Data network. Image courtesy of LeoSat

Low Earth orbit – A new era for satellite communications

In the satellite sector, the emergence of a new generation of low Earth orbit (LEO) constellations has been a noteworthy and much debated topic. How will LEO networks transform satellite communications? And what are the market opportunities for the Asia-Pacific region? Ronald van der Breggen, Chief Commercial Officer, LeoSat Enterprises, looks at the requirements for data communications and explains that with the significant advantages provided by low Earth orbit constellations - the time is now right for LEO.

It is widely recognized that the world is increasingly data-driven, cloud-based and trans-national, creating an ever-growing demand to move large quantities of data quickly and securely around the globe. In the last 10 years data usage has exploded, with more data created in the past two years than in the entire previous history of the human race. In 2015, global networks for the first time carried more than 1 Zeta Byte of traffic globally, and this is forecasted to grow exponentially. What is evident is that the creation and consumption of all this data is fast outpacing the infrastructure needed to carry it.

In addition, a new generation of technologies such as IoT and M2M, and a cultural shift toward data-driven decision making and automation continue to drive our dependency on Big Data, and fast and resilient communications networks. Bandwidth requirements are also rising with the demand for always-on connectivity, and businesses are increasingly looking at how technology and connectivity can improve operational efficiency.

With the ever-increasing dependency on Big Data and cyber security this will have a lasting impact on the satellite sector. So, can satellite remain relevant?

Traditional satellites not designed for data

It is true to say that satellite has up until now been viewed as a last resort or gap-filler for data transport as traditional satellite networks operating in geostationary orbit (GEO) suffer from high latency and typically provide little throughput.

Ronald van der Breggen, Chief Commercial Officer, LeoSat Enterprises

While only annoying for voice and video applications, for data communication it is truly a limiting factor in reaching the desired performance or simply a showstopper for certain applications to work. So, whilst GEO remains strong in video, true data-driven applications such as 4G and 5G backhaul, remote management and enterprise connectivity, require a fundamentally different satellite architecture that can solve the issues of latency, throughput, reach, mobility and security. For when data is delayed, even the best algorithms in the world become useless.

Latency matters

Let's look at latency and why is it so important in data transport. Network latency is defined as how much time it takes for a packet of data to get from one designated point to another. Ideally in the world of data, latency needs to be as close to zero as possible in order to create a smooth user experience. For satellite networks, the closer you get to earth, the less latency there is. With LEO satellites orbiting the earth at around 1,500km, that's 25 times closer than GEO satellites (36,000km) and five times closer than MEO satellites (8,000km); the case for using LEO for data networking becomes compelling. These low Earth orbit (LEO) satellites bring latencies down from 500+ms to less than 20ms, and in doing so they can now measure up to the latencies typical for terrestrial infrastructure.

Adapting to a changing connectivity landscape

In addition to the issue of latency, as we move to a more data centric world, the traditional satellite architecture of 'bent pipe' is very much showing its limitations. Bent pipe means that whatever is transmitted to a satellite needs to come down straight away. While this has worked well to connect our continents back in the 1960s and 1970s, and still works well for DTH video applications, it does not work well for data. Using that type of technology for data requires the use of many Earth stations with antennas that are connected to terrestrial infrastructure to carry traffic to its final destination and/or beyond the reach of the satellite. This is suboptimal to say the least, and comes with a great amount of expense and operational requirements. So, while LEO as such will solve latency issues typically associated with satellite, the real game-changer for data will be achieved by stepping away from traditional 'bent pipe' and taking satellites to the next level, to what we call 'spatial networking.'

A new satellite architecture for data

There are a number of new LEO systems in development which will have a positive impact for data communications. Each of these forthcoming systems, be it Oneweb, SpaceX, Boeing, Telesat, bring different capabilities and opportunities for broadband communications. One such system in development is LeoSat, a new network solution with more capacity, but more importantly, also offering new routing and switching capabilities on board the spacecraft, leading to new applications which are not possible using traditional satellite networks.

LeoSat's network consists of a constellation of 78 satellites which form a fully-redundant meshed network interconnected through laser links – effectively an MPLS network of routers in space. This new 'spatial network' is capable of delivering data approximately 1.5 times faster than fibre networks. Data is transferred from satellite to satellite without having to come down to Earth as is required in a bent pipe system. This way, traffic can be sent from where it originates all the way across the globe to where it needs to terminate without touching anything on the ground until it reaches its destination. As obvious as this architecture may sound from a networking perspective, up until now it has not been available for high speed data in the satellite communication industry.

In addition, traditional satellite design only allows for modulation of data in RF, posing limitations for integration with terrestrial networks. In order for satellites to be seamlessly interoperable with terrestrial networks, either MPLS, IP or whatever other standard, the satellites need to support full duplex, and they also need to have routing and switching capabilities, similar to their terrestrial counterparts. With on-board processing (OBP) and MPLS networking as integrated features of the new LEO systems, they will be able to operate as a full-duplex, spatial extension to terrestrial networks that can carry traffic to any place on Earth, from pole to pole and from land to sea. With LEO bringing all of the above advantages to the satellite market, allowing satellites to go beyond their traditional role of 'gap-filler,' LEO systems will actually start to become a technology of choice for data communications.

Opportunities for the Asia-Pacific

What can a new LEO data network offer Asia? In sectors such as telecommunications, multi-national enterprise, government services, maritime and energy, LEO systems can solve essential communications and connectivity issues and meet the ever-growing demand to move large quantities of data quickly and securely around the world. For a typical Fortune 1000 company, just a 10 percent increase in data accessibility will result in more than US$65 million additional net income. The key attributes of a system in low Earth orbit can be used for a number of applications, for example, to provide 4G and 5G satellite backhaul to the cellular industry, give banks secured networks with their foreign offices, provide enormous uploading bandwidth required for oil and gas exploration, or allow Internet access to passengers on cruise ships. LEO will not only provide a competitive advantage in the existing satellite services market, it will help to expand these markets by enabling new opportunities through previously unavailable levels of performance with true worldwide reach.

Increased capacity for cellular backhaul

As cellular protocols become more and more sophisticated and cellular use accelerates, there is an ever-increasing need to transport cellular signals for long distances, at high speeds, in high volumes and in its native form. These growing backhaul needs are not being met by current terrestrial networks, and existing and planned satellite networks are too slow and the bandwidth too limited. For existing and emerging market telecom operators, LEO offers significant advantages as its latency, timing and transport are in compliance with the network standards of the newer 4G, 5G and LTE cellular systems. And with the continued growth in Internet use, streaming media, Smart phone use, mobile apps and the IoT, the low latency of the LEO systems will become an increasingly attractive alternative to the high latency of GEO systems.

Secure, high-throughput, resilient network for governments

Governments are increasingly looking to the commercial satellite sector and next-generation satellite constellations to provide the innovative and resilient communications infrastructure they need. The military and government sector relies on a number of key attributes when it comes to communications networks. Critical operations require bandwidth intensive applications, near real time command and control and advanced sensor capabilities. The proximity LEO satellites have to the Earth translates into lower latencies and better data rates. Security and resilience are also key attributes and with a 'touchless architecture' - taking traffic in its native form and carrying it from any point on Earth to any other point on Earth without touching the Earth's surface in between, and therefore completely isolated from any terrestrial infrastructure – this is an enormous advantage to the military. And for embassy communications, rooftop-to-rooftop without any terrestrial touchpoint in between, means an ultra-secure, resilient communications network.

Seamless, global connectivity for maritime communications

Maritime operators face significant problems getting adequate broadband networks to interlink ships to each other and to a main office and to serve the ever-increasing data and Internet needs of passengers and crew. On cruise lines, passengers are demanding more and more bandwidth to power consumer devices and for Internet access. Existing satellite systems, most of which can only illuminate limited portions of the Earth from GEO or MEO orbits, cannot satisfy these needs**.** A LEO system with interconnected satellites can bring ships 'on-net,' regardless of their global position, just as if they were a local network node enabling operators to leverage the new 'Smart Ships' digital infrastructure where cloud-based operations will reduce average load of the ships and improve efficiency, operational effectiveness and safety as well as providing new business opportunities.

LEO and GEO – A perfect partnership

With the increasing rise of data traffic and the continued globalization of business, low Earth orbit systems can be viewed as a new way to expand the traditional satellite market by filling the space between satellite and fiber. And with these new LEO solutions come a host of new opportunities for the data and mobility markets in Asia and around the world. From government applications to corporate networks, and from cellular data solutions to the maritime sector: All markets present the need for fast, secure, low-latency communications.

With companies such as LeoSat combining the speed of fibre with the ubiquity of satellite, a new communications paradigm is created, shifting the perception of satellites from a last resort option to a first choice for data transportation. In this light, there is a growing trend whereby FSS operators, looking to complement and expand their capabilities are partnering with LEO/MEO satellite operators to provide combined GEO/LEO/MEO data services that cannot be supported by GEO alone (SES/O3B, Intelsat/Oneweb). Most recently SKY Perfect JSAT in Japan has invested in LeoSat, and can now offer the market enterprise grade, low-latency, extremely high-speed and secure data services worldwide. ■

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