



MOBILITY CONNECTIVITY

CONFERENCE

15 - 17 NOVEMBER, 2022 BREMEN, GERMANY

**GROUND STATIONS AND
SATELLITE CONSTELLATIONS:
BRIDGING THE GAP IN REMOTE
MARITIME AND AVIATION
CONNECTIVITY WITH NEXT-GEN
SATELLITE CAPABILITIES**





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**IF THEY DO NOT HAVE
CONNECTIVITY, PASSENGERS
CAN SUDDENLY DECIDE TO
GO TO ANOTHER AIRLINE**

There are various megatrends intersecting the maritime and aviation industries. A key one is developing strong onboard connectivity capabilities when flying and sailing in remote areas to ensure efficient remote maintenance and navigation, crew safety and welfare, as well as optimising a passenger's onboard experience through high-speed, high-data rate reliable connectivity. The necessity for these capabilities has been accelerated following the pandemic and our increased need for connection.

For seafarers, keeping connected with ship operators as well as their family and friends while spending a significant amount of time at sea is paramount to their mental wellbeing. The pandemic has put into context how much human connection means and having the ability to (video) call loved ones is vital. The pandemic illustrated how difficult it was for seafarers to get around new regulations, protocols and restrictions as they were waiting to get into ports.

Spyros Goumalatsos, at the time Head of Electrical / Navigation Support and Vessel IT at TORM, a ship management company operating over 80 tanker vessels across the globe, explained during the Onboard Connectivity Summit at Space Tech Expo Europe in 2021 that one of their main targets is to bring connectivity to their crew. "The benefit we gain out of this is a happier crew, which means they will do their work better, hopefully, and then we will actually retain them, meaning they would like to go on board again. They won't go somewhere else, meaning that they know us, they know the ship and how we do things. So, in the long run that will assist us in operating safer ships more cost-efficiently".

Meanwhile, and something that again has become even more important during the pandemic, is the option to provide remote training and maintenance through video calling, onboard software updates and staying connected with onboard industrial Internet of Things (IoT) sensors. "On the IoT and troubleshooting side, of course we have a huge need of connecting the world with us because we are not actually at the port very often. We go from A to B but that can take a month and if you lose your navigation system within that month, then you are not in a very good situation. It would be to the benefit of all, crew and us, to be able to connect remotely and to work on it. So that's kind of our pain point", says Goumalatsos.

Similarly, and this accounts to both the maritime and aviation industry, the need for high-data rate onboard connectivity is increasing. Seafarers would like to spend their downtime being able to stream services such as Netflix, Amazon Prime and others, and video call with their friends and family wherever their ship is sailing.

The aviation industry sees an increase in customers wanting to access their personal devices onboard while flying, to use it for video calling, streaming and other services that require higher bandwidth than currently available on most commercial aircraft.

According to Eric Peyrucain, digital transformation leader at Airbus, it is key that airlines integrate connectivity systems, and he sees more and more of this happen. At the Onboard Connectivity Summit he explained that “today we see airlines equipping the aircraft [with connectivity systems]. About 100% of our new and long-range aircraft are going out of the final assembly line with onboard connectivity, broadband connectivity. Short-range aircraft are going out with around 20-30% with broadband connectivity onboard. The airline who decided to go there, decided to make it, because if they do not have connectivity, passengers can suddenly decide to go to another airline. They see it as a differentiator and if they do not have it, people go [elsewhere]”.

THE SATELLITE CONNECTIVITY OPPORTUNITIES

So where is the satellite industry at in terms of providing higher bandwidth and ubiquitous connectivity to meet these end-user requirements?

New satellite connectivity capabilities can be a real game changer for the maritime and aviation industries. Having said that, satellite connectivity is far from new for these sectors: “Aeronautical and especially maritime sectors are certainly not new to satellite communications, actually besides broadcasting, those are the areas where satcom was used since the very beginning, if we think, for instance, through the very first Inmarsat systems”, says Dr Sandro Scalise, Head of Satellite Networks with German aerospace agency DLR.

However, the opportunities that low-Earth orbit (LEO) constellations, and other non-geosynchronous orbiting (NGSO) and geosynchronous (GEO) high-throughput satellites and software-defined satellites, as well as optimised ground infrastructure and terminals, can bring to these industries are tremendous. “From a technical point of view, I think the key words shall be flexibility, reconfigurability and intelligence in space. Oversimplifying a bit, we need to depart from the old concept of a satellite as a kind of repeater in the sky, and look at it like as an intelligent network node in space”, says Scalise. “There are of course, also other important challenges. Maybe at business level, but I let experts in that area to eventually address those”.

Indeed, after a challenging start with proving business cases, the satellite services market to enterprise, and as part of that businesses such as shipping companies, appears to be growing and has seen various announcements of investment and satellite companies actively promoting the steps they take to work with the mobility



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INSTALLATION [OF AN ANTENNA] IS NOT A PROBLEM, BUT UPKEEPING AND GETTING CONNECTIVITY OUT OF IT, IT IS ACTUALLY AN ISSUE

sectors. More organisations see the opportunity for satellite infrastructure to complement terrestrial infrastructure, especially for those requiring satellite backhaul in remote areas. The key technologies highlighted by Scalise are paramount to providing a seamless connectivity service to the maritime and aviation sectors, wherever their fleet is.

However, there remain questions about the quality of service of new, developing satellite connectivity solutions. As satellite industry-veteran Ronald van der Breggen **explains**, there are hurdles to overcome in order to provide the flexibility, reconfigurability and intelligence that Scalise is referring to, which will eventually complement terrestrial networks. Especially NGSO satellites experience the added challenge of dipping in and out of one satellite connection to another, due to the moving nature of satellite constellations. As Van der Breggen writes in his piece: “When satellites operate in NGSO, any connection to such satellite is lost every couple of minutes, up to an hour. NGSO satellites orbiting Earth are only visible for so long, which is why sometimes thousands of satellites are being launched to ensure that at least one satellite is always in view. When a connection is about to be broken due to a satellite disappearing beyond the horizon, the service is reconnected to another satellite until this satellite is also fading from view, upon which the process is repeated”.

However, as quality of service is still being developed, there are reasons to be excited. “Particularly for the enterprise market, the operator that has developed a robust and well documented system that guarantees quality of service by not only managing bandwidth but also these connections, is almost guaranteed huge commercial success relative to those who rely on the best-effort approach of make before break ... or TCP for that matter”, **writes** Van der Breggen.

THE COST AND CHALLENGES OF ONBOARD CONNECTIVITY INTEGRATION

While the satellite operators are working on improving and guaranteeing quality of service, there is a lot happening on the ground segment as well. One of the main challenges for maritime and aviation end-users is the cost of advanced connectivity systems.

A large chunk of that cost can be assigned to the price of next-generation terminals, such as flat panel and phased array antennas, which to date have been intriguing to these markets, but have not always convinced mobility end-users to switch. The integration of new terminals is expensive and, especially within the aviation industry, requires a lengthy certification process.

During the Onboard Connectivity Summit, a panel with maritime and aviation experts discussed the challenges of next-generation terminal installation onboard vessels and aircraft.

Matteo Berioli, Senior Director for Aircraft Connectivity at Safran Passenger Innovations, said: “The idea of a having a flat antenna has always been the dream of the aviation [industry], as it has lower drag, lower fuel consumption. We know the technology has been around for many years, but of course there have been challenges to integrate this into the airplanes, mainly because of the high-power consumption linked to phased array. These are the big challenges today and that’s also why we don’t see so many phased array antennas deployed on an airplane just yet”.

Jan Hetland, Director for the Data Services Division with Telenor Satellite, added that the maritime industry has its own unique set of challenges: “For maritime use it has several flaws that make it a bit problematic, such as power consumption, size, performance and cost. It hasn’t really been available at a cost point where it competes effectively against traditional parabolic antennas”.

The integration of new antennas is particularly challenging for the aviation industry due to the strict certifications that are typical for this sector as well as the demanding requirements for such terminals on aircraft, although there have been several efforts recently to bring in standardisation, such as the **ARINC 791 and 792 standards**. “[The standards] tried to standardise the lags and fittings which are installed on top of the fuselage but also the wiring inside the cabin and the components and different elements of an aeronautical terminal. This, in the vision that having an industry that focuses effort on common set of standardised elements, creates communal scale and creates lower cost”.

Peyrucain illustrated the challenge aircraft integrators experience without standardisation: “If we could have only one way to integrate

the antenna, and radome, it’s much simpler. Simpler when you are in operation for the maintenance and so on, and so having standardisation for this is key. It helps a lot. Installation is a big topic. Certification is also because you imagine this big bubble on top of the roof outside of the aircraft – all requires water and temperature management, so you need to demonstrate it, test fly it, and it takes a while. In Airbus we are not choosing to have a single radome or single installation. We have left it to the vendors in order to optimise the end-to-end bandwidth [...] so we need to have all this in perspective.”

While initiatives like ARINC have helped, Berioli adds that there is still the challenge of the lack of interoperability between different vendors with the terminals now available – something that has been perceived as a major challenge by airlines who want to ensure affordable, reliable network use at all times. Berioli: “There is no interoperability between the different vendors. I cannot replace one box in one system from one vendor, with a box from another”. Having said that, Berioli felt that the industry made major steps in the right directions by coming together on creating the ARINC standards.

Airbus is responding to this lack of interoperability by advising their customers to not choose a connectivity solution at the beginning of the development of an aircraft, says Peyrucain: “We recommend that they put the infrastructure or the structural provisions inside the aircraft before the aircraft is delivered, so that they can choose later on to retrofit the aircraft with the connectivity solution. The retrofit is much simpler and can go much faster”.

For the maritime industry, the installation of an antenna is less of a problem. Unlike the aviation industry, installing new antennas on vessels will not add any significant weight that would make a difference in a ship’s fuel consumption. The connectivity itself is more of an issue. Goumalatsos: “What we are struggling with the most is blockage. We usually have a single antenna onboard and we have huge steel structures all over. Depending on where the vessels is heading, we actually don’t get any coverage because we are hit by a funnel so then there’s no satellite to be seen. Installation is not a problem, but upkeep and getting the connectivity out of it, it is actually an issue. So new technologies, coming closer to port and getting connectivity from ports when we are there, not relying so much on satellite only, or combining in a way is what we are looking for”.



COST SAVING EFFORTS THROUGH CONNECTIVITY

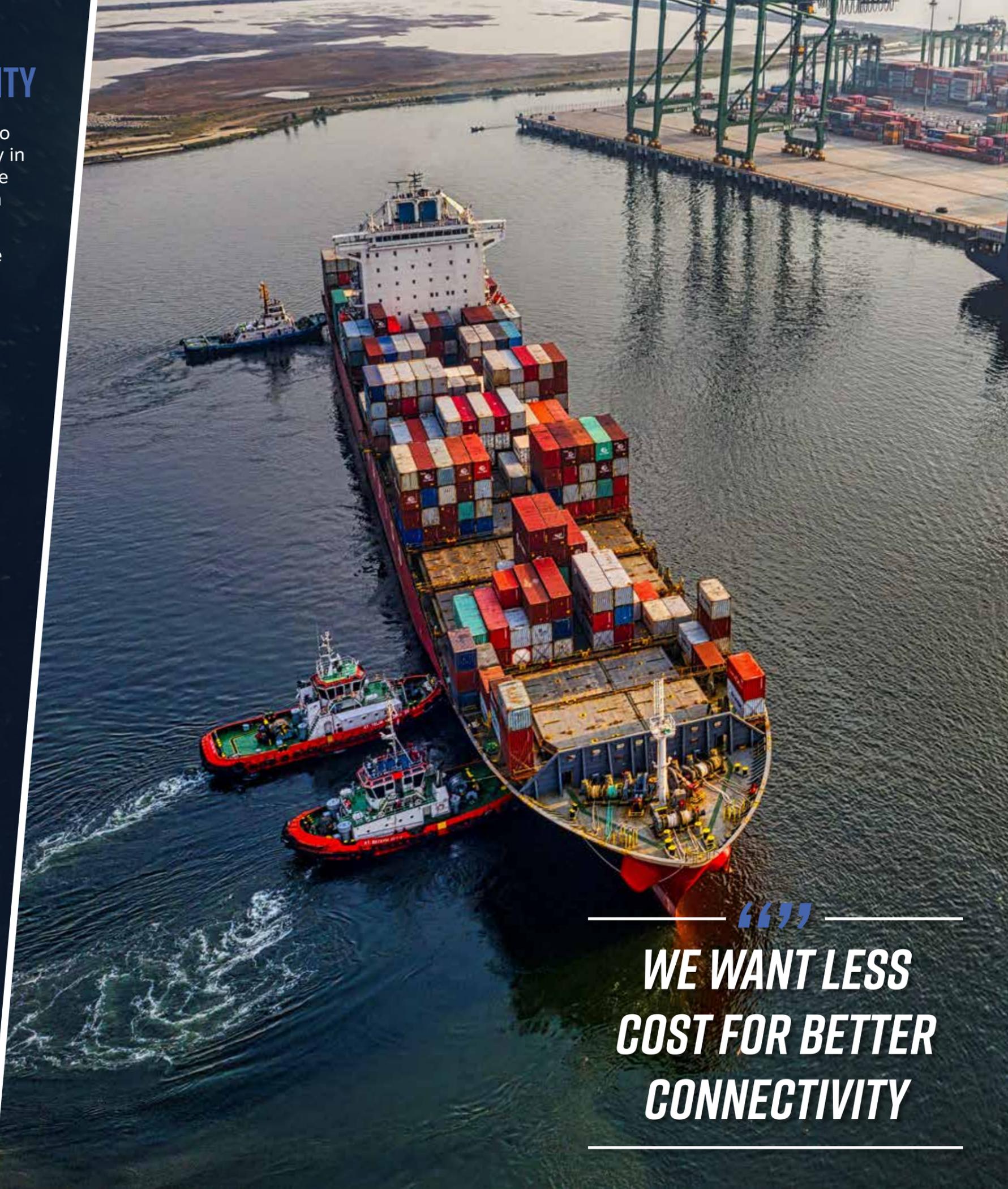
While technology is maturing, at the end of the day it all comes down to cost. Currently, advanced connectivity is still seen as a burden for many in the aviation and maritime aviation industry alike, but both industries are considering solutions to ensure the cost-savings that can be made with next-generation connectivity make up for the price.

Goumalatsos: “We don’t see ourselves making money out of it, anytime soon at least. There’s a lot of things being talked about, like using the vessels as a hub so we are receiving and transmitting at the same time, and then, I don’t know if you’ve seen the marine traffic recently but the sea is filled with ships, so that could also be an idea to capitalise on, but for the time being it’s a cost-centre. So, we want less cost for better connectivity”.

Peyrucain agrees with finding solutions in order to save money, and also to become more sustainable through enhanced connectivity capabilities. Peyrucain refers to two types of connectivity – the one that is required for the cockpit and is used for safety-critical purposes, and the broadband connectivity for passengers and crew. He expects that increased collaboration between the cockpit connectivity and the in-flight entertainment and connectivity departments could help: “The guys [on the cockpit connectivity side] use expensive things – and they often do not speak and do not see the benefit of something else because they are not talking together. But let’s think for a second to as if the guy in the cockpit was in constant discussion with his operating centre just to have advice for better routes, just imagine that we can save 1% of fuel early – it pays for the connectivity directly. I am still surprised to see that we do not see this business model popping up more often and this is one of my favourite [examples] because of sustainability. This is one way where we can have more sustainable flights by having optimised [routes] for each and every single flight. And having big connectivity like this, it would be just a no-brainer for the operation and to move the aircraft in an optimised way. This could be one of the potential solutions to see out to save money instead of making it, but your investment would be covered by the savings you do”.

THE CONNECTIVITY APPLICATIONS

Beroli thinks the LEO and MEO constellations are promising to the maritime and aviation market to address their challenges and eventually lower cost. Beroli: “The coming LEO constellations that guarantee on average high elevations, satellites not just on equatorial plane but also higher latitudes, it makes possible to use the antenna looking with a higher ‘look angle’ exploiting the full gain of the full antenna area. This makes it more appealing for airplanes”.



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**WE WANT LESS
COST FOR BETTER
CONNECTIVITY**
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And with the arrival of LEO constellations, other NGSO satellites and Very High Throughput (VHTS) and software-defined satellites, the use-cases and applications that come available for mobility end-users is incredibly promising. Scalise: “In the future, this will not be a niche anymore, and [maritime and aviation] will profit from a fully integrated communication infrastructure with all the benefits that I mentioned before”.

These benefits are myriad. Eliot Minn, Chief Technology Officer at e2E, a systems engineering and technical support business to the satellite, space and communications industries, says: “For aviation uses, I think it is going to enable broadband, 5G business streaming services to someone in business class, such as teleconferencing sort of services. And they can be delivered to the users on their smartphone or laptop during flight. And obviously the communications would switch intelligently between terrestrial and satellite so that you're not always on satellite and you can reduce the end-user cost to some extent”.

Minn: “For the maritime side, cruise ship passengers, when you provide 5G video voice and data services, they could be [...] delivered directly to the users of handsets and laptops whilst they are on the move and looking at the next-generation satellite payloads there you can have beams dedicated to a ship's path and it can be dynamically configured and shaped and resourced to meet the capacity and the service demands of the customers throughout that ship's path”.

And so, the technology and business cases for onboard connectivity develop and improve as the applications become greater across the mobility sectors. While key steps have to be taken on terminal integration, standardisation and the affordability of (LEO) satellite communication capabilities, there is a lot to be excited about.



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SATELLITE INDUSTRY, GROUND SEGMENT
AND MARITIME AND AVIATION END-USERS
BRIDGE THE GAP IN HIGH-DATA RATE,
REMOTE CONNECTIVITY?**

Join us at the **Mobility Connectivity
Conference** this November 15-17
in Bremen, Germany, to learn about
the latest developments regarding
connectivity at sea or in the air.

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