade path that covers many years, currently at Release 17. (Which allows for network speeds up to 20Gbps, with 50-230Mbps available in many places today.)

Certainty of standards and roadmaps

Even more importantly, 5G standards anticipate all the factors in Section 2 above. The standards don't just increase bandwidth availability over time; they increase the number of simultaneous connections possible through a single cell tower, and also make other allowances for greater environmental complexity (machines moving around) and building densities.

In other words, LTE/5G has already solved many of the problems LEO satellite providers are just starting to grapple with.

Practical coverage area

It may sound like there's a clear division between where LEO can be most useful – the open ocean, over 50km from shore, and nearshore, where cellular connections are possible. But is that distinction so clear-cut for maritime operators in the real world?

As Section 2 above summarises, the actual time many vessels spend on the High Seas is limited – often half their operating hours or less. Which means a great deal of time in port and ploughing coastal routes. Meaning that for a large part of each month, connecting to terrestrial cellular networks offers a solid option: more cost-effective, more established technological infrastructure.

How LEO and LTE/5G can work together

This presents a unified use case: use LTE/5G for your maritime broadband connectivity – except where you can't. Providers like Blue Wireless have dozens of case studies showing how LTE/5G with high-grade antennas and cellular routers deliver seamless and reliable internet service to offshore and nearshore vessels, easily and cost-effectively. The two technologies aren't in competition; they're complementary.

Expected evolutions

Of course, the LEO sector is exploding, improving and innovating by the day with new entrants to the market expected. Expect broadband speeds to increase from today's 34Mbps+ average to Starlink's ambition of 500Mbps within the next few years – and for this to happen in more areas than are currently covered.

However, there's no obvious timeline for Starlink's plan to achieve 10Gbps, or even 1Gbps, especially if the number of users increases dramatically. This would need 20,000 Starlink satellites, and there are fewer than 5,000 in its Generation 1 constellation so far. FAA launch approvals for so many satellites aren't yet forthcoming – at present 12,000 is its maximum.

LTE/5G, of course, operates on a terrestrial network approved to expand to multigigabit speeds – and that's just in its current iteration. The wireless ecosystem of cellular infrastructure, technology standards, antennas, and endpoint devices is well-financed and has an established business case.

In summary, LEO connectivity is evolving fast, and will continue to improve – but of course, terrestrial wireless technology is evolving too.

CHAPTER 4

Blue Wireless LTE/5G maritime connectivity

Reliable connectivity is essential in any organisation, regardless of where it operates. What is driving change in the maritime industry?

Changing needs

Post-pandemic response

Restricted operations caused by the pandemic pushed the maritime industry to look for new ways of working to maintain productivity.

Efficiency in operations

Competition happens both in land and sea, and improving efficiencies in the maritime industry through better, faster processes is as crucial as for any business.

Crew engagement & wellfare

Maritime crew can be weeks, or even months on board. Good communications with the “outside world”, and even online entertainment on board, helps greatly with people’s morale.

Industry trends

Digitalisation

Digital technologies are enabling maritime companies to increase agility on board, perform tasks remotely, and allow real-time visibility, monitoring, and control.

New applications

Maritime applications for all different functions on board continue to evolve. While most are plugged into the cloud, they require network connectivity to be always on – especially for mission-critical ones.

High-speed crew WiFi

Offshore businesses know the importance of keeping their workforce healthy and satisfied. High-speed and cost-effective WiFi allows them to browse the internet, stream movies, and communicate with their family and friends.

Your partner at sea: end-to-end wireless network solution

At Blue Wireless, we remove all complexity across all the required steps: from product selection, staging, and installation to ongoing management and support.

Multiple roaming networks

Blue Wireless offers a range of data plans covering all LTE networks worldwide, and the option for data pool plans helps businesses reduce costs by sharing allowance across multiple vessels.

Cradlepoint routers: ruggedised for the role

Powered by Blue Wireless' strategic partner, Cradlepoint, these edge devices enable high-speed connectivity and advanced SD-WAN capabilities, ideal for load balancing with satellite or for connecting devices on board. All routers are IP-rated to withstand adverse conditions, such as humidity, vibration, and heat.

Poynting maritime antennas

Poynting's omnidirectional maritime antennas connect the router to an onshore cell tower, bringing terrestrial 4G/5G networks onboard up to 20km and sometimes up to 50km offshore.

Cloud management

When choosing Blue Wireless, all your network devices are controlled centrally with Cradlepoint NetCloud. This enables fleet owners to monitor and manage devices, usage, and remote troubleshooting without the need for onboard IT staff.

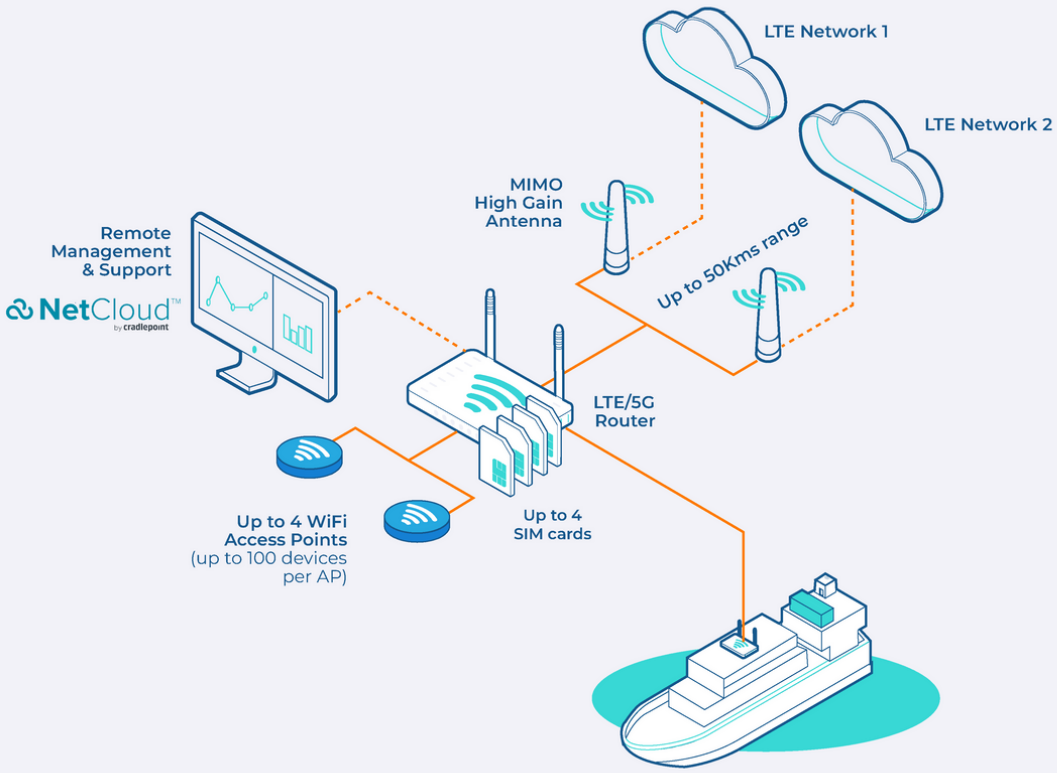
Professional services

By working with Blue Wireless, businesses get the complete package: solution design, hardware staging, testing, and configuration, in addition to our network of field engineers to help deploy and install equipment on board.

Hybrid Networks: satellite and LTE/5G integration

Blue Wireless integrated solution allows vessel owners to optimise both satellite and LTE/5G traffic from a single platform.

Blue Wireless maritime LTE/5G connectivity solutions are customisable, depending on the size of your vessel and/or fleet, international routes, or specific crew requirements. It can also be stand-alone or integrated with your onboard LAN environment or VSAT WAN connectivity.



CHAPTER 5

An action plan for maritime and offshore operators

This is the case for LTE/5G if your business is at sea. Taking advantage of reliable technology, offered by established providers, in an industry active in almost every part of the world.

If intrigued by its potential, we suggest the following.

01 Conduct a basic survey of your operations

You'll doubtless know your fleet size, employee numbers, and routes – so a first step is to work out how much time your assets spend near the shore. If a significant part of operating hours is within 50km of land, LTE/5G may well be an excellent choice for your internet connectivity. If it's any easier, use our scoring tips from chapter 2.

02 Talk to a Blue Wireless professional

Next, contact Blue Wireless for a no-obligation conversation. We'll take you through how it works and how we work with you – and the advantages and assurances available. And if you're in Amsterdam or Singapore, why not visit one of our Technology Experience Centres in person?

03 Calculate your cost of alternatives

If you're currently using other connectivity methods, the next step is to see how much they're costing you – both in sticker prices, maintenance costs, and business risks if anything goes wrong. We'll give you an honest appraisal of where the advantages might be.

04 Start with a proof of concept

When you're ready to go, see how Blue Wireless has delivered on an actual project and how the same approach could work for you. Whether it's one vessel or 1,000, we'll conduct a comprehensive assessment of what each vessel needs to get the connectivity you need, and can implement a proof of concept for you to see the results yourself. From then on, it's welcome to Blue Wireless.

Learn more at www.bluewireless.com/maritime

List of references

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