

WHITE PAPER

Versa SD-WAN Solution Use Case for Satellite ISPs

By Gerardo Melesio, Jeff Schoch, and Julio Carranza

Introduction

Satellite networks offer their customers several advantages over other types of connectivity. They are easily deployed, reliable, and allow a wide degree of mobility, making them a perfect fit for Disaster Recovery Plans (DRP). They are an essential asset in places where other connectivity methods are not available, such as oil rigs, vessels, or even planes. However, they have several characteristics that make them harder to manage when compared to other kinds of networks. This document will discuss those challenges and explore how the Versa Operating System (VOS™) can help you extract better performance out of your Satellite links.

Some challenges that make the satellite links unique are higher latency and limited bandwidth. The available bandwidth is expensive and is often not allocated symmetrically for upload and download or even along the same path. The available space and power for networking equipment can be low, especially in remote locations. When deploying satellite networks, a customer must consider all these factors and deploy innovative networking solutions to help overcome them.

Versa SD-WAN provides intelligent link bonding between potentially diverse transport systems, integrating them into a seamless network for the end customer. 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. VOS™ also integrates advanced networking functions like TCP Optimization and Hierarchical Class of Service. Using these services, customers can prioritize the most important applications for their business while optimizing the performance of their connections to their critical services. Finally, by integrating Advanced Security features into the same operating system, you can consolidate your network and reduce your appliance sprawl.

Satellite use cases and verticals

The VOS™ has been deployed in many environments with satellite connectivity. From cargo ships to remote locations in Central Africa and luxury cruise ships in the Mediterranean Sea, the Versa Secure SD-WAN solution is the perfect solution for any scenario that requires network intelligence and security. Here are some verticals where we have successfully deployed the VOS with customers.

Maritime and Aviation

Long-range and mobile deployments, such as maritime and aviation applications, require satellite links because ships and planes can travel well beyond the range of cellular and other terrestrial-based radio technologies. These vehicles often have several communication methods and networks that would benefit from a standard management method. Large ships may need to segregate networks into different VPNs, to serve other purposes—for example, crew traffic, Internet for passengers, or corporate services. Ideally, the onboard system should detect the best available network path depending on the ship's location and make the necessary changes automatically.

Remote sites

Although the Internet sometimes appears almost ubiquitous, there are still areas with no access to fiber, cable, or even cellular networks. The latter may be because the population density of a land area is too low or because deploying landlines is too difficult or nearly impossible. Islands, oil rigs, or remote research facilities come to mind, but many developing nations may also need to use satellite networks while they develop their wired networking infrastructure. Some of these deployments may also need multiple private networks that share the same transport links and could benefit from optimization features such as intelligent traffic steering, TCP optimization, and intelligent class-of-service.

Cellular Backhaul

Mobile networks are almost omnipresent these days. To work, operators must install cells close to the users so that the wireless signal gets to users adequately. The operators then get the traffic back to their core network, where it can be processed and forwarded accordingly. However, there are remote places where conventional connectivity methods like fiber or microwave links are unavailable. Mobile operators usually depend on satellite links to connect their cell sites in those scenarios.

For the Cellular Backhaul use case, multitenancy is undoubtedly one of the critical features needed. Operators must isolate traffic from different mobile providers or MVNOs in different VRFs. The ideal solution should enable operators to create both L2VPNs and L3VPNs in a fast, reliable, and automatic way.

Critical Features

SLA Monitoring

The VOS™ Service Level Agreement Monitoring system ("SLAM") measures many aspects of the paths used for the SD-WAN traffic. The system can enact policies based on jitter, latency, packet loss, or several other measurements to help decide the "best" path for any particular traffic. For example, if a specific application is susceptible to packet loss or jitter, a policy can be put in place to send it over path 1 by default. If rain fade causes packet loss or jitter on path 1 above a certain threshold, then that application will automatically move to path 2.

Versa's SLA Monitoring capabilities can also be very helpful in hybrid environments. For example, in some countries where fiber is in its early days, optical networks have to coexist with satellite networks. Although fiber usually offers higher throughput rates and lower delay, it may be unreliable in new deployment areas. VOS™ can automatically switch from one transport network to another, ensuring the connectivity is always working.

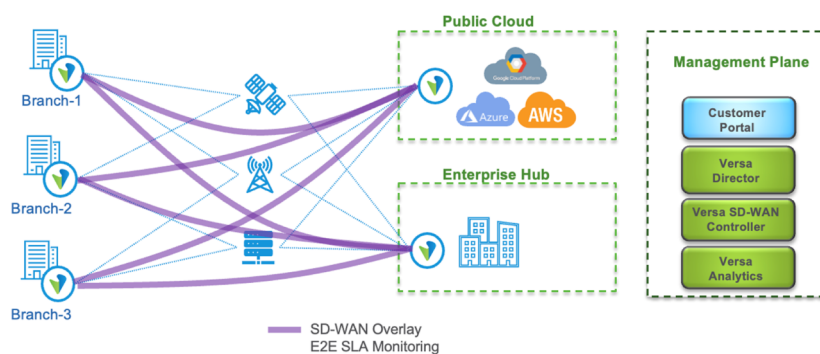
Link bonding in Hybrid Satellite Environments

The Versa solution can be used to bond different satellite links. For example, a customer may have an MEO (Mid Earth Orbit) connection for most of their low latency requirements and a GEO (Geosynchronous Orbit) connection for redundancy. Because GEO satellites orbit much higher than MEO satellites, they naturally incur much higher latencies than the MEO paths. However, the electromagnetic spectrum which the MEO satellites use are more affected by weather conditions.

The VOS™ can be configured so that, by default, traffic less sensitive to latency will flow over the GEO connection so that the latency-sensitive traffic has more bandwidth available on the MEO connection. For example, data transfer traffic for update services such as Windows Update or storage sites like Dropbox can be forwarded over the GEO connection. In contrast, conferencing traffic services

such as Skype or Zoom are forwarded over the MEO path. Policies can also be set up so that in the event of an outage on one of the paths, the less important traffic is blocked to allow more critical traffic to flow.

There may be some situations where a path between two sites cannot use the same satellite connections. Perhaps all the uplink bandwidth for link one is provisioned for other products, but it has downlink bandwidth available. The customer can get their uplink service via link 2. Link 1 will need to have enough bidirectional bandwidth available for control and OAM functions of the SD-WAN path. The Versa solution can tie links one and two together as two unidirectional traffic paths combined for bidirectional service. The platform has intelligent tools to apply these bidirectional routing techniques only to specific applications or perform them solely under congestion conditions.

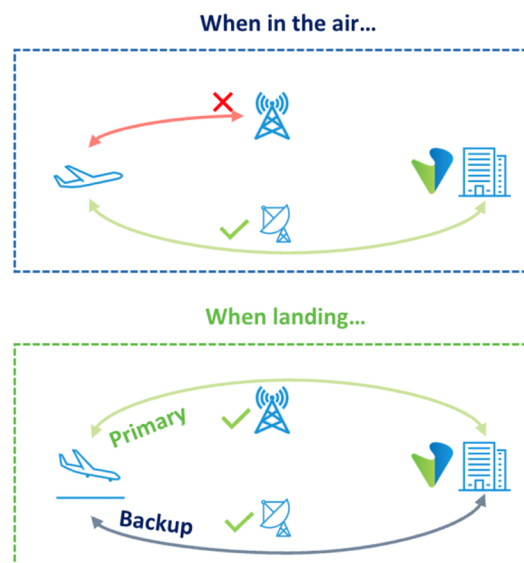


Sometimes, the customer will want to simply use all the available WAN links to utilize their bandwidth fully. The Secure SD-WAN solution can also implement Path Weighted Round Robin to load balance sessions across satellite links with different bandwidths. In a hub and spoke scenario, the hub distributes the sessions considering the download speed of the spoke. The download and upload bandwidths should be configured in the physical or sub-interface in the spoke.

Best Path and Gateway Selection

Although most use cases above assume a fixed data topology, satellite networks also benefit mobile applications such as maritime or aviation. In some mobile applications, combining satellite communications with LTE, WiFi, or other kinds of wireless connectivity may make sense to take advantage of different billing or bandwidth properties when LTE or WiFi networks are in the range.

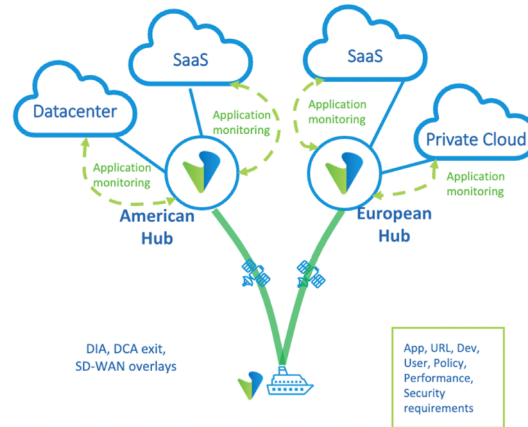
For example, VOS™ can be set up to prefer the shorter range transport when a plane is on the ground and then switch over automatically to the satellite service when it is in flight without needing to change any of the local network settings. The transition from one transport to another is seamless to the end user as VOS™ abstraction of data plane tunnels, SLA monitoring, and failover mechanism ensure a smooth transition. The same idea applies to ships, which might prefer using an LTE when they are close to the port and fall back to satellite links once they are in the open sea.



Several models of Versa branches have LTE and WiFi modems built directly into the device to simplify the deployment and maintenance of the solution. Also, the user can leverage the available Ethernet ports to connect to an external device.

SaaS Application monitoring can be added to enhance the path selection process between multiple local break-out (LBO) paths where the Versa SLAM is unavailable between branches. Customers can set up ICMP, TCP, or HTTP monitoring for a specified host and set thresholds for latency or loss on the monitoring profile. These monitoring profiles are then used to determine the best choice between the two Internet connections.

For Maritime and Aviation customers and any other customer continuously on the move, SaaS monitors also allow you to choose the Best Gateway for every application.



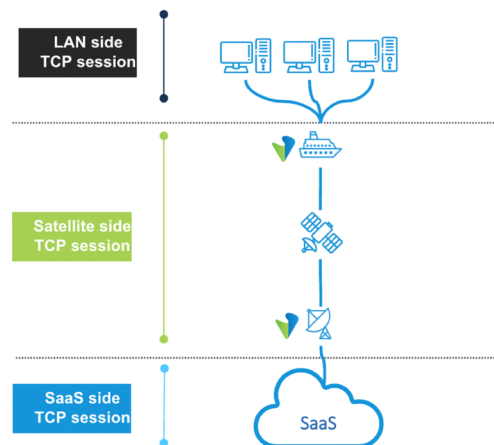
Automation

Satellite operators can leverage Versa REST API infrastructure to develop REST API automation to update the Satellite BW using their telemetry. The latter task is essential as Satellite BW changes with the location of the mobile deployment on a ship or with the weather.

Another task that Satellite operators can automate is to use the GPS to update the location of the SD-WAN device. The latter enables the operators to modify the priority of hubs or links based on the ship location.

TCP Optimization

The long latencies introduced with satellite links are a good case for TCP optimization. TCP optimization splits the high latency TCP session into multiple TCP segments. By enabling the TCP optimization service at one or more points between the client and server, both slow start convergence and loss recovery times are dramatically improved since the end-to-end latency is split into smaller, independent segments.



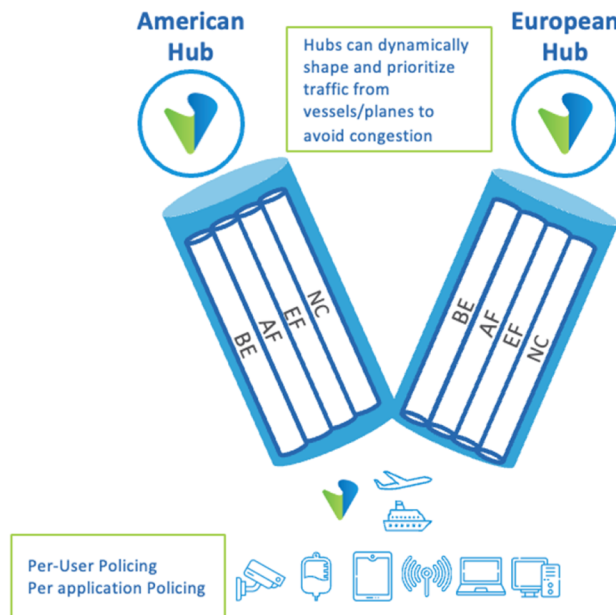
Additionally, Versa also implements state-of-the-art Congestion Control protocols to improve the performance of TCP connections, especially when they are subject to high latency or packet loss in the link. There are many congestion control protocols in the industry. Some of them are engineered to achieve high throughput transactions in low latency environments. Others are designed to get the best output from a link under hardship conditions, such as a satellite link in the middle of the sea. By letting you implement different Congestion Protocols on different segments of the connection, you can choose the appropriate protocol according to the conditions of the link. Furthermore, you could overcome any client or server limitation, especially in hand-held devices that might have smaller TCP buffers. Versa Operating System currently has the following TCP Congestion Avoidance protocols:

- Cubic
- BBR
- New Reno
- Hybla

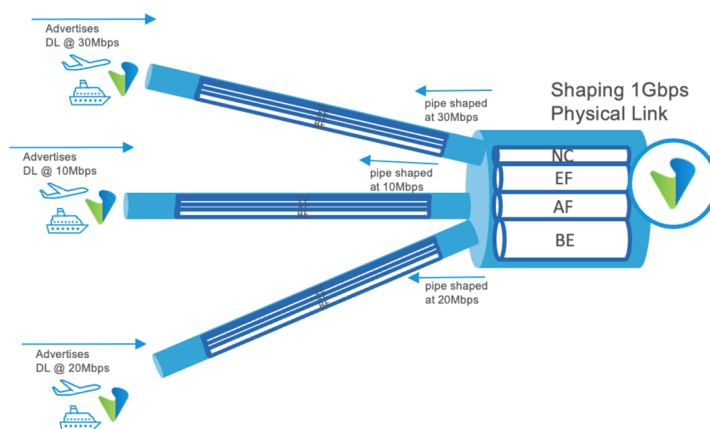
Quality-of-Service and Shaping

The limited bandwidth available with satellite transports means that network operators will want to classify their traffic and prioritize the more critical sessions in times of congestion. The ability to match application signatures in the VOS™ system allows classification and prioritization beyond the traditional patterns of interfaces or IP prefixes. For example, some mobile customers may use a particular conferencing application such as Skype, WhatsApp, or Zoom for meetings or maintenance windows which requires these applications to be prioritized over other traffic. Class-of-service markings can be updated in the 801.2 P-bit or DSCP bit fields of the outer encapsulation so that the transport network honors the prioritization set by the customer in case of congestion in the underlay.

In addition to shaping local traffic at the physical interface, logical interface, or forwarding-class level, the VOS™ system allows a device to signal its configured receive rate to remote devices.

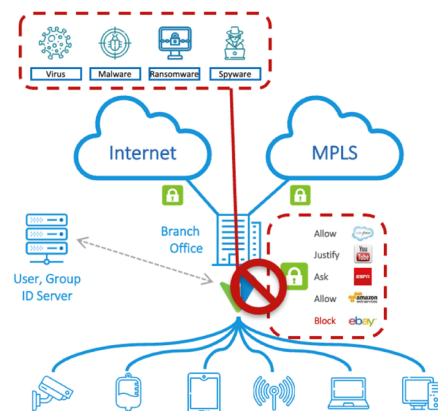


In an SD-WAN deployment, adaptive shaping allows a branch or hub device to enforce a dynamic egress shaping rate on any device sending its traffic to force the sending device to limit the amount of traffic it sends. The adaptive-shaping feature tells the remote device to shape traffic to the advertised rate and apply a scheduler-map so that the quality-of-service policy can be preserved and prevent traffic from using underlay resources dropped at a congested satellite modem. This feature can also be used so that a device can signal to multiple devices to lower their transmit rates when the receiver is being oversubscribed. Using adaptive shaping allows a hub to send traffic to numerous spoke devices without having to manually configure a transmit rate to each spoke and reduces the number of logical interfaces that would otherwise be needed to control traffic flow to the spokes.



Security Features

The VOS™ solution includes the ability to integrate security features such as Next Generation Firewall, Intrusion Prevention, and Anti-Virus features into the same device. The latter allows the power and space footprint to be reduced compared to using separate network and security devices and also 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 added to replace existing security devices in brownfield SD-WAN implementation.



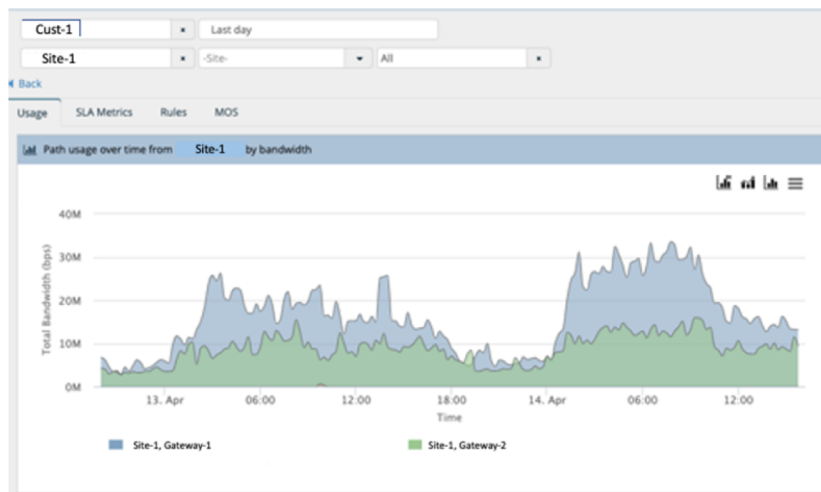
uCPE Competitive Advantage

Satellite sites are usually allocated in remote locations where operators must optimize the power and space. Versa uCPE capabilities allow the customer to implement different network functions (Firewalls, WAN Optimization, Authentication, etc.) in a single box, leveraging VNFs of other vendors. Versa has a wide range of options for deployment: White-boxes, Hypervisors, Cloud environments, or Versa branded boxes that adapt to each customer's needs and requirements.

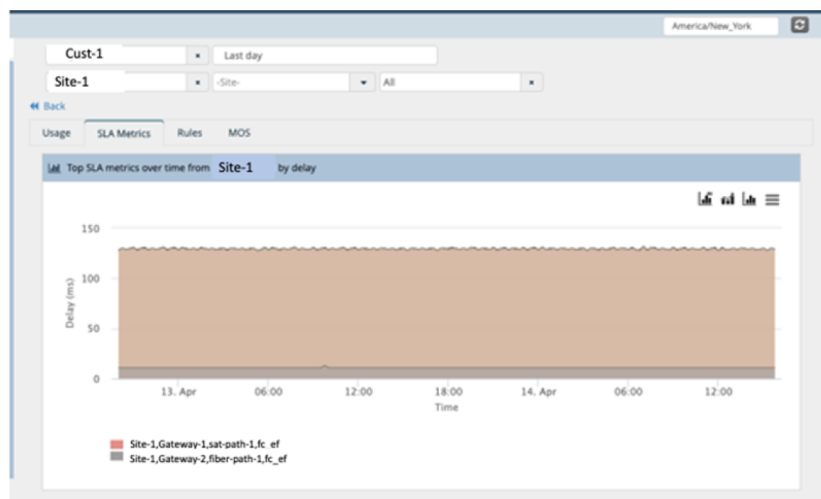


Analytics

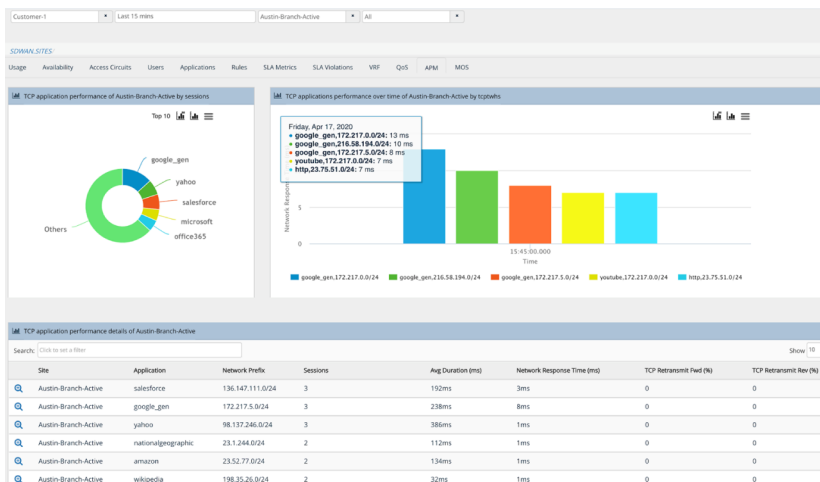
The Versa Analytics cluster is the central resource for SD-WAN network reporting. It provides status and statistics for data aggregation, per-port, and per-application to monitor trends over time and report outages on the network. Satellite customers will find it helpful to know the latency for tenant endpoints measured per path and the ability to measure which applications are flowing over particular links so they can fine-tune steering policies.



The above chart is an example of the path usage dashboard from a remote site to two gateways.

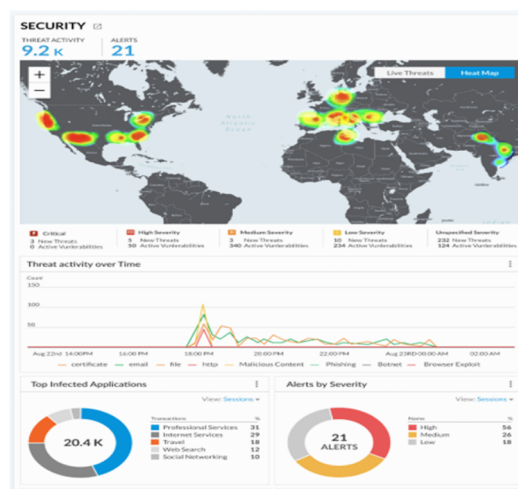


The above chart is an example of path SLA metrics showing that the latency is around 130 ms to Gateway-1 over the satellite link and about 11 ms over the fiber path.



The above picture shows a sample of the application performance monitoring (APM) output. The operators can use this information to confirm how applications perform for particular transport paths and to see how much bandwidth any specific application uses.

When security features are enabled on the VOS™, the Analytics dashboard will also present audit trails for security events related to the security policies enabled in the network. If required, the Analytics dashboard can be presented to end customers using role-based access controls for on-demand information specific to that customer.



Periodic reports can also be implemented to email a daily health report to end customers automatically.

Success Cases

Global Cruise Company

A major cruise line with service areas all over the globe upgraded the network on their ships with Versa Secure SD-WAN, which they get as a managed service by their service provider. The cruise line uses satellite links in the high sea and fiber connections when docked in their home port. With these connectivity options, they can manage corporate networks on their ships and provide Internet access for their crew and passengers, providing a superb experience to all their users.

Challenges

The typical transport solution for these ships uses multiple satellite beams, which may have different bandwidths and latencies. Shifting traffic between the beams was manual, and load balancing between beams was difficult. Traditional networking solutions used complicated policy-based routing and were not getting the expected results. Furthermore, network failures on the ships or satellite blockages generally meant manual configuration changes to mitigate the outage while the problem was being fixed.

Managing the available bandwidth was a manual process involving adding hard policers or shapers on shipside firewalls, with little control over traffic returning to the ship. Traffic from shore to ship would have to traverse the transport network to get dropped at the modem when a path was oversubscribed. Typical satellite modem class-of-service implementations are rudimentary, with no visibility for networks or applications.

When ships came into port, traffic would be manually shifted to wired connections. The ship staff would wait for the network manager and Service Provider to perform these changes.

Solution Highlights

Versa traffic steering policies are flexible and can be tailored per ship to match the characteristics of available bandwidth. With the addition of the Versa SD-WAN solution, implementing load balancing across multiple WAN paths has become simple and much more precise, even if the bandwidth on the various types of transport is unequal.

The application detection engine built into VOS™ devices also allowed the customer to create class-of-service or traffic steering policies based on the detected applications. The customer has automatic policies to deal with failure scenarios and consider the different characteristics of the available beams. Failures of a primary link are much more graceful, preventing any outage in the system.

The VOS™ class-of-service implementation allows the ship to signal the configured bandwidth for each satellite path and shape traffic based on this rate using the adaptive shaping feature. Since the gateway VOS™ device sits close to where the corporate or Internet traffic enters the provider's network, the service provider does not monitor backhaul traffic across their network just to be indiscriminately dropped at an oversubscribed satellite modem. By the time traffic has reached the satellite modem, network and application-based matching have been applied to prioritize the customer's traffic based upon their requested policies, P-bits or DSCP marking. The marking is applied to help the modem prioritize the traffic in the case that additional traffic must be dropped. Greater control of classification and scheduling results in a smoother network experience for the users on the ship.

Ships are pre-provisioned so that when they are in port, simply plugging a cable into the ship network automatically updates traffic to flow over the terrestrial link without waiting for a manual reconfiguration. Once the ship leaves port, the link is unplugged, and traffic automatically shifts back to the satellite links.

Results

The cruise company added a new ship to its line and invited members of the media and Internet influencers to attend the celebrations associated with the maiden voyage. The combination of clear satellite bandwidth, traffic steering policies, and class-of-service configuration to protect media traffic during the special event led one media leader to call the experience a "game changer" for such events.

Service Provider in Central Africa

A regional service provider in Central Africa uses terrestrial links, RF, and satellite services to provide connectivity for various customers, including governmental, international organizations, faith-based organizations, and businesses, including other telecommunications providers.

Challenges

The service provider serves remote areas with unstable infrastructure. The rainy season sometimes degrades satellite signals with rain fade. Even when fiber became available, the infrastructure was unreliable, and the customer often needed to balance traffic over several links to achieve the bandwidth for their service level agreements.

Solution Highlights

The provider added VOS™ devices into their network through a managed service. The combination of full BGP support and Versa traffic steering capabilities allowed the provider better control of their network, leveraging the different available transports. As a result, the customer could steer traffic from the more latency-sensitive applications across links with lower latencies while putting the less sensitive traffic over the satellite path to save bandwidth on the main link.

When fiber paths became available, the provider was able to integrate these paths with the satellite paths to balance traffic. Versa SLA profiles allowed them to create granular policies to automatically switch between available paths in cases of rain fade or fiber outages. Application monitoring allowed the provider to detect problems upstream of their network peers and prevent traffic blackholes.

Results

The centralized control and visibility of the Versa solution allowed the service provider to use multiple types of transport to serve their customers in a remote region. The customer has been able to expand their transport network and peering connections. The Versa workflow and template framework have made deploying new devices with consistent policies straightforward.

Conclusion

Satellite networks provide ideal use cases for Versa Secure SD-WAN deployments. The strengths of the Versa SLA monitoring combined with the traffic steering policies allow customers to plan the best available paths for their traffic types. The power of bundling security features with SD-WAN devices and uCPE will enable customers to reduce their overall hardware footprint in deployments where space and power may be at a premium. Versa intelligent class-of-service features allow finer granularity with classification and scheduling and the ability to signal the link shaping configurations via the SD-WAN network. The Versa Analytics tools provide transparency for how well the network is running. Together, these features make a compelling justification for introducing Versa SD-WAN solutions into Satellite topologies.



Versa Networks, Inc, 2550 Great America Way, 3rd floor, Suite 350, Santa Clara, CA 95054
+1 408.385.7660 | info@versa-networks.com | www.versa-networks.com