Secure SD-WAN for Satellite Operations

Protect your cloud data with unparalleled visibility and control!

Satellite connectivity provides ubiquity and flexibility that other transport methods cannot match. Versa Secure SD-WAN provides intelligent security and agility to optimize these networks, with support for use cases in Defense, Maritime, Oil & Gas, and many other vertical industries.

Introduction

Satellite networks provide connectivity around the world in places that terrestrial networks cannot reach, including oceans, aircraft, remote or inhospitable locations, and regions impacted by war or natural disaster. Satellite operators connect users who cannot use other methods due to their remote location or mobility requirements. Satellite connectivity is also crucial when connecting IoT (Internet of Things) devices and mobile backhaul networks, thanks to its increased reach. Satellite networks are also used to operate in Denied, Disrupted, Intermittent, and Limited Impact (DDIL) conditions that require special treatment to achieve the desired secure connectivity.

This extra flexibility and coverage that comes with satellite connectivity is not without trade-offs. Satellite networks have higher latency and lower available bandwidth compared to wired or LTE connectivity. Moreover, satellite connectivity is more expensive compared to other means of connectivity.

SD-WAN has emerged as a critical architecture that enables satellite users to make the most out of their connectivity. The rise of managed solutions and multi-orbit networks also highlights the benefits of combining modern satellite networks with the Versa SASE solution, including Secure SD-WAN and integrated network security.

This solution brief will explore the main challenges of deploying satellite networks in the modern world and the relevant features in the Versa SASE solution that enable customers to optimize and secure their satellite networks. First, it will cover how Versa Secure SD-WAN provides advanced traffic engineering features to perform intelligent link bonding between potentially diverse transport systems, integrating them into a seamless network for the end customer. Also, the network operator can match applications to the path that most closely matches the needs of the traffic patterns as well as provide resilience options.

Then, it will review how Versa integrates advanced networking functions like TCP Optimization and Hierarchical Class of Service. These features help improve the user experience even in environments with high latencies, packet loss or congestion.

Furthermore, it will explore how our integrated security stack and the flexibility of running security functions in our Versa Cloud Gateways allow customers to reduce their network sprawl and consolidate their services.

Finally, it will talk about our Zero Touch Provisioning capabilities that enable our customers to deploy network endpoints even in the most remote locations.

Challenges of Networking via Space

For many businesses and users, connecting via satellite may be their only choice due to their remote location. Satellites can bring Internet services to areas without fibre, cable, or even cellular networks such as islands, oil rigs, or remote research facilities. Even when other means of connectivity are available, satellite provides added resiliency required in many applications. Some developing nations or areas suffering from natural disasters may use satellite connectivity while they build or restore their terrestrial based infrastructure.

While satellite access solves the problem of connecting these locations, it adds latency due to the time it takes information to travel into the sky and back. It is also constrained by limited capacity, since operators need to navigate complex regulatory environments related to spectrum allocation. Furthermore, available bandwidth for a particular satellite beam is often limited due to the constraints of the RF network in that area.

New technology is increasing the bandwidth per beam, but many times a business may be served by several satellite beams which need to be combined to provide the required bandwidth for the user. Therefore, most enterprises and carriers offering satellite connectivity are adopting a multi-orbit strategy to leverage the strengths of different satellite offerings.

There are three main orbits in which satellites operate: geostationary (GEO), medium earth orbit (MEO), and low earth orbit (LEO). Services provided by GEO satellites provide the widest coverage per satellite and tend to be a stable service due to the RF properties they use. However, latencies in GEO networks are several times greater than other orbits because they operate farthest from the earth. MEO links provide improved latencies and guaranteed bandwidth. This makes them a good fit for most enterprise applications. Yet due to their orbit, they are not available close to the poles. Also, they often use Ku bands which are more susceptible to rain fade. Finally, LEO has found a niche in residential and IoT segments by offering significantly lower latency, but this approach often struggles to provide symmetric connectivity for more robust use cases.

Hybrid and multi-orbit solutions are becoming the standard for the satellite networking industry. Steve Collar, former CEO and President of SES Networks summarized this move as: "What multi-orbit does is it allows you to put the right customer in the right place in the network at the right time... There's no religion about it ... is it MEO or LEO or GEO? ... For us, it will be a mix, it will be integrated and most of the time the customers won't know what they're on."[1]

The mobility industry is one of the main use cases for satellite links. Connecting airplanes and vessels requires optimizing the network path to the current location and selecting the link that provides the best service. In these mobile use cases, the requirements for visibility and monitoring are critical to ensure their correct operation.

Whether you are deploying services on a ship, an aircraft, or in the middle of the jungle, satellite terminals are usually deployed with power and space limitations. That is why consolidation of network functions is critical. The use of virtual network functions (VNFs) and of Universal CPEs (uCPEs) is critical to reduce the network sprawl. Reducing the number of appliances also helps organizations to reduce their OPEX and CAPEX.

Satellite operators must be able to monitor their remote terminals, efficiently manage the available bandwidth, and secure the remote networks.

Optimizing the Satellite Network with Versa

The Versa Solution

Versa Secure Access Service Edge (SASE[2]) integrates a comprehensive set of software defined networking services with integrated security. It has the ability to provide these services via on-premises deployments, cloud-based infrastructure, or some combination. Versa SASE services include Secure SD-WAN, Next-Generation Firewall, Unified Threat Management (UTM), and other capabilities all delivered via the Versa Operating System (VOS). VOS provides intelligent traffic steering, QoS, and security solutions using a DPI engine that currently recognizes over 4000 different applications.

Versa is consistently recognized as a leader in the Gartner® Magic Quadrant for SD-WAN[3]. Versa has also been identified by Gartner as one of the few Single Vendor SASE solutions in the market[4].

Traffic Engineering

The advanced application-based traffic steering engine in VOS can be used to bond several different satellite paths together and either load balance or prioritize applications for different paths. VOS considers the configured bandwidth for WAN interfaces and load balances sessions effectively even when the links have differing bandwidths. The best use case for the application prioritization is when providing a multi-orbit or hybrid solution. Policies can be created where latency tolerant traffic types, such as bulk updates, are sent to a GEO link to free up bandwidth on the lower latency links for the more latency sensitive traffic such as Zoom calls or Teams traffic.

The VOS traffic steering policies enable very flexible WAN redundancy scenarios. Satellite backup policies can be set up for terrestrial traffic to switch to satellite in the case of fiber cuts or similar outages. The built-in SLA monitoring feature can consider the health of the link so that if a weather event is causing "rain fade" on a MEO or LEO link, the traffic can switch over to the GEO link at a certain packet loss threshold. Similar policies can be used to automatically switch over paths in mobile deployments when latency or packet loss increases if a device moves from one coverage area to another.

Alternatively, policies can also be implemented to load balance across paths, even applying weighted algorithms to optimize the available bandwidth in every link. The Traffic Engineering policies take decisions on a per-session basis, which allows them to be transparent for users.

Versa can also implement traffic remediation techniques to overcome degraded links when there is no other transport available. VOS supports packet replication techniques that enable it to send copies of the same packet over different transport to ensure that it arrives to its destination one way or the other.

Furthermore, Versa integrates Forward Error Correction (FEC) into its network stack. FEC sends a hash packet for every set number of packets. This extra piece of information allows the system to recover any lost packet in transit. Since both these features add overhead, the system provides flexibility so that they can be turned on only under certain degraded link conditions.

SaaS application monitoring can be provisioned to find the best gateway to use to reach cloud-based applications. By using SaaS monitoring, the system can measure the latency and loss of a particular link using active or passive mechanisms. Active mechanisms included generating test probes. These probes can be sample HTTP connections, DNS probes, or even ICMP messages. The system can also gather information passively by measuring the retransmissions and RTT of TCP connections and derive packet loss and latency from them.

Due to all the considerations discussed in this white paper, overhead can be a big issue with Satellite networks. Legacy SD-WAN solutions usually require building and maintaining IPSEC tunnels to form a secure overlay to manage and protect communications.

Lightweight tunnelling protocols reduce the overhead added for SD-WAN networks. Versa Networks has integrated a tunnel-less SD-WAN solution for its VOS. This feature identifies the mutable and immutable parameters of the packet headers and replaces the immutable parameters with a session identifier. That way it can reduce much of the overhead created by a tunnel and save valuable throughput on a satellite link. Furthermore, this allows us to achieve a higher MTU inside the SD-WAN overlay.

TCP Optimization

Network latency and packet loss throttle TCP connections because they affect the way TCP negotiates connection windows. VOS includes a TCP Optimization engine that helps reduce the effects of network impairments over application.

First, the user can implement an intelligent TCP Proxy that splits connections in situations where the user can improve the connection behavior. Furthermore, you can configure several available congestion avoidance protocols and buffer tuning settings. This enables the administrator to couple the Client and Server TCP buffers taking into consideration the latency and other network considerations.

Finally, Versa implements different congestion avoidance protocols. The user can select the protocol that better suits its application and network conditions. The user can even configure protocols that are not available for the host operation systems.

TCP Optimization is managed by traffic policies. Hence, the user can apply it only to interesting traffic. Also, you can guarantee that certain applications get preferential treatment. Similar to the FEC feature, this feature can also be configured to only take effect under specific network latency conditions.

Versa supports advanced TCP optimization features and congestion control algorithms like BBR, Hybla, SACK, and Recent Acknowledgement.

Hierarchical QoS

The VOS solution can optimize expensive satellite bandwidth even for a single path connection with application aware QoS policies. In one example, a cruise ship operator had limited bandwidth and was getting many complaints about the performance of internet services from their passengers. Reviewing the data provided by Versa Analytics showed that passenger traffic included a lot of automatic traffic such as iCloud, Google Cloud, and software update traffic that was competing with the passenger's interactive traffic. Once policies were put into place to lower the priority of these apps, the number of passenger complaints dropped to a fraction of what they were.

VOS offers traffic shaping at the physical interface, logical interface, or forwarding-class level. With the adaptive shaping feature, a spoke can signal its configured receive rate to remote hub devices to reduce the strain on the underlay network. The adaptive-shaping feature tells the remote devices to shape traffic to the advertised rate and apply shaping so that the quality-of-service policy can be preserved and prevent traffic from using underlay resources just to be dropped at a congested satellite modem.

DNS Proxy

VOS software has integrated a DNS proxy that enables network administrators to intercept DNS requests and provide them with a special treatment. It can redirect the DNS request to the most optimal server. It can even match based on the request conditions and steer it accordingly. Furthermore, it can reduce the latency for DNS lookups by caching results on the VOS device after the first lookup.

Advanced Security

To protect against the growing threat landscape, Versa enhances the network security by offering its industry leading next-generation firewall (NGFW), secure remote access, and unified threat management (UTM) services that protects application and user activity across the network using the same VOS software. This allows the power and space footprint to be reduced compared to using separate network and security devices and allows simpler logistics for a total network solution.

Versa hardware can be added into a greenfield package to bundle SD-WAN and security functions as a single device. The functionality can be also added to replace existing security devices in brownfield SD-WAN implementation.

As part of the SASE Framework, Versa offers its advance security services both on-premises and in the Versa Cloud. Versa has a global network of POPs where it has the ability of not only offering UTMaaS, but also some other advanced security services like DLP, CASB, and SWG. These POPs are strategically located to provide low latency connections to content and cloud providers.

When combined with the SaaS Monitor discussed before, the system can automatically determine which is the Gateway that provides the best performance for the critical applications. Also, the administrator can decide whether to run these services on premise or on the cloud. Running services in the cloud allows users to deploy thinner branches. Satellite customers often have power and space limitations. So, they can choose to deploy a light hardware option in their premises and running their advanced security features in the Versa Cloud.

Deployment Options

Versa has a wide range of options for deploying VOS: white-boxes, hypervisors, cloud environments, or Versa branded boxes to adapt to each customer's requirements. Several of the models have LTE modems or Wi-Fi access points built directly into them to simplify the solution. This gives our customers a wide range of hardware options to choose from so that they can select the one that best suits their needs. To further reduce the hardware footprint, VOS devices support uCPE capabilities to integrate VNFs of other vendors.

Configuration for VOS devices is highly templatized to keep network configurations consistent. The most common configuration tasks use Versa Workflows to create the initial templates. Optionally, Versa Titan™ or Concerto™ make managing device configurations even more streamlined.

Several provisioning options allow for sending new equipment to locations with minimal support from field engineers. For devices with Internet connectivity, Global Zero Touch Provisioning (ZTP) allows a factory fresh device to securely reach out for its configuration automatically without any input from an on-site technician. For deployments without Internet connectivity, URL based (ZTP) allows a technician to paste a URL via the LAN port to trigger the device provisioning. Device provisioning can also be triggered via a simple script. In all cases, the initial configuration is stored on the Versa Director waiting for a device to download it via one of the provisioning options: there is never any pasting of large quantities of configuration over a slow console port!

Other Considerations

To help ramp up a new Versa SASE network, Versa offers several levels of managed services. Versa can manage the headend while the operator handles the VOS deployment or can also help manage the VOS deployment. Versa also offers professional services to help plan and design enhancing networks with new SASE features.

VOS has been implemented in various satellite deployments worldwide across different verticals. Versa has deployed our solutions on airplanes, ocean-going vessels, oil rigs, and in various remote locations. Versa's technology is being used in the most demanding networks worldwide, which has let it develop the necessary expertise required in satellite networks. Versa's Systems Engineering team has experience sizing, designing, and deploying our solutions in diverse environments.

Conclusion

Versa Secure SD-WAN, part of the Versa SASE platform, allows satellite operators to use their networks more efficiently. The VOS application-aware software incorporates intelligent traffic steering, QoS features, advanced traffic features, and advanced security options into one package with the ability to present multiple paths to end-customers as one network. With all these features, Versa is a clear leader for simplifying how organizations connect and protect today's satellite networks!

For more information on Versa Networks, please visit https://versa-networks.com, contact us at https://versa-networks/contact or follow Versa Networks on Twitter @versanetworks

Reference and Resources

[1] SATELLITE 2020 Show Daily — Day 3 - Beyond GEO: Major Operators Have A Multi-Orbit Focus | Via Satellite (satellitetoday.com)

[2] https://versa-networks.com/documents/solution-briefs/versa-sase.pdf

[3] https://versa-networks.com/news/2022/versa-networks-is-recognized-as-a-leader-in-the-gartner-magic-quadrant-for-sd-wan/

[4] https://blogs.gartner.com/andrew-lerner/2022/09/30/single-vendor-sase/

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