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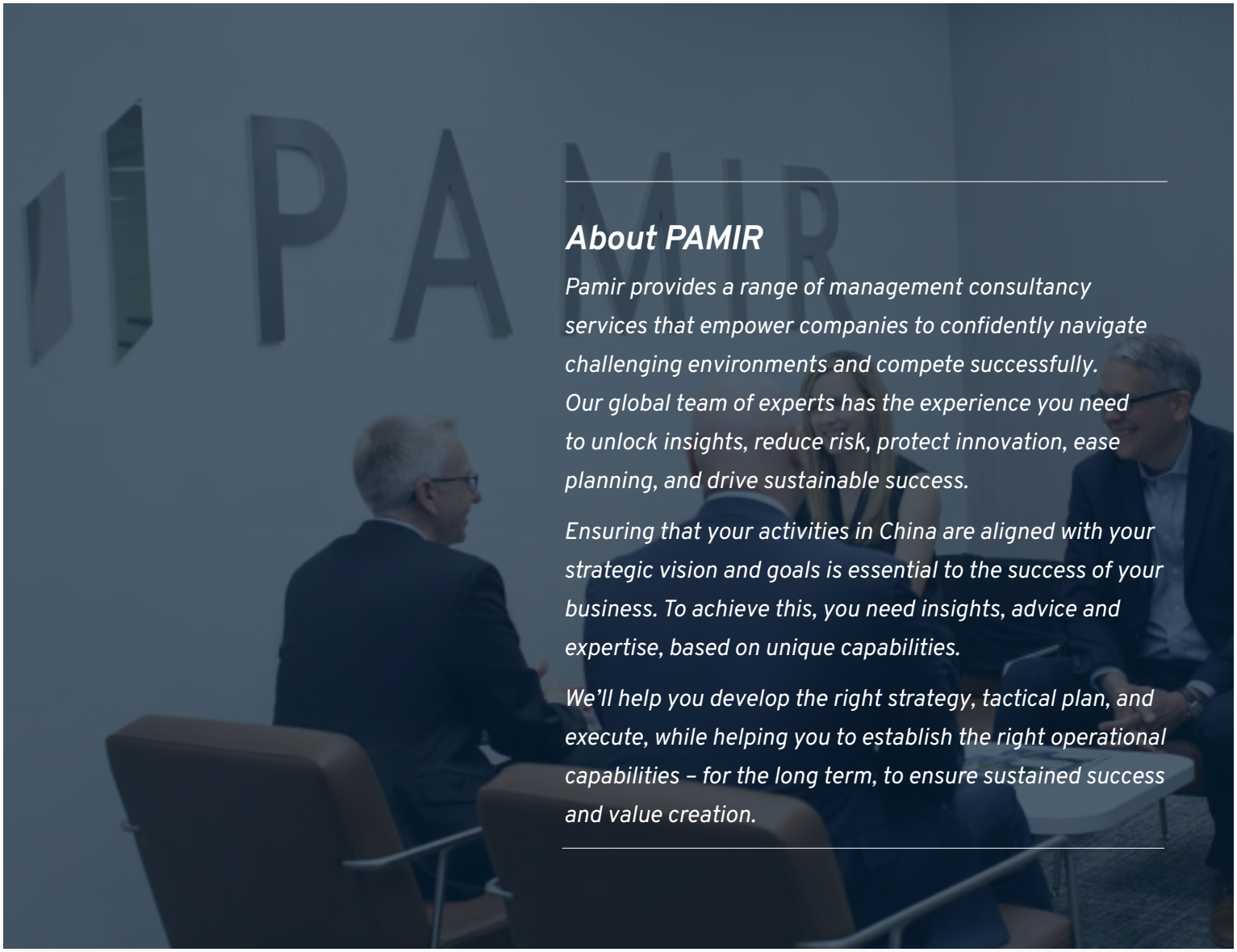
The risk and opportunity of satellite 5G services

A Pamir analyst paper



About PAMIR

Pamir provides a range of management consultancy services that empower companies to confidently navigate challenging environments and compete successfully. Our global team of experts has the experience you need to unlock insights, reduce risk, protect innovation, ease planning, and drive sustainable success.

Ensuring that your activities in China are aligned with your strategic vision and goals is essential to the success of your business. To achieve this, you need insights, advice and expertise, based on unique capabilities.

We'll help you develop the right strategy, tactical plan, and execute, while helping you to establish the right operational capabilities – for the long term, to ensure sustained success and value creation.

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The risk and opportunity of satellite 5G services

Satellite services direct to unmodified 5G smartphones, as well as IoT devices and machines, are in their infancy, but a host of satellite service providers and MNOs view it as the 'holy grail' of 100% mobile coverage. However, with this opportunity comes security risks, and may require further de-risking from China and other potentially malicious actors.

Cellular and satellite connectivity are converging

On 8 September 2023, the first ever satellite-based voice call was made between two unmodified 5G Samsung S22 smartphones. The call was made between two AST SpaceMobile engineers – one in a coverage dead zone in Hawaii, the other based in Madrid. The call lasted two minutes and was carried via AST SpaceMobile's Bluewalker 3 (BW3) low Earth orbit (LEO) test satellite using AT&T's 5G spectrum and its Terrestrial Network (TN) in Spain.

In a separate test, AST and AT&T also broke the record for satellite download speeds at 14 Mbps – previously 10.3 Mbps over 4G LTE – which is enough for video streaming, downloading files, and Internet browsing. Previously, in April 2023, AST held the first satellite phone call using AT&T's 2G spectrum.

AST rival Lynk, meanwhile, claims it has "video proof" of a series of the first-ever satellite two-way calls via its own Lynk Tower 1 in July. However, these appear not to have been made over 5G.

Lynk describes itself as a sat2phone telecoms provider, and was the first to deploy a commercial cell-tower-in-space. It was also the first company to gain a Federal Communications Commission (FCC) commercial license for a satellite-direct-to-standard-mobile-phone service.

ACCORDING TO THE INTERNATIONAL TELECOMMUNICATION UNION

35%

OF THE WORLD'S POPULATION DO NOT HAVE ACCESS TO INTERNET SERVICES

SELECTED OPERATOR-SATELLITE PROVIDER PARTNERSHIPS

SpaceX and T-Mobile

Starlink is SpaceX's internet mega-constellation, which currently consists of more than 4,000 operational satellites and it started rolling out its powerful V2 Mini satellites earlier this year. While it does not currently offer direct-to-5G phone, it announced on 13 March 2023 that itself and T-Mobile would start testing its Starlink satellite-to-cell service shortly.

AST SpaceMobile and AT&T

AST and AT&T are notable in making the first ever satellite-5G voice call on unmodified Samsung S22 devices in September this year. The call was made using AT&T's 5G spectrum and its Terrestrial Network (TN) in Spain. In May the two partners announced, in an FCC filing, that AT&T would lease some 850 MHz cellular A and B block spectrum, as well as some lower 700 MHz B and C block spectrum, to AST. AST plans to start launching its new satellites – known as BlueBirds – early in 2024. They will be launched through a share deal with SpaceX's rocket, and AST expects to require around 1,000 satellites for 100% global mobile coverage.

Telstra and OneWeb

On 19 June 2023, Telstra and OneWeb announced that they have agreed commercial terms to start moving hundreds of existing remote mobile base stations currently using satellite backhaul to OneWeb's LEO solution from later this year. In time it will provide 25 Gbit/s of LEO capacity to Telstra's most remote mobile customers in Australia, providing voice and video calling. Notably, however, OneWeb is in the process of being acquired by Eutelsat.

Telefónica and Sateliot

In July, the two companies demonstrated 5G roaming with a regular SIM-enabled unmodified IoT device between Sateliot's LEO 5G IoT constellation and Telefónica's TN – the demo was witnessed by the European Space Agency. The companies were able to switch the IoT devices seamlessly between the two networks and used Sateliot's two-step authentication method to support standard roaming between an MNO and an NTN.

Satellite-to-phone represents the 'holy grail' for MNOs

What is not in doubt is that satellites (and particularly satellite-direct-to-phone services) currently represent the 'holy grail' for both satellite comms providers, and operators and MNOs.

They are looking to partner with satellite companies as they look to reap the rewards of potential 100% coverage globally, in turn unlocking the Global South digital divide.

Conversely, satellite providers need to partner with MNOs in order to gain or share spectrum, and to gain income by demanding payment for satellite connectivity services from MNOs.

Surprisingly, according to the International Telecommunication Union (ITU), an estimated 2.9 billion people – 35% of the world's population – do not have access to internet services, while an estimated 19 million Americans – 6% of the population – still lack access to fixed broadband service at threshold speeds. Coverage gaps still exist in Europe, Asia, Africa, and South America.

Of course, satellite-backed 5G (and 6G) connectivity could also enable estates of devices, for example cargo on ships, remote wind farms, and machines (6G is likely to enable the latter with applications such as self-driving vehicles).

Network of networks

Importantly, satellite connectivity – via a mix of LEO, MEO (medium earth orbit), and GEO (geostationary) – is a key enabler for 5G and is an integral component of the latest 3GPP standards. It means that a new combination of Terrestrial Networks (TNs) and Non-Terrestrial Networks (NTNs) will supplement the now familiar mix of PLMNs and NPNs. Furthermore, satellite is considered necessary for the evolution towards 6G, so the two sectors that have previously been largely separated are rapidly converging.

This 'network of networks' – terrestrial and non-terrestrial – will combine fixed, terrestrial mobile, and satellite constellations (arrays of satellites that form a single network) to provide globally available, high-speed, high-capacity connectivity. Not only will this require a new era of partnerships and openness between players to ensure innovation, but also the development of open standards.

Notably, advances are being made in satellite-direct-to-phone technologies – as highlighted by SpaceMobile's recent call. Satellite connectivity will be embedded in handsets (although unmodified devices have been proven to work – and in devices, eliminating the need for additional equipment, such as a satellite dish.

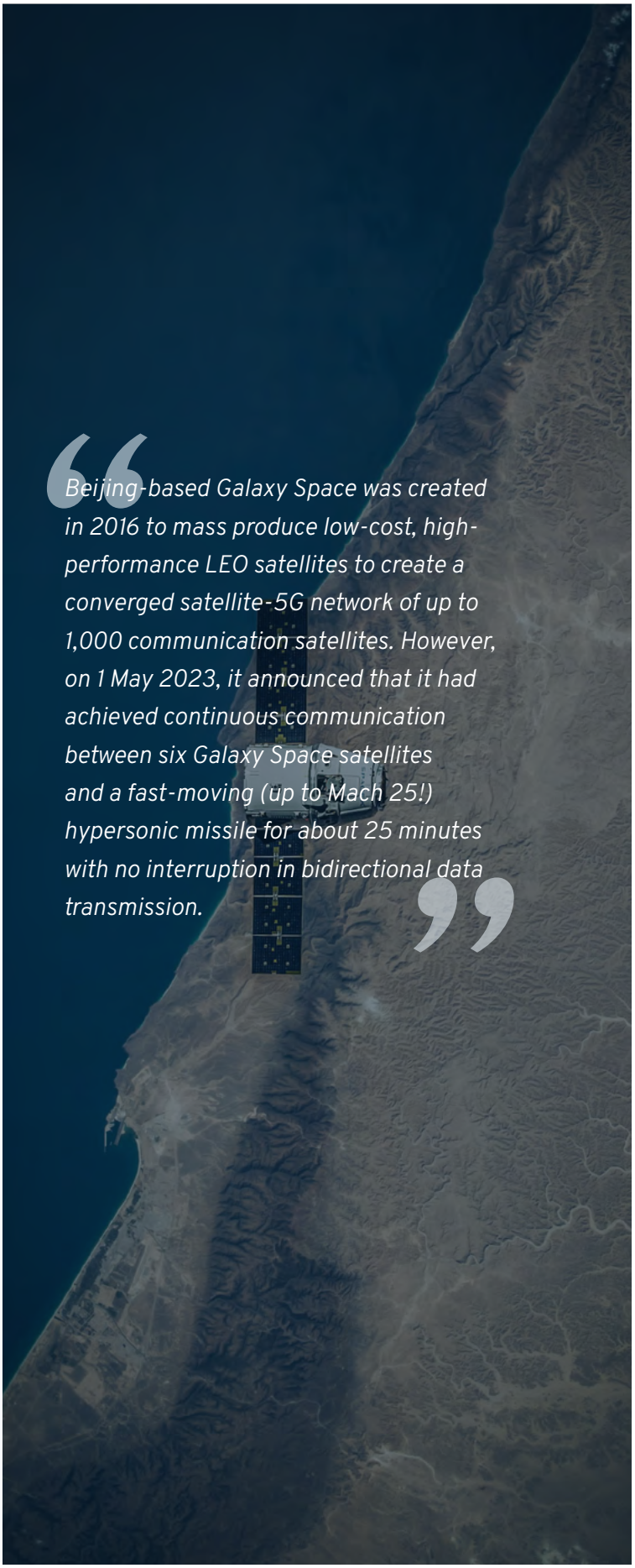
China. Satellite-5G networks. High-risk vendors

The end goal of this global network will be to provide ubiquitous global coverage – not just for voice services, but also data-heavy applications (particularly as we reach 6G). Users will essentially be roaming between fixed, mobile, and satellite networks and most likely without being aware of it.

However, this brings us to the thorny issue of how high-risk vendors (HRVs) will be dealt with. For example, on 7 September 2023, Hong Kong-based Silkwave announced that it had started to actively deploy a converged satellite-5G mobile network for "multimedia, communication, broadcasting, and navigation services for vehicles, smartphones, and IoT edge devices".

The end-to-end satellite-5G platform will combine LEO, GEO, and the mobile broadcasting satellite, AsiaStar, to create (what Silkwave claims) will be the world's first GEO-LEO-5G network. The initiative is part of China's 'Belt and Road' strategy – of which the Digital Silk Road strategy is a core component – and will bring three core use cases (satellite-to-vehicle infotainment and telematics; satellite-to-device communications; and satellite-to-IoT) to China, the Association of Southeast Asian Nations, India and Pakistan.

It's not the first such satellite constellation developed by Chinese companies, and the threat is not just confined to HRVs in the network infrastructure. Beijing-based Galaxy Space was created in 2016 to mass produce low-cost, high-performance LEO satellites to create a converged satellite-5G network of up to 1,000 communication satellites. However, on 1 May 2023, it announced that it had achieved continuous communication between six Galaxy Space satellites and a fast-moving (up to Mach 25!) hypersonic missile for about 25 minutes with no interruption in bidirectional data transmission.



A new risk surface in the sky?

But back to HRVs. Many governments (the US and allies) have already embarked on a strict policy of removing or eliminating Chinese telecoms and technology vendors, most famously Huawei, from their infrastructure. Some Western enterprises are even isolating networks that contain Chinese equipment from their other networks.

Once converged satellite networks are in place, it means that the satellite effectively becomes another RAN access point. The latest 3GPP standard, Release 17 version 3, finalized earlier this year is aimed at the 5G era, but also includes new standards for satellite networks, IoT-NTN and New Radio NTN or NR-NTN (where NTN means non terrestrial networks, as opposed to today's largely land-based mobile networks, or terrestrial networks in the new taxonomy). However, Release 18 (known as 5G Advanced) will also bring further enhancements to NTN, including aggregation with other frequency channels.

At that point, SIM-based satellite access combined with 5G (and 6G in future) will enable a seamless channel for global cellular communications.

It means that consumer and IoT devices will be able to connect to either TNs or NTNs. If one of the NTNs is Chinese (as per 3GPP alignment) then the device may not necessarily be aware. Could Chinese constellations provide LEO connectivity to, for example, Africa? Could Chinese operators become the default backhaul and wholesale connectivity enabler?

If Western democracies are concerned about removing Chinese suppliers from the RAN and core network, what implications does shifting to satellite (where the LEO-based satellite is the RAN) mean when new constellations may be (directly or indirectly) under the control of a foreign power? Or, if one of the providers could be classified as an HRV?

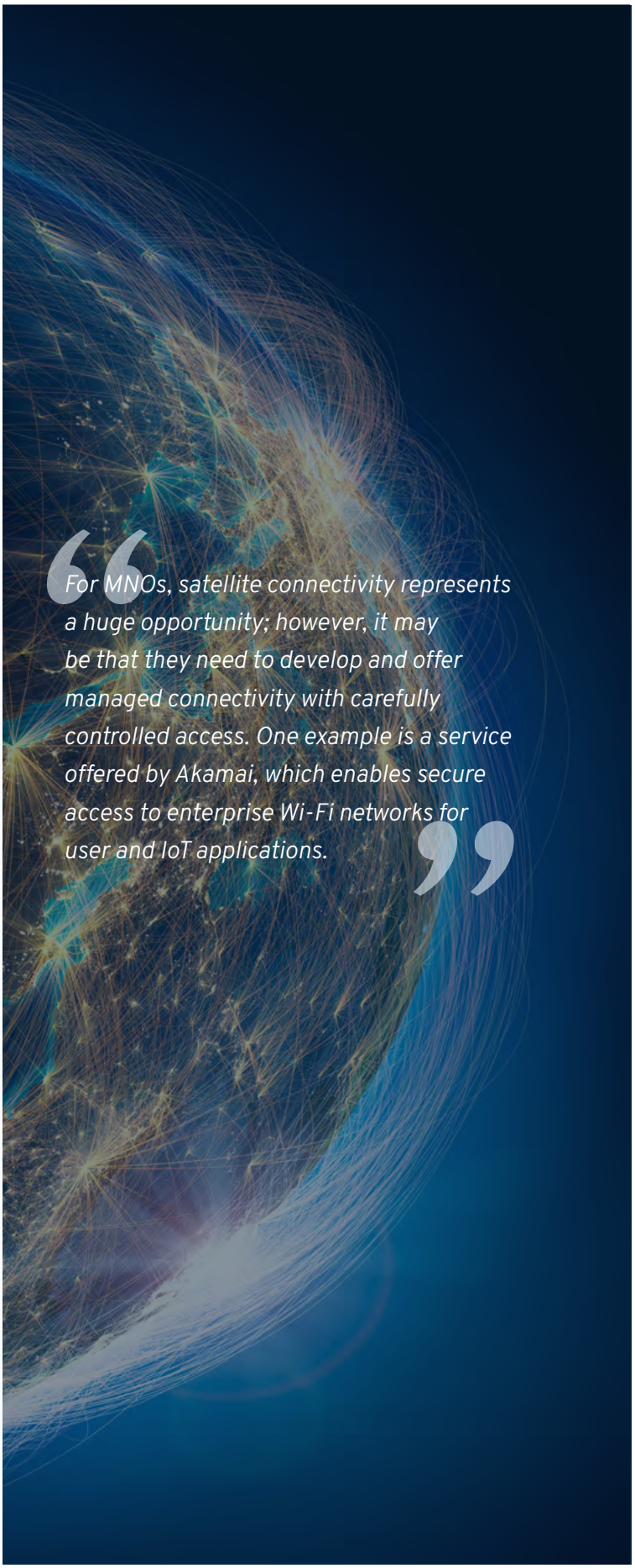
Satellites will enable 6G

On 22 June 2023, during Indian Prime Minister Narendra Modi's visit to Washington, India and the U.S. launched public-private Joint Task Forces – one for the development and deployment of Open RAN systems and the other on advanced telecoms research and development. India's Bharat 6G and the U.S. Next G Alliance will co-lead this public-private research.

The Bharat 6G Alliance was launched by India's Department of Telecommunications on 4 July 2023, following the visit. The alliance aims to "drive innovation and collaboration in next-generation wireless technology." The alliance provides a collaborative platform for public and private companies, academia, research institutions, and standards development organizations.

Essentially, India is pitching the U.S. for co-operation with 6G development. However, it is important to note that India does not necessarily align with China's policies, as reflected by tensions between the two nations at the recent BRICS summit. It is also important to note that, so far, no Indian companies are on either the U.S. 'Entity List', or the UK's HRV list.

However, it still leaves the issue of how mobile operators and satellite service providers can ensure that satellite networks, for example from China, remain partitioned from SIM-based smartphone-satellite roaming. More importantly, how will enterprise users protect data, both from user devices and IoT solutions that could be widely distributed?



De-risking the network of networks with policy and access control?

While there is no direct solution to this, so far, and the scenario remains to unravel, there are a few options. For example, governments might enforce satellite-5G access via approved networks There is no point removing equipment from TNs if users can simply connect to networks when roaming or when switching to NTNs, which may contain HRVs.

A further option might be to develop innovative new security and policy control mechanisms to control / limit access to NTNs and PLMNs, where there is equipment from HRVs. However, this would be technically challenging and complex – but enterprise needs could demand such solutions, which would, in essence, be similar to those in which policy control is applied to permit (or deny) access to enterprise Wi-Fi networks, providing an additional layer of security above SIM-based authentication.

It may even be that control is pushed down to the enterprise level, whereby companies may seek to prevent devices under their control from connecting to such networks, which feeds into the concept of de-risking (as opposed to de-coupling). As noted earlier, enterprises are already isolating network infrastructure that contains Chinese equipment, so it would make no sense to do this, if employees can simply connect to a NTN that may contain HRVs.

For MNOs, satellite connectivity represents a huge opportunity; however, it may be that they need to develop and offer managed connectivity with carefully controlled access. One example is a service offered by Akamai, which enables secure access to enterprise Wi-Fi networks for user and IoT applications.

The service is based on policy control and managed access using SIMs and user credentials to enable access to the local Wi-Fi network and is offered by MNOs to their B2B customers and to provide additional layers of security while facilitating access from authorized users and devices, because it avoids separate registration to the Wi-Fi network, as the SIM can be used to initiate the sign-on process.

Such a service could serve as a model for providing mechanisms to manage satellite 5G connectivity – and enable organizations to validate the network to which a device may seek to attach in a dynamic manner.

Conclusion

At this point in time, companies, governments, and organizations are still grappling with the concept of de-risking and how it can be applied to technological advances, without stifling innovation. Mobile connectivity to NTNs represents uncharted territory in this regard and, hence, risk which remains to be explored in full. In this paper, we have identified one such potential risk. Doubtless more will be discovered, as media scrutiny turns, not to the ability to use satellite seamlessly for mobile, but rather to the implications of doing so.

It is essential, though, that this aspect is carefully considered as the technology (satellite-5G) continues to be developed and commercially deployed – before the RAN moves into the stars. Watch this space – and depend on Pamir's expertise as we track this emerging risk surface.

Glossary

3GPP	Third-Generation Partnership Project, a standards development organisation
4G	Fourth generation mobile technology
5G	Fifth generation mobile technology
6G	Sixth generation mobile technology
GEO	Geostationary Equatorial Orbit
HRV	High-Risk Vendor
ITU	International Telecommunication Union, an agency of the United Nations
LEO	Low Earth Orbit
LTE	Long-Term Evolution, a radio technology that meets the performance requirements for 4G
MEO	Medium Earth Orbit
MNO	Mobile Network Operator
NTN	Non-Terrestrial Network
PLMN	Public Land Mobile Network
RAN	Radio Access Network, the wireless element of a cellular network to which mobile devices connect
SIM	Subscriber Identity Module, a physical or virtual component of a mobile device which uniquely identifies and authenticated the user when connecting to mobile networks
TN	Terrestrial Network

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