Low Earth Orbit Satellites And Connectivity

The Future Of The Cruise Ship Industry

Executive Summary

It would be unfair to state that the cruise industry has been left behind by the great social, cultural and technological advances of the 21st Century.

The unprecedented developments in connectivity and communications during these decades have led to a sector that is smarter and more streamlined than ever before – and this is reflected in the surging popularity of cruises amongst younger demographics.

But similarly, it would be inaccurate to say that the industry has been able to capitalise fully on these emerging opportunities. Not because of reticence, reluctance or conservatism; but because of the technical difficulties of delivering reliable connectivity at scale to the oceans.

The emergence of Low Earth Orbiting (LEO) satellites will finally redress the imbalance between land and sea. And this report will uncover the opportunities that this lays out before the industry.

This report will cover:

- The current connectivity issues stifling the cruise industry.
- The benefits which LEO satellite technology offers both cruise operators and passengers alike.
- How improved connectivity and 5G technology has been changing the hospitality game - and how the cruise industry is next to take advantage.
- The surge in popularity of cruises among younger demographics - and how this can be capitalised on.

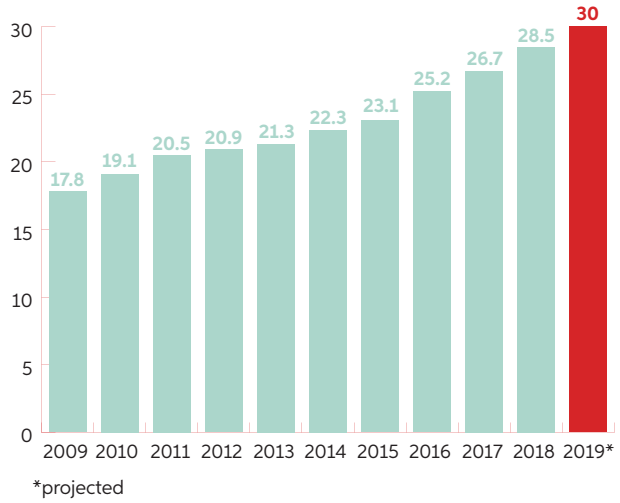
A bright and exciting future is opening up for this industry; now all that remains is to chart a course forward.

The Stats

1. THE CRUISE INDUSTRY IS BOOMING

- CLIA 2019 Cruise Trends & Industry Outlook

CLIA global ocean cruise passengers (in millions)



*projected

2. TARGET DEMOGRAPHICS ARE CHANGING

- Mintel UK Cruises Market Report 2019

Of those interested in taking a cruise in the next 5 years

3. CONNECTIVITY DEMANDS ARE RISING

- We Are Social and Hootsuite Global Digital 2019 Reports

67% of the Earth's population are **unique mobile users.**

57% of the Earth's population are **active internet users.**

45% of the Earth's population are **active social media users.**

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Chapter One:
A New Wave

Upwards of thirty million tourists travel on cruise liners every year. And just as in their everyday life, achieving reliable connectivity to all-pervasive internet services is one of their most immediate concerns. Yet for most of the industry's history, at-sea connectivity has been a major hindrance to travellers and operators alike.

Achieving reliable internet connections on the high seas is a complicated endeavor. In recent years, the relatively slow advancement of at-sea communications services has emerged as one of the greatest challenges for the industry to solve.

Traditional, land-based mobile communication technologies, such as the 3GPP evolution of networks (3G, 4G/LTE, etc.), are of limited use in these circumstances.

Typical maximum transmission distances of 4G, for example, do not extend beyond 10 km from the cell tower.

In recent years, alternative advanced networks have sprung up to facilitate IoT (internet of things) connectivity. Some of these create mesh networks based upon traditional mobile connectivity points. However, a cruise liner traversing the Atlantic Ocean is simply too far from any source to pick up a signal.

The result has been that while advances in connectivity have brought the last remaining offline "things" and people into the digital era, cruise liners have unfortunately been left out at sea.

Current approaches to connectivity at sea

Until now, connectivity has been limited to those traveling through off-coast locations where land based communications are accessible, or where they're allowed (as some countries do not grant connectivity access to cruise liners).

These include those navigating along major shipping channels and are able to avail of at-sea cellular network providers; and those traveling aboard major international providers who are able to operate proprietary cellular-based systems.

Unfortunately, all of these systems have inherent limitations:

1. Connection speed and strength when accessing land-based networks from the sea can be problematic.

2. Performance is also likely to fall far short of the expectations of digital natives accustomed to having high-speed internet available at all times and in all places.

3. Due to the physical limitations surrounding land-based networks, this also means that customers and operators are likely to be offline for a substantial part of the journey. This creates an inconsistent user experience and does not meet the needs of modern enterprise technologies, many of which are optimized for locations with always-on connectivity.

4. Because of the high cost of the current satellite technology available to operators, this expense also has to be passed on to the customer in the form of often prohibitively expensive per-minute connection rates.

5. Due to the cost, latency, and speed of these services, unacceptable stipulations often also have to be made, such as that VoIP services and other technologies with high data throughput rates, cannot be used.

"We don't know from one minute to the next whether the cloud is going to be up or not.

You have to have an on-prem solution and if you haven't then the conversation is over."

- Arnold Bramnick, CTO Norwegian Cruise Line

Getting cruise liners off the back foot

The current state of affairs has created a situation in which the kind of benefits that other travel and hospitality industries have been able to realize for years have simply not been attainable for cruise line operators, hampered as they have been by poor connectivity.

For instance, the ubiquity of reliable fixed and mobile internet has made electronic booking systems the gold standard used virtually across the world by the hospitality industry.

In fact, the rise of popular accommodation reselling websites such as Booking.com, or airfare ticket aggregation services such as Skyscanner, would scarcely have been possible without a reliable, worldwide, and real-time network to centrally coordinate room and seat availability.

From Marconi to LEO

It's been well over a hundred years since Guglielmo Marconi made the first ever wireless radio transmission, using radio waves rather than copper wires to carry a communication signal. Without wireless technology, modern commercial maritime — especially the act of traveling thousands of miles by sea purely for leisure — would scarcely be possible.

Marconi's legacy made long-distance non line-of-sight radio transmissions possible, ensuring that basic safety equipment could function and that passengers had some means of staying in touch with loved ones.

Times have changed, however, and today's technologies demand faster and more reliable connectivity. Just as Marconi laid the seeds for change in his day, Low Earth Orbit (LEO) satellites will usher in a new era of life at sea. One in which from a technological standpoint, life at sea will be barely distinguishable from life on land.

LEO is the way forward

A long overdue advancement in satellite technology called Low Earth Orbit (LEO) is prepared to turn the cruise industry's dire connectivity situation on its head. The industry, as it stands, is ready for a coiled spring effect of rapid change.

This white paper will examine exactly how this promising technology is going to bring cruise liners into the mobile age and the enormous benefits which this will realize for both operators and customers.

Chapter Two:
The Sea And The Sky

Low Earth Orbit (LEO) satellites remain at a lower altitude than traditional satellites, which orbit at a higher altitude, in order to provide operations for television, mainstream telecommunications and data providers.

LEO satellites remain in orbit at altitudes between 400 and 1,000 miles above the earth's surface and offer lower latency (delay) than higher-circulating satellites including Middle Earth Orbit (MEO), which are mostly used for GPS applications, and Geostationary Orbit (GEO) satellites.

While GEO satellites remain fixed to a single point on earth — and satellites can therefore be calibrated to focus towards them —LEO satellites are designed to fly around the globe at various trajectories, which means that an average cruise liner can plan to connect to multiple satellites while moving between the unpopulated waters that lie between continents.

Relative to traditional satellites, LEO satellites orbit at higher speeds, which means that for operators, their operating expenses (OPEX) are also higher. As a result, LEO satellites have typically been used to provide connectivity to underdeveloped countries; where the on-the-ground infrastructure to support typical communications methods is absent, LEO satellites provide an ideal intermediate solution as these territories move towards more sustainable forms of connectivity.

However, from the perspective of cruise line operators, they do offer an enormous advantage: reliable connectivity that can meet the needs of operators.

“With Low Earth Orbit satellites we get 20ms response times on the ground. There are things that we can offer to guests that latency up to now has pretty much ruled out.”

- Arnold Bramnick, CTO Norwegian Cruise Line

The connectivity advantage

By connectivity, we mean more than simply “having an internet connection”; modern cruise liners are veritable IT fortresses and can carry a vast number of systems on board that can together create substantial requirements for bandwidth and speed.

These include:

Payments processing systems, such as Electronic Point of Sale (EPOS) and other connected devices.

Internet access services for passengers, including web cafés and complimentary guest WiFi networks.

Inventory management and book-keeping ERP tools that integrate with the company’s centralized resources to ensure timely stock replenishment.

Cellular-based navigational systems.

For these systems to work effectively — and to integrate with modern add-on cloud-based technologies, which are optimized for continuous connections — it is essential that they work consistently and well.

Therefore “connectivity” means much more than simply “having internet” or internet simply being “available” for ad-hoc requirements.

For the cruise line industry to be truly connected, it needs to be able to avail of shore-calibre internet that is:

1. SUFFICIENT SPEED
Customers expect downlink and uplink speeds that are comparable to at least basic consumer internet connections.

In the enterprise environment, limitations as to what services can be used (including VoIP and video-conferencing services) are simply not acceptable.

2. ALWAYS-ON
Automation systems and payment gateways need to have 24/7 internet connectivity.

3. EXCELLENT QUALITY
Bandwidth must be sufficient to allow a large and predictable number of simultaneous connections without throttling.

Current issues regarding connectivity at sea today

Since LEO satellites are not widely available at the moment, cruise line operators have to rely upon several alternative technologies, none of which really address the industry's connectivity needs.

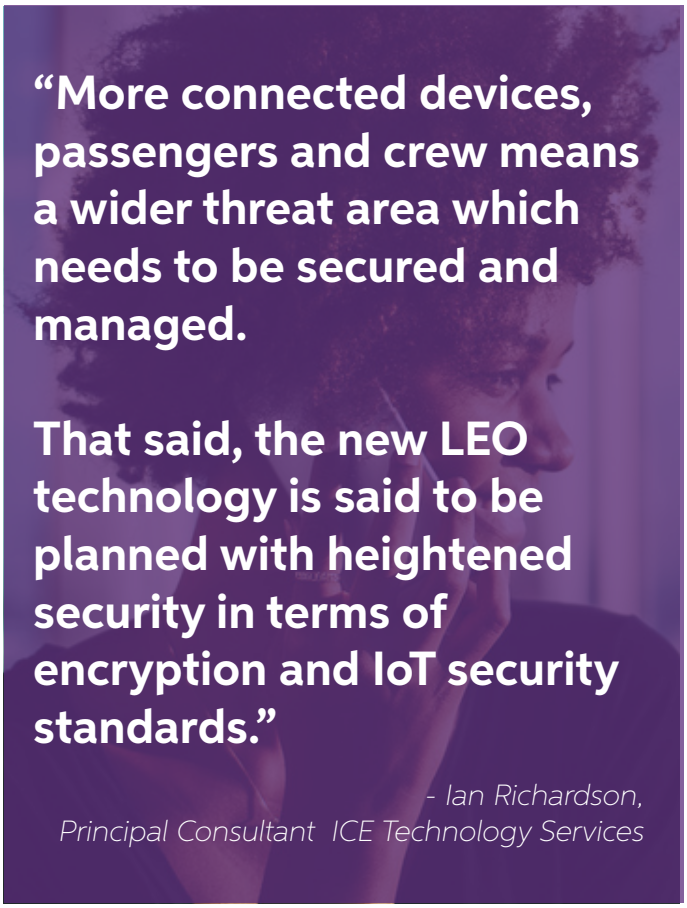
This included:

1. Higher orbit MEO and GEO satellites

- The constellation of satellites needed to provide continuous coverage with this form of satellite is fewer (i.e., less satellites are needed to provide an ongoing signal), but LEO coverage can be more reliable, particularly over sea.
- LEO is more suitable than MEO and GEO for mission-critical real-time latency-sensitive applications, including payments processing.
- LEO also has better elevation at polar regions, and is therefore a better choice for cruise liners navigating close to the North and South poles.
- Third-party connectivity providers sometimes service high-volume shipping corridors with MEO and GEO-based connectivity, but these tend to have prohibitive subscription costs.

2. Land based cellular towers

- Land based cellular connectivity can be a useful adjunct for cruises that are taking place close to populated shores. However, the distance the transmissions reach is limited, and therefore they are of very marginal use to the kind of requirements that modern cruise operators pose.



The future is LEO

The LEO constellation is comprised of both traditional GEO operators and dedicated LEO-only networks. It is a very active market with many disruptive operators, including SpaceX, OneWeb, and Telesat.

As more networks are provisioned, higher-orbit and geostationary constellations' advantages over this technology will continue to diminish — particularly from the perspective of cruise liners.

The cruise line industry is a spring coil ready to unfurl — the emerging widespread adoption of LEO satellite networks will be the catalyst for that change, realizing enormous benefits for millions of annual seafarers.

Chapter Three:

Cities Of The Sea

The echoes of the smart city revolution are beginning to reverberate around the world. The Internet of Things (IoT) is allowing non-human-operated "things" to be connected to the internet at an unprecedented rate.

The result has been that entire critical infrastructure segments are being brought online throughout the world.

What the IoT can do for mankind, however, extends far beyond allowing people to change the settings on their smart refrigerator while they are out watching a movie — or adjusting their thermostat while strolling through the park. These, in fact, are only the tip of the iceberg in terms of the IoT's potential.

The growth of the consumer IoT is paralleled by the emergence of the industrial IoT which brings entire systems like water distribution networks, energy grids, and even transport control systems, onto the internet.

The potential of smart city projects — such as the one in Quayside, Toronto that Google is pioneering — is enormous in terms of the efficiencies that can be realized for operators.

Hotels of the future

Some of Google's plans for Quayside — such as a centralized identity management system, through which each resident is granted a pass to access public services — may seem somewhat dystopian, at least at the present, but it and other smart city projects are able to leverage the power of data from things in order to optimize efficiency, improve service to customers, and boost reliability.

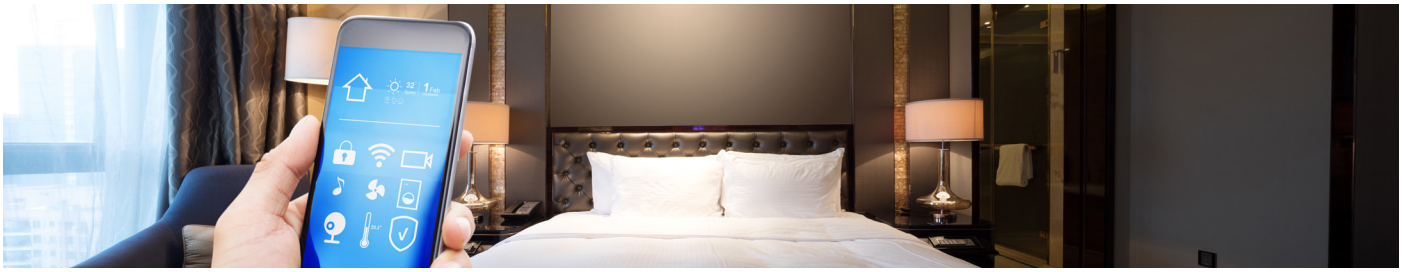
These changes are also being realized in the land-based hospitality industry, the cruise liner industry's non-seafaring equivalent.

A typical land-based hospitality company, such as a hotel, might be able to use the IoT to:

1 Adjust HVAC (heating, ventilation, and air-conditioning) systems according to the number of identified guests in a dining room.

2 Implement continuous monitoring of A.C. power sources in order to detect the first hint of abnormal operating conditions in order to provision backup power sources such as generators before they are required.

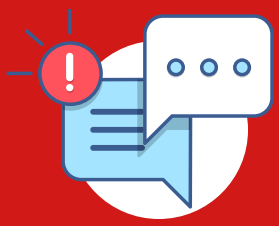
3 Offer their guests Alexa for Hospitality, a voice assistance technology from Amazon. This allows guests to order room service, for example, simply by speaking into a device.



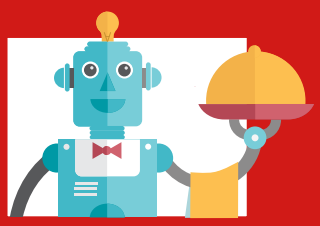
This mixture of consumer-centric IoT systems (such as Alexa) and those intended for the enterprise and industrial sectors (power quality monitoring) can together work to substantially improve the quality of the guest experience.

Besides improving the experience for guests staying at "smart" hotels, the IoT has also allowed operators to increase their revenue per guest by creating new means for up-selling and cross-selling.

Examples include:



Automatic notifications can be pushed to guests' email and phones as soon as they have been checked in to the hotel and IoT devices sense that they have engaged in key experiences such as accessing their room (via smart lock). These can suggest further internal experiences, such as visiting the hotel bar, as an ideal way to settle in to the location and unwind after an arduous flight.



Robotic concierges that can optimize their guest recommendations based on guest identity and demographic. This can increase the likelihood that a certain internal referral, such as dining at the hotel restaurant, will be accepted by the customer.

Floating cities

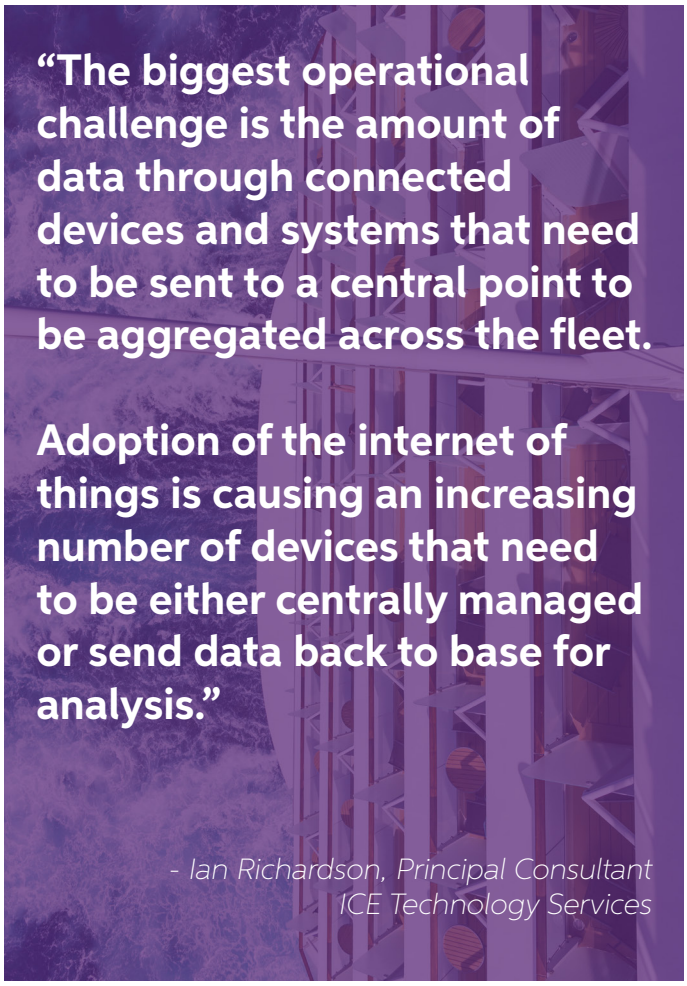
With an average guest capacity of between 3,000 and 6,000, cruise liners are, in effect, miniature floating cities, and the very same benefits that can be realized in land-based hospitality venues can be taken advantage of at sea. Cruise liner specific applications for IoT technology include:

1 In-room electronics, such as smart picture-frames, which can suggest on-port experiences once central navigation systems project docking there within a certain number of hours.

2 Automated IoT-based payments systems which can allow guests to pay for onboard services without having to interact with staff.

3 Targeted location-based advertising that can be delivered to guests through in-cabin systems such as smart speakers and VR type technology.

4 IoT services, of course, require a reliable internet connection in order to function optimally. LEO satellites will quickly speed up the advance of the IoT revolution aboard cruise liners.



World's most innovative hotels

The world's most innovative hotels have leveraged the power of the IoT to offer truly exemplary smart experiences for their guests.

The Marriott hotel chain is currently running pilots placing voice assistants in hotel rooms. This first experiment with "IoT-in-every-room" is the product of the company's innovation lab, based out of its corporate headquarters.

The stated goal of the company's approach to IoT is that a customer should be able to walk into a hotel room that instantaneously "knows" its occupant. The customer will then be able to interact with every facet of the room simply through their smartphone, which will already have been computed to understand some basic details about them and their preferences. This concept can certainly be extended to the cruise liners of the not-too-distant future.

However, hotels are just the starting point, and from here the cruise line industry is set to capitalize on the IoT revolution.

Chapter Four:

The Digital Natives

Taking cruises is increasingly an activity for all age groups to enjoy.

While cruises may have traditionally been thought of as an activity that those after retirement chose to participate in, the industry has been successful in its effort to attract a younger demographic to step aboard.

According to a recent report from the Cruise Lines International Association1 (CLIA), 85% of digital natives expressed an interest in taking a cruise, a remarkably high figure.

In fact, industry data indicates that digital natives (Generation Y) and Generation Z are the fastest growing segment of the cruise market.

However, both generations come with entirely different expectations about connectivity than their parents and grandparents — and it will be the responsibility of operators to find solutions that can satisfy that demand.

The digital native psychology

To deliver a truly exemplary customer experience that can do more than simply meet this demographic's need for always-available connectivity, operators will have to understand digital native psychology and offer the kind of on-board experiences that will leave them wanting more.

Those that have studied this demographic have observed some trends which include the following; cruise operators and those managing the on-board experience should ensure that what they offer is in alignment with these values.

Key aspects of digital native psychology for cruise operators to understand:

The experience generation

Digital Natives are more interested in accumulating experiences than buying 'stuff'. Consumerism has saturated markets with goods and services; but many digital natives are being influenced by thought leaders that emphasize minimalism and the value of experiences.

Research conducted by Harris Insight and Analytics[1] found that 78% of those surveyed would rather spend money on an experience they found appetizing rather than spend the equivalent sum of money on an equally appealing product or service.

Cruise operators catering to this demographic should therefore seek to offer an on-board programming itinerary that includes things such as music, theater performances and festivals.

Not only this, but offer the opportunity for passengers to book and organise shoreside excursions while at sea.

Expect seamless interactions

According to research from Accenture Consulting[2], digital native consumers are focused on ordering processes that are "easier" and "faster". 73% of those surveyed are currently using or "can't wait to try" voice-activated ordering.

Cruise operators that can avail of technologies such as smart speakers should therefore try to integrate this throughout their on-board experience.

Will tell you what they think

Generation Zs are not shy about conveying feedback. In fact, the same Accenture report found that 40% of Generation Zs (and 35% of digital natives) will willingly share what they thought about a product or service.

Cruise operators should therefore ensure they have as many means to capture that vital information as possible, particularly via digital methods like touchscreen surveys.

Put it on the card

The tendency for digital natives to pursue quick and seamless interactions over more involved exchanges extends to their financial transactions as well.

According to a survey carried out by Capital One[3], a third of digital natives "rarely" or "never" carry cash, thus preferring to pay by card and, as a result, driving the global change that we are now seeing in this sector.

Being able to cater for this demand is essential in turning curious digital natives into fully-fledged cruise customers.

1. Millenials: Fuelling The Experience Economy, Harris Insight and Analytics on behalf of Eventbrite, 2014
2. Redesigning Retail For The Next Generation: Gen Z Accelerates The Millennial Digital Trend, Accenture Consulting, 2017
3. Going Cashless At The Point Of Sale: A Matter Of Time, Capital One, 2018

DIGITAL NATIVE PSCHOLOGY:

Top Statistics For Cruise Ship Operators

"Guests don't understand why their internet experience is so poor on board vessels - so its a customer satisfaction issue."

- Arnold Bramnick, CTO Norwegian Cruise Line

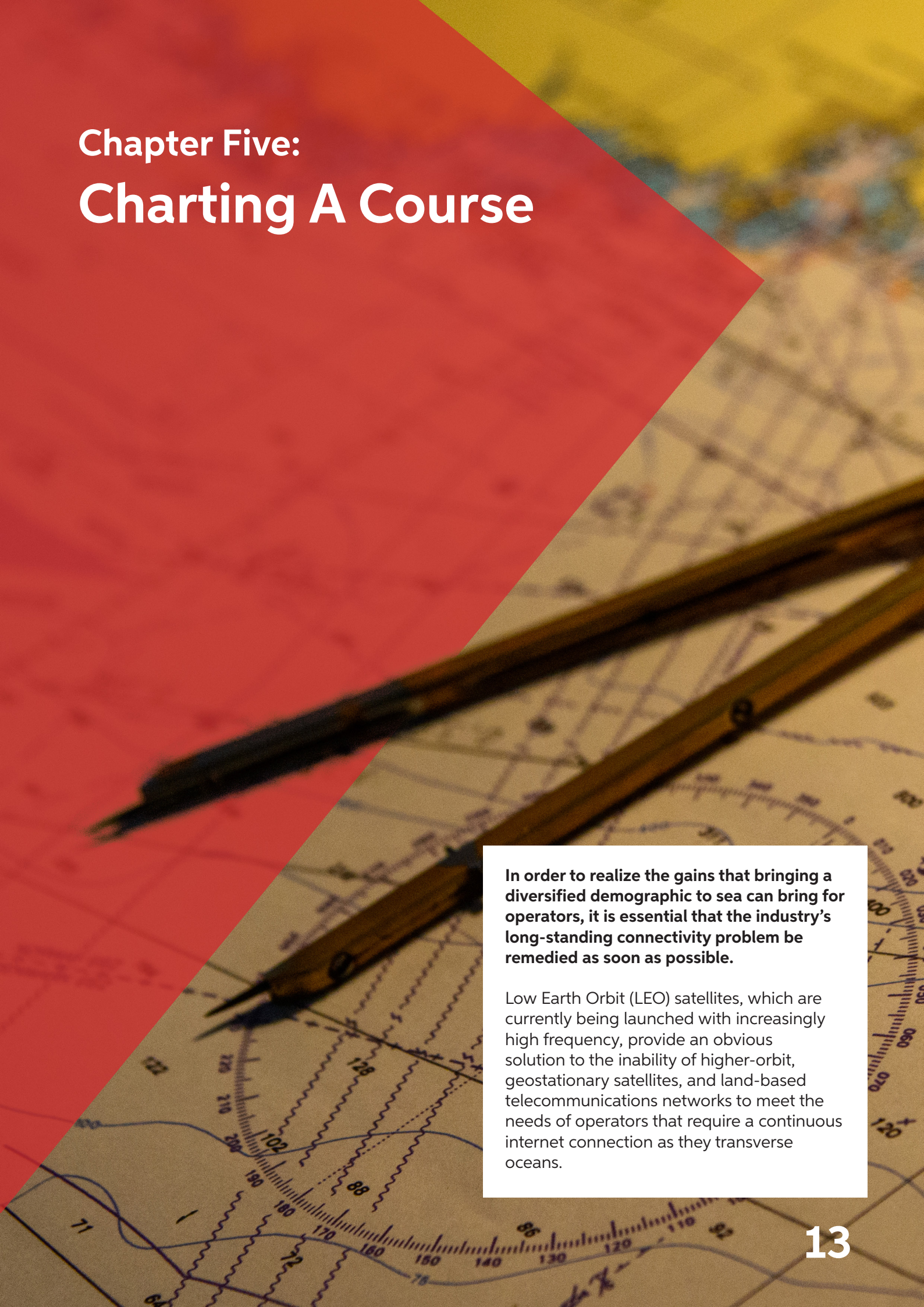
78% of digital natives prefer spending on experiences to physical goods (Harris Insights and Analytics).

1/3 of digital natives "rarely" or "never" carry cash (Capital One).

73% of digital natives already use, or are excited about trying, voice-activated ordering (Accenture Consulting).

The bottom line

Digital natives are a growing force in the cruise industry. They have a markedly different psychology to traditional cruise consumers. For this demographic connectivity is as basic a need as electricity. Operators should study their purchasing habits in order to deliver them the experiences they will find most satisfying.



Chapter Five:

Charting A Course

In order to realize the gains that bringing a diversified demographic to sea can bring for operators, it is essential that the industry's long-standing connectivity problem be remedied as soon as possible.

Low Earth Orbit (LEO) satellites, which are currently being launched with increasingly high frequency, provide an obvious solution to the inability of higher-orbit, geostationary satellites, and land-based telecommunications networks to meet the needs of operators that require a continuous internet connection as they transverse oceans.

“LEO satellites will deliver tremendous opportunities to the cruise sector. Apart from the many customer opportunities that hyper-connectivity will deliver, there are also many significant commercial benefits.

Real-time payments and data analytics will deliver more efficient cash-flow, combined with reduced fraud risk, while also enabling cruise customers to purchase more via the in-cruise app.

With the arrival of digital on-board, the vision of making payments frictionless can be realized, delivering, at an individual level, a cruise experience which is the Holy Grail of next generation business models.”

Barry O’Sullivan, General Manager, Fexco OpenConnect4Cruise

Today’s solutions

The LEO satellite market is dynamic and continuously growing — SpaceX’s Falcon 9 rocket recently launched 64 satellites into orbit from one flight, the largest number of LEO satellites ever placed into orbit in American space history.

However, without the proper technologies in place, cruise operators will not be able to fully take advantage of the heightened connectivity that these constellations provide at sea.

Receiving equipment

Cruise line operators wishing to receive LEO satellites must ensure that they have the right technology to do so in place on their vessels. This might require investing in new connectivity systems.

Additionally, operators that were not able to offer their guests amenities which required always-on connectivity before should continue offering these to their passengers.

Market research findings consistently demonstrate that the millennial and Generation X customers that are increasingly turning to cruises regard continuous connectivity as basic a service as an electricity supply.

Cruise line operators that were not able to take advantage of up-selling strategies — such as proximity-based offers to participate in on-shore experiences — may find that they are suddenly able to do so, and should act accordingly.

“Losing out on market share is the biggest risk of inaction.

As soon as the big lines start to buy LEO services they will be able to offer a much better guest experience and also benefit from operational aspects that will enable their fleet to digitalise much quicker than the competition without LEO.”

- Ian Richardson, Principal Consultant ICE Technology Services

The four questions

As the LEO era continues to advance, those wishing to stay ahead of the change in the connectivity market for cruise liners should ask themselves the following questions to assess their level of readiness to implement new solutions:

1. What level of connectivity do we typically experience during our cruises?
2. Have we collected feedback from our customers about their satisfaction with what we currently offer?
3. What payment solutions do we operate and have we conducted a cybersecurity audit to assess how vulnerable we are to a local, on-ship data breach?
4. Do we have the connectivity and payments infrastructure available to take advantage of LEO satellite technology and token-based payments solutions?

The course is ahead

The widespread accessibility of LEO satellites will completely alter what can be achieved in the cruise liner space. The industry will no longer be left “out to sea” and operators will be eager to take advantage of the multitude of revenue-building opportunities that these advancements will bring about. Payment processing solutions which can comprehensively meet the needs of the cruise sector are on the market and ready for immediate implementation.

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