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Epic era begins

Intelsat has successfully launched the first in its EpicNG series of high throughput satellites, adding tens of gigabits of capacity for vessel traffic between Europe and the Americas. With a second launch scheduled in a matter of months, the availability of maritime broadband is set to change in a big way

The maritime communications revolution is well and truly gathering pace, with Intelsat completing the successful launch of the first in its EpicNG series of next generation high throughput satellites, promising to offer a massive increase in capacity for major shipping routes over the next couple of years as the fleet of spacecraft is put into orbit.

The Intelsat 29e satellite was launched from French Guiana aboard an Ariane 5 vehicle and signal acquisition was reported as confirmed shortly afterwards. Manufactured by Boeing, Intelsat 29e will bring high throughput capacity in both C-band and Ku-band to North and Latin America and the North Atlantic region when it is placed into service at 310° East, where it replaces Intelsat 1R.

The all-digital next generation Epic satellite platform combines wide beams and spot beams with frequency reuse technology and a digital payload, which the company says offers significant improvements on its analogue predecessors in areas like security and flexibility, allowing capacity to be shifted to match usage needs in a particular region or timeframe.

The satellite has been designed with mobility in mind, with the maritime sector identified by the company as a key future growth area as it looks to pull in a total of $3 billion in incremental revenue by the year 2020 from the Epic fleet as it is rolled out.

Intelsat 29e, the company's first Epic satellite, was successfully launched in January. Photo: ESA

Intelsat Epic is also backwards compatible and fully interoperable with Intelsat's existing satellite fleet and terrestrial infrastructure, which means that ships with existing Ku-band antennas should be able to benefit from improved performance as soon as the satellite is live.

New generation

Intelsat 29e is the 56th Intelsat satellite launched by Arianespace. The 57th, and the second in the Epic series, is Intelsat 33e, which is set to be launched in the third quarter of 2016.

Intelsat 33e will serve Europe, Africa, the Middle East and Asia, which means that Intelsat should be able to cover a significant portion of major shipping routes by the end of the year if all goes according to schedule.

In January, two weeks prior to the launch of 29e, *Digital Ship* was invited by Intelsat to visit the Boeing satellite facilities in El Segundo, California, where the 33e was still in situ as it underwent the final stages of construction before it is prepared for launch in the second half of the year.

During the visit, we spoke to Intelsat chief technology officer, Thierry Guillemin, and senior vice president space systems, Kenneth Lee, about the Epic project, and what this new generation of satellites will mean for end users in the maritime industry.

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"Epic is a new generation of technology from a number of standpoints," explained Mr Guillemin.

"Firstly, it's high-throughput. The six Epic satellites under contract with Boeing represent more throughput than the entire Intelsat fleet to date, of more than 50 satellites. In three years of deployment we will more than double the capacity of the fleet. To give you an order of magnitude of what we are talking about, an Epic satellite is roughly ten times the throughput of an existing Intelsat satellite."

"We're going to get global pretty quickly with Epic, 29e will cover the Americas, Latin and North America, and the North Atlantic Corridor. Intelsat 33e we're going to launch in August, and that's Europe, Africa, Asia and a little chunk of Australia, covering most of the land mass and maritime, like the Mediterranean and the Asian seas. Then we've just signed with our partner JSAT recently for a satellite for the Pacific Ocean region called Horizons 3e."

Two other planned satellites in the Epic series, 35e and 37e, will also be launched within the next few years to offer redundancy and additional capacity.

For Intelsat, backward compatibility for its existing customers, with the ability to use already purchased equipment on its established frequency bands, was a fundamental part of the design strategy for the new constellation – smoothing the path to migration without the need for capital investment by partners or end users.

"Epic is not separated from the rest of the Intelsat fleet, Epic is the evolution of the fleet. Customers who are already on the fleet who have terminals on their ships, can use the Epic capacity with the same terminals, with the same technology, with the same networks," said Mr Guillemin.

"We are using the same frequency as the rest of our fleet, it all stays in Ku-band, or C-band, and we have a digital payload that Boeing is providing that gives us total flexibility in connecting any spot beam with any spot beam in the coverage."

"The Panasonics and the Airbuses have started with us, they are developing their network and capacity on the traditional fleet and will be able to bridge to Epic and provide much higher throughput to their customers with antennas that are already being installed today. It's total continuity. Take any other system, at least from a frequency standpoint, there is disruption. With Global Xpress you go from L-band to Ka-band, O3b is Ka-band."

While end users may not see an immediate boost in bandwidth speeds on their ships when connected to the new Epic satellite, which would be dependent on the specific contract they have agreed with their own service provider, there still should be some immediate benefit felt on board from the increased power available.

"They will have enhanced reliability, because we have more power. So you can degrade more [such as with 'rain fade'] without disrupting the service," explained Kenneth Lee, senior vice president, space systems, Intelsat.

"Power can be used for reliability or more services, so it immediately improves the current situation."

The compatibility strategy also extends to Intelsat's recent investment in One Web, which plans to create a huge fleet of some 900 low Earth orbit satellites for global internet connectivity – a network that Intelsat sees as offering complementary capabilities alongside the Epic constellation.

"We are investors in OneWeb, and OneWeb is in Ku-band as well, so now what you are looking at is terminals that make it possible for customers to ride either our traditional capacity or our high throughput capacity or, if they are in the polar regions for instance, ride on OneWeb – all with the same terminal," said Mr Guillemin.

"That's why we're doing this, we're looking at an ecosystem where everything, from a user standpoint, gives them access everywhere, with high throughput everywhere."

Digital payload

One of the new technologies that has allowed Intelsat to significantly increase the available Ku-band capacity from its Epic class spacecraft in comparison with previous generations is the use of a digital payload on the satellites, rather than analogue.

To use an analogy, the difference between the analogue and digital payloads could be compared to the difference between a mirror and a digital camera – while a mirror, like the analogue satellites, can be used to reflect an image (or transmission) from one place to another, a digital camera allows you to capture that image and manipulate it in a myriad of ways before you send it on to wherever it needs to go.

As such, the new digital payload on the Epic satellites will allow Intelsat significant flexibility in how they process signals, and consequently in how they manage the efficient operation of the network.

The technology has been developed by Boeing, and has mainly previously been used for military projects prior to its inclusion in the design of the Epic series. The satellite manufacturer is currently supplying Intelsat with its sixth generation digital payload, and is in the process of developing the seventh generation.

"I would say it's a first in the commercial industry. What differentiates us from others is that we saw the capability of the technology that Boeing had and we were able to then use that technology for our needs," explained Mr Lee.

"It has never been used in this way before, we're using the technology that has been developed, but with our requirements like backward compatibility, and having an open system. Some of the other high throughput systems are closed, so they manage everything and existing customers can't take advantage of the new system. We wanted to make it backward compatible and able to provide the same type of services that we are providing today."

"This technology allowed us to make that transition, we get a lot of benefits with these new capabilities but at the same time we're still compatible with our existing customers, their existing equipment and their existing services. That was our mission, and we basically scoured the world for technology that would enable us to do that. It took us a few years to figure out how we'd use that capability before we got to the end product we have today with Epic. The technology was Boeing's, how we use their technology is what makes Epic."

Some of the benefits that this might provide include the ability to pass signals between satellites rather than down to gateways and the ability to manipulate the signal if needed, which will help in moving capacity from idle areas to where there is greater demand, thus providing greater throughput to end users.

'In three years of deployment we will more than double the capacity of our fleet' – Thierry Guillemin, Intelsat

"That's the beauty of the digital payload, it gives us the ability to fine tune how you want to use the system, and that creates better economics because in the end you have a better fill factor, better utilisation of the capacity. If you have something that is designed without this flexibility, maybe 30 per cent of your spot beams are in areas where they are not used – and that's 30 per cent of your power that is wasted. It's as simple as that," said Mr Guillemin.

"There is another technology which has changed on Epic, which interestingly existed before but nobody was really using it, and that's to do multi-spot beams in Ku-band. These high throughput systems have started on Ka-band, where it got to a point a few years ago where some people thought 'high throughput means Ka-band'. What makes the systems high throughput is not the frequency band, it's reusing the same bandwidth over and over again, and instead of having global coverage focusing on smaller cells, like the cellular industry."

"If you have smaller spots then you can reuse the same frequency you are using in one spot in another that isn't touching that spot – and then in another and another, and so on. So all of a sudden my 500 MHz that I was limited to before, I can multiply that by 20 because I reuse it twenty times in different places in the coverage. That's what gives you the high throughput, the frequency reuse technology. It has nothing to do with the frequency band, you can do the same thing in Ku-band or C-band, you just build spot beams that are reusing the frequency over and over again."

Broadband applications

One of the longer-term elements of Intelsat's strategy for the Epic fleet is to be part of the broader availability of satellite internet across the globe, with technological advancement helping to bring the cost of both airtime and equipment down to a level that will make broadband at sea and

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in other remote locations much more attractive than it is today.

To this end the company says it is also putting its money behind the development of hardware that will be cheaper and more accessible for those looking to get connected.

"There are a number of applications, particularly in the Internet of Things, where if you do not bring the right economics at the user level your space capacity will not be used. That's where we start realising that we need to invest in ground technology as well," said Mr Guillemin.

"It's not just about a new generation of satellites, it's also looking at the applications end to end. It's our impression that there are a number of areas where the potential users don't know about satellite or don't want to know about satellite – we need to make things transparent and easy for them. A lot of that will be in the terminals, the terminal's the part that's most costly and we really need to go smaller with a better form factor."

"The first step we made in this direction, which was relatively new to Intelsat, was Kymeta, which is a flat panel antenna which can electronically steer towards the satellite it wants to use in orbit (see page 14). So there are no moving parts. We invested $25 million in this Kymeta antenna development, they did not have Ku-band antennas before, they were working for Inmarsat on Ka-band. We invested because we wanted to be exclusive, when you use this Ku-band antenna it's used on Intelsat capacity."

Mr Guillemin points to the recently announced deal between Panasonic and Kymeta for use of this antenna technology as an example of how this exclusive arrangement will work – if Panasonic is using a high throughput Ku-band network with the Kymeta antenna, then they will be using Intelsat capacity (and Panasonic has already agreed a separate deal with Intelsat for Epic capacity through its Avionics division).

"What they (Panasonic) are doing for the moment is with their (Kymeta) antennas, so we had no participation in that. We just wanted to make sure that the next technology of antennas would be made available where it is needed," said Mr Guillemin.

"Connected cars is one area, maritime is another one, and we are looking seriously with Kymeta at Internet of Things applications because there you also need to reduce the form factor, size and cost of the antennas if you look at things like asset tracking, logistics, the connected ship or the driverless car."

Ka competition

The launch of the first Epic satellite came shortly after Inmarsat's announcement at the end of 2015 that it had begun global commercial service on its Global Xpress network, its own high throughput satellite system and the one which Intelsat is likely to be most closely competing with on a global basis.

There are a number of fundamental differences between the two satellite constellations, chief among them being the choice of frequency band, with Inmarsat's Global Xpress (GX) operating in Ka-band, while Epic is primarily a Ku-band system.

The companies also differ on the coverage area of each satellite, and in the design of the networks themselves.

"If you compare it to other systems, the only system that is really global like Epic will be is Global Xpress, from what is in the public domain a Global Xpress satellite has roughly 6 to 10 Gbps throughput, depending on whether you're talking about the commercial payload or also the military side of it. For an Epic satellite you are talking 25 to 60 Gbps of throughput. So it's roughly five times more," said Mr Guillemin.

In comparing Intelsat's plans with the development of GX, he also points to a difference in philosophy when it comes to the coverage areas for these high throughput constellations. While GX has successfully achieved global coverage from three satellites, Intelsat will focus Epic on specific high traffic areas and continue to serve areas of lower demand from its existing satellite fleet.

"What Inmarsat did was spread their throughput uniformly over the globe. We didn't really need to do that because we already had global Ku-band mobility coverage with our traditional satellites, we have 10 satellites that have different pieces of coverage around the globe and we wanted to bring the high throughput where it was needed," said Mr Guillemin.

"We worked from the maps of high traffic routes, both for maritime and aero, and designed the coverage of Epic to focus the high throughput capacity there. For example, over the Atlantic is the North Atlantic Corridor where most of the traffic is, we'll focus there (with 29e) instead of having the capacity spread all over."

"I think that when demand really starts to take off, for maritime for instance you're talking about roughly going from 9 Gbps of global capacity demand to something like 90 Gbps in 2024, this will take off pretty fast. When it does, I think others will have the capacity saturated pretty much right away in the areas where it is needed, where we will have the capacity to go pretty far. I think we stand to capture a lot of the growth that will happen in these markets."

Mr Guillemin suggests that the difference in capacity available from the competing systems is a mixture of the legacy networks the companies have been operating to date, as well as the complexity involved with expanding the coverage regions under the satellites.

"Inmarsat came from a world of narrowband, where you really do not have much capacity to use in L-band, but they were pretty good at making the most of it with technologies that use capacity in very efficient ways," he told us.

"But what you have in L-band is nothing. When Inmarsat designed the system going to Ka-band I think it was plenty of capacity, going from something very little to something very big that was relatively new for them. They went to Ka-band because Ku-band was essentially taken, and I think at the time they designed it in a way that was relatively simple, they just have it global and spread everywhere."

"I think if you come from a broadband world, which was already our case, you know that even if it's broadband you will need to use it efficiently because the demand is constantly growing, so I think we were a little more focused in how we designed our capacity just because we are more used to doing that."

Of course, the throughput available from these new generation VSAT satellites, like their predecessors, can be detrimentally affected by inclement weather, with heavy rain likely to reduce the connectivity speeds that can be achieved, though Intelsat notes that the difference in frequency bands between its system and GX will play a role in their relative performance.

'We wanted to make it backward compatible and able to provide the same type of services that we are providing today' – Kenneth Lee, Intelsat

"All of those comparisons are 'clear skies' comparisons, in addition to that if it starts to rain, which happens quite often in areas that are of interest to maritime customers, then just by virtue of the frequency – we're in Ku-band while Inmarsat is in Ka-band – Ka-band is much more sensitive to weather impairment. It's only temporary but it's an impairment," said Mr Guillemin.

Regardless of the different merits of the competing networks, it is clear that the launch of Intelsat Epic constitutes a major step towards widespread availability of choice in high throughput satellite capacity to the maritime market.

As the increase in capacity builds downward pressure on the cost per bit for communication between ship and shore, and antenna development continues to push capital expenditure to a much more manageable level, the maritime industry may well move that bit closer to the goal of accessible and affordable broadband at sea. DS

Two new VSAT beams for NSSLGlobal

www.nsslglobal.com

NSSLGlobal reports that it has upgraded its VSAT network with the activation of two new beams, one in Ku-band and another in C-band.

The company says that its VSAT network already covers 95 per cent of the Earth's surface, including all of the world's major commercial shipping routes, but this will be extended further by these additional beams.

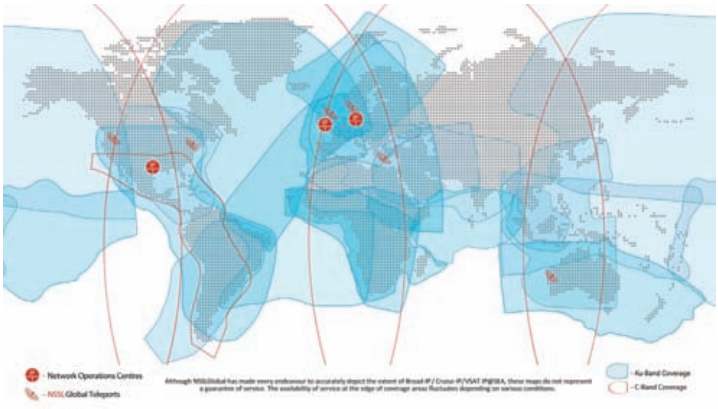
The added capacity will also provide greater service availability for customers by overlapping coverage in key areas.

The new Ku-Band beam went live at the beginning of January 2016 and runs on the Yamal-402 satellite (55° East), covering Sub-Saharan Africa and waters around Madagascar and the Indian Ocean.

The new C-band coverage also went live in January 2016, running on the Intelsat IS-23 (53° West) to give increased capacity and alternative look angles for vessels in the Gulf of Mexico. The beam also covers most of the North and South American mainland, coastal waters to the West of Mexico, and part of the coastline around South America.

"The addition of these new beams highlights NSSLGlobal's ongoing commitment to investing in our fully owned and controlled VSAT infrastructure and giving our customers the industry's best service. Owning our infrastructure gives us the flexibility to cater for every potential client's need, whether that's with off-the-shelf or fully-bespoke products and packages," said Sally-Anne Ray, managing director of NSSLGlobal.

"This differentiates NSSLGlobal from most other providers, allowing the company to deliver world-leading coverage, service and support, and create fully-bespoke VSAT packages for its customers."



NSSLGlobal's VSAT coverage map

"Our new Gulf of Mexico beam will offer vessels a better, more robust service in one of the most crowded shipping areas in the world. The new Ku-beam helps maritime companies to take advantage of faster shipping routes in the Indian Ocean, while maximising satellite coverage uptime. Ultimately we want NSSLGlobal to be known for offering the best, widest and most robust coverage in these strategically important regions."