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Provision of Cellular backhaul connectivity via Satellite through VSAT under commercial VSAT CUG Service Authorization – Consultation Paper 02/2020

Dear Sir,

SES S.A. ("SES") is pleased to submit its comments on the Telecom Regulatory Authority of India's (TRAI) Consultation Paper on the "Provision of Cellular backhaul connectivity via Satellite through VSAT under commercial VSAT CUG Service Authorization," issued on 29 January 2020.

SES is a global satellite operator with a fleet of over 70 satellites in geostationary (GEO) and non-geostationary (non-GEO) orbit. For 20 years, SES affiliates have reliably supported the Indian Space Research Organization (ISRO) in the supply of satellite capacity to India's VSAT operators, and cellular operators through Antrix Corporation and now New Space India Limited. As India pursue its 2022 Connect India goal of providing all Indians with 50 Mbps of broadband connectivity, SES stands ready to help meet this demand by augmenting ISRO's impressive High Throughput Satellite (HTS) capacity with additional GEO capacity (e.g. SES-12 HTS), as well as the unique non-GEO offerings of its innovative O3b medium Earth orbit (MEO) constellation.

Cellular Backhaul via Satellite

In general, SES supports changes to the Indian licensing regime that would enable more flexible and efficient use of satellite VSATs for the provision of cellular backhaul, including allowing VSAT CUG licensees to offer such services and allowing the use of a shared hub to support backhaul and broadband Internet. If India is to achieve its 2022 Connect India goals,[1] a full range of technologies – fixed line, mobile, microwave and satellite – will need to be marshalled. A flexible regulatory

[1] *See* Digital National Communications Policy, 2018, at p.5.

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framework that enables all of these technologies to work together to deliver competitive solutions will be essential if those goals are to be achieved.

Based on its global experience, SES can attest that cellular backhaul via satellite is a cost-effective and efficient solution. SES has helped many mobile network operators (MNOs) in many different countries to upgrade their networks from 2G up to 4G-LTE, and to accelerate network coverage to previously unserved or underserved areas. Recently, SES has worked with MNOs and local service providers to use a mix of technologies – e.g., a combination of SES's GEO and MEO assets, terrestrial microwave links, and mobile base stations – to cost effectively deliver upgraded mobile broadband services to previously unserved or underserved areas. A few of our success stories include:

- Brazil – SES's O3b MEO solutions helped mobile operator TIM to expand coverage of its 4G-LTE network.[2]
- Democratic Republic of Congo – SES's GEO and MEO solutions, though a local partner, helped mobile operators, such as Orange DRC, to deploy a resilient 4G network, with support for cloud computing services.[3]
- Chad – SES's GEO and MEO solutions helped mobile operator Tigo to upgrade its 2G network to 3G/4G and to provide coverage in previously unserved areas[4]
- Peru – SES's O3b MEO capacity helped mobile operator Entel provide 4G-LTE service in Iquitos, Peru's sixth largest city at the edge of the Amazon rainforest.[5]
- Malaysia – SES's GEO backhaul solution helped expand the coverage of mobile operator Digi's 3G network.[6]
- Myanmar – O3b MEO aggregated backhaul solution helped upgrade and extend Telenor Myanmar's 3G and 4G networks to previously unserved areas.
- Digicel Pacific – high capacity O3b trunks enabled mobile operator Digicel to upgrade its mobile networks in the Pacific Islands to 3G and 4G.[7]

Opportunities in India for Cellular Backhaul via Satellite

In SES's view, there are opportunities in India to deploy advanced satellite backhaul solutions to help expand mobile broadband coverage, including places such as the Andaman & Nicobar Islands (ANI) and the Northeast. India's licensing framework should enable and facilitate such solutions, rather than inhibit by requiring duplicative infrastructure.

SES's GEO- and MEO-enabled solutions enable backhaul from individual cell towers/eNodeBs as well as aggregated backhaul from multiple eNodeBs. For example, VSAT backhaul can be efficient

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[2] https://www.ses.com/blog/lte-now-made-available-anywhere.
[3] https://www.ses.com/press-release/sess-and-gilat-telecoms-resilient-network-restores-connectivity-africa.
[4] https://www.ses.com/case-study/delivering-managed-mobile-backhaul-chad.
[5] https://www.ses.com/case-study/delivering-4glte-services.
[6] https://www.ses.com/pt/node/9176.
[7] https://www.businesswire.com/news/home/20160519005414/en/Digicel-Pacific-Upgrade-O3b-Networks-Capacity-Marks.

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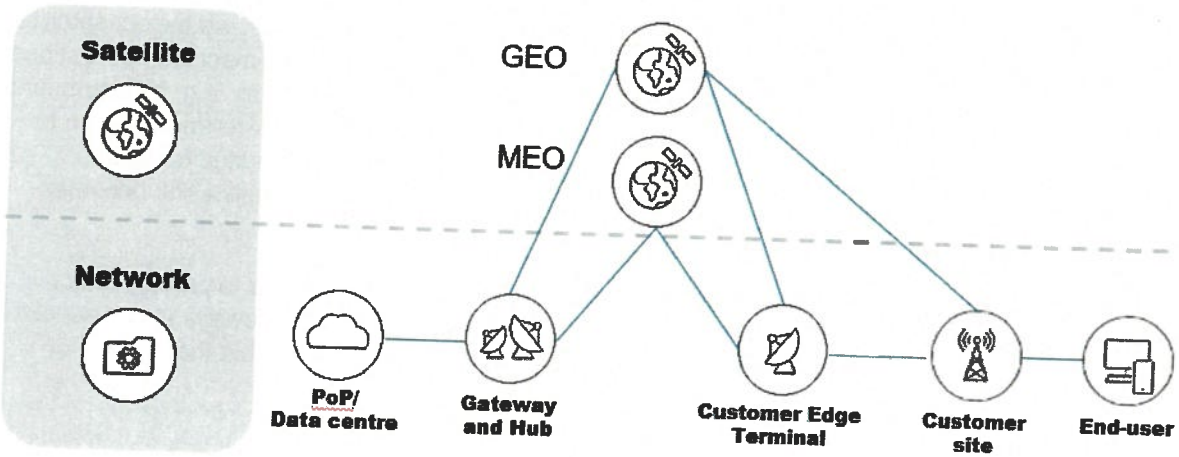
from individual eNodeBs in areas with low- to moderate- data bandwidth demands (e.g. 3-10 Mbps) distributed across the wide geographic coverage of GEO satellites. For higher demand areas, it may be more efficient to aggregate the mobile traffic from multiple eNodeBs via, e.g., microwave fixed links to a single satellite backhaul site where a single, high-capacity VSAT can be used to carry traffic to the core network and back.

In the context of aggregated backhaul, SES's O3b MEO satellites offer a unique solution with 10 steerable beams on each of 20 satellites in the constellation, up to 1.6 Gbps of throughput per user spot beam, and low latency of about 150 milliseconds. In a typical O3b backhaul configuration, the 4G traffic from multiple eNodeBs would be aggregated at one or more VSATs within an O3b spot beam. The spot beam would then carry the aggregated traffic to a one or more gateway hubs located in India, enabling a fully secure backhaul solution. If more capacity is required, additional spot beams can be steered over the VSAT locations. SES MEO backhaul solutions can be deployed on a standalone basis, or in combination with GEO capacity provided by SES and/or another satellite operator.

Figure 1 – Illustration GEO and MEO backhaul solutions



Shared Infrastructure and Multi-tenancy

MNOs may also be able to share the cost of advanced satellite backhaul solutions – e.g. by sharing the hub and/or the VSAT aggregation point for multiple eNodeBs – especially when none of them alone have the subscribers in an area to justify the build-out investment. This shared satellite infrastructure could be operated by a third party, e.g. a Commercial VSAT CUG licensee, that is not affiliated with any of the MNOs, thus alleviating the anti-competitive risks associated with sharing. SES would encourage India to evolve its regulatory framework to accommodate such cost-effective solutions.

The Future – Satellite Backhaul for 5G and Cloud Computing

TRAI recognizes that satellite is expected to remain a relevant technology for cellular backhaul in the future, and that MNOs will continue to rely on a variety of different techniques for backhaul to suit different scenarios. Indeed, SES believes that satellite can play a larger role, if given the chance. We have demonstrated with our GEO and MEO solutions that satellites can support not just low-moderate

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capacity tower backhaul applications; they can also support the expansion of high-capacity 4G-LTE networks using such techniques as aggregate backhauling. We are also taking steps to ensure that satellites will remain an attractive and competitive option in the future.

First, we are building more HTS and next-generation Very High Throughput Satellite (VHTS) systems to support the expected growth in broadband demand. ISRO itself is building multiple GEO HTS systems to satisfy growing demand. Besides SES-12 and O3b, SES will be launching its next-generation O3b mPower MEO constellation in 2021 with even more throughput and more flexibility. Other satellite companies, such as Intelsat, Inmarsat, Hughes, and ViaSat, have launched or are planning to launch HTS and VHTS systems in a variety of frequency bands. In addition, new non-GEO constellations from companies such as OneWeb, SpaceX and Telesat are being launched to provide global broadband connectivity.

Second, we are working to ensure that satellites can be seamlessly integrated into 5G mobile networks and support all of the expected 5G network functionalities. For example, SES is part of the European Commission's "SaT5G"[8] and the European Space Agency's "SATis5"[9] programmes. Under these programmes, we have successfully demonstrated on multiple occasions the integration of satellite backhaul solutions in 5G networks, including support for software-defined networking, network function virtualization and multiple-access edge computing.[10] As a result, we expect satellites to be able to support the enhanced mobile broadband and massive machine-to-machine applications in 5G. We also expect satellites to be able to support low-latency 5G applications, e.g. by distributing commonly accessed content to multiple edge caches over a large area for quick re-transmission to the end user upon demand. The wide coverage of satellites is particularly well suited for such "broadcast"-like applications. In such architectures, the higher latency of the satellite link becomes irrelevant to the user experience.

Finally, satellite operators and cloud computing companies are working together to provide direct connectivity to the global intelligent cloud platforms, e.g. by placing satellite gateways at or near cloud computing data centres.[11] The initial focus of these cloud partnerships is to enable the Internet of

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[8] https://www.sat5g-project.eu/
[9] https://satis5.eurescom.eu/
[10] *See* K. Liolis, J. Cahill, E. Higgins, M. Corici, E. Troudt and P. Sutton, "Over-the-Air Demonstration of Satellite Integration with 5G Core Network and Multi-Access Edge Computing Use Case," 2019 IEEE 2nd 5G World Forum (5GWF), Dresden, Germany, 2019, pp. 1-5, *at* https://ieeexplore.ieee.org/document/8911717. *See also* https://www.sat5g-project.eu/sat5g-industry-day-27-november/; https://satis5.eurescom.eu/2019/11/13/satis5-demonstrates-at-the-10th-anniversary-fuseco-forum-of-fraunhofer-fokus-in-berlin/; https://www.ses.com/newsroom/accelerating-5g-roll-out-satellite; https://www.esa.int/Our_Activities/Telecommunications_Integrated_Applications/Satellites_bring_multi-faceted_5G_to_Barcelona; https://satis5.eurescom.eu/2018/11/21/space-enabled-internet-of-things-at-berlin-5g-week/; https://www.sat5g-project.eu/eucnc-2018-in-ljubljana-18th-to-21st-june/; https://www.idirect.net/2019/06/19/sat5g-project-announces-successful-demonstrations-of-5g-over-satellite-use-cases-at-eucnc-2019-event-in-valencia/.
[11] *See, e.g.*, https://azure.microsoft.com/en-us/blog/satellite-connectivity-expands-reach-of-azure-expressroute-across-the-globe/; https://www.inmarsat.com/press-release/inmarsat-and-microsoft-azure-iot-join-forces-to-deliver-cloud-services-via-satellite/; https://www.ibm.com/cloud/blog/improve-

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Things, which is one of the key applications of 5G networks. Such direct connections to the cloud can also be used to enable the edge computing capabilities that are anticipated in 5G networks.

Conclusions

For all of these reasons, SES would support changes to India's licensing framework that enable greater and more flexible use of satellite VSATs for cellular backhaul under the Commercial VSAT CUG Service Authorisation. Satellite connectivity will help ensure that the benefits of broadband can be enjoyed by all Indians, and not just those in well-connected urban and semi-urban areas. A regulatory framework that enables the simple, flexible and cost-effective deployment of satellite connectivity solutions will be essential to help bridge the digital divide in India.

Please contact the undersigned if you have any questions about this submission.

Yours Sincerely,

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digital-experiences-with-ses-networks-and-ibm; https://awsinsider.net/articles/2020/01/28/aws-iridium-satellite-iot-launches.aspx.

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