Intelligent Traffic Steering and Resiliency with Versa Secure SD-WAN and Telesat Lightspeed

Lessons from Interoperability Testing: Link Aggregation, Failover, and Restoration Across Unequal LEO Links

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1. Executive summary

Today's Low Earth Orbit (LEO) satellite networks offer high-capacity, low-latency connectivity. However, a single user terminal (UT) still represents a potential bandwidth constraint and single point of failure. A common answer is to install several UTs at a site and aggregate them using an SD-WAN solution. The practical questions for network teams then become how to configure SD-WAN optimally so traffic is shared across paths of different sizes, steered away from degraded paths, and returned when paths recover? This paper examines and answers these questions and more.

Versa and Telesat have partnered together to perform interoperability testing using the Telesat Lightspeed Network Emulator. Four emulated terminal paths were aggregated in Layer 2 SD-WAN mode using Versa Secure SD-WAN CSG770 appliances and evaluated with equal and then differing terminal bandwidth profiles. The testing demonstrated that Versa Secure SD-WAN can combine multiple LEO satellite links to increase available bandwidth and improve connectivity resilience. When a terminal failed, traffic was automatically redistributed across the remaining links, maintaining broadly stable aggregate throughput. When connectivity was restored, traffic was rebalanced across all available links. These capabilities help organizations make more effective use of satellite capacity while reducing the impact of individual link failures.

The paper provides recorded outcomes, engineering interpretation of the configuration, and offers recommendations for production tuning.

2. Understanding the aggregating constraints of LEO deployments

Aggregating multiple LEO paths creates a specific design problem: while paths share the same access technology, each path may deliver different usable capacities and changing quality. If an SD-WAN design assigned a fixed equal split among LEO paths, this could result in an overload of a smaller path while underusing a larger one.

To understand the aggregation constraints, testing was performed using a mixed-capacity scenario with four configured Versa circuit bandwidths paths ranging from 32 to 300 Mbps forward and 8 to 100 Mbps return (Table 1). The Versa SD-WAN forwarding configuration therefore had to accommodate unequal paths.

Normal fluctuations in satellite latency and jitter do not necessarily indicate a degraded or failed link. SLA thresholds must distinguish between acceptable network variations and performance degradation that requires traffic to be redirected to other available links.
The testing focused on validating two key capabilities: efficient aggregation of bandwidth across multiple LEO links and service resiliency when network conditions change. The tests evaluated how Versa distributes traffic across available paths, redirects traffic when a link degrades or fails, and rebalances traffic when the link recovers.

3. Defining a three-domain model for solution tuning

The Versa SD-WAN configuration used during the tests can be organized into three functional domains: path eligibility, traffic distribution, and reaction to changing network conditions. Each layer addresses a different aspect of traffic steering, and understanding these distinctions helps engineers select and tune the appropriate parameters.

Domain	Parameters	Question it answers
Eligibility	SLA profile: latency, jitter, total loss, forward loss; circuit tags; unmatched priority	Is this path good enough to carry this traffic class right now?
Distribution	Connection selection method (path weighted round-robin); configured circuit bandwidth	Among eligible paths, how much traffic should each one take?
Reaction	Recompute timer; evaluate continuously; gradual migration; SLA smoothing; SLA violation action	How should traffic respond to changing path conditions, including degradation, failure, and recovery?

4. Versa & Telesat Lightspeed Solution Setup

4.1 Topology and tools

The environment deployed in Figure 1 consists of a Telesat Lightspeed Network Emulator emulating four user terminals (UTs) on the network, each on its own VLAN, and two Versa Secure SD-WAN CSG770 appliances. The Versa appliance at the point-of-presence (POP) side aggregated the four UT paths over an 802.1Q trunk, and the second Versa appliance was configured similarly at the remote site. Traffic generator appliances at both ends produced and measured test traffic, and monitoring components from all devices provided throughput, latency, jitter and loss views. The Versa appliances operated in Layer 2 SD-WAN mode, aggregating traffic across the four emulated LEO paths.

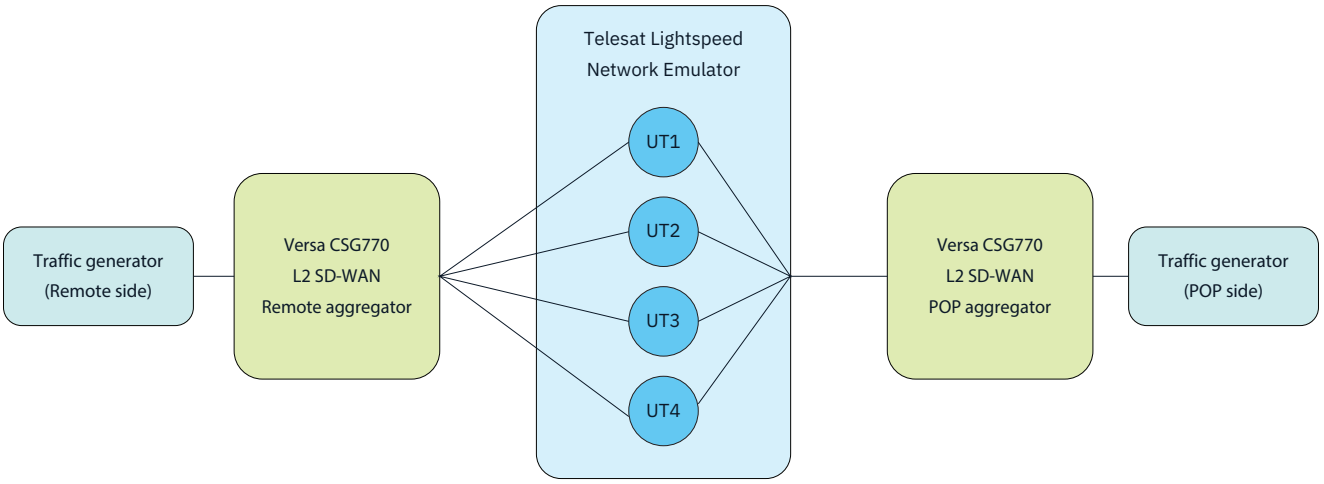


Figure 1. Environment topology.

4.2 Testing scenarios

Telesat evaluated link aggregation, failover, and restoration across four emulated LEO satellite links under two scenarios:

- Equal capacity: Four terminals with identical bandwidth profiles.
- Mixed capacity: Four terminals with different bandwidth profiles, configured on Versa with circuit bandwidths ranging from 32 to 300 Mbps forward and 8 to 100 Mbps return (Table 1).

Both scenarios were tested using committed information rate (CIR) traffic and a combination of CIR and excess information rate (EIR) traffic. Test traffic was marked using Differentiated Services Code Point (DSCP) values to represent four traffic classes and evaluate forwarding behavior.

4.3 Mixed-capacity bandwidth configured on the Versa appliance

For the mixed-capacity tests, Versa circuit bandwidths were configured to reflect the different link capacities and provide the baseline for weighted path selection. Table 1 summarizes these settings and the corresponding expected traffic distribution across the four LEO paths.

Path	Circuit	Forward (Mbps)	Return (Mbps)	Role	Bandwidth Configured
UT1	LEO0	90	30	Lower capacity	15%
UT2	LEO1	180	60	Medium capacity	30%
UT3	LEO2	300	100	Highest capacity	50%
UT4	LEO3	32	8	Lowest capacity	5%
Total		**602**	**198**		**100%**

Table 1. Versa circuit-bandwidth settings for the mixed-capacity comparison.

These values represent the bandwidth configured on Versa circuits, not the Telesat terminal CIR/EIR profiles. Versa uses the configured circuit bandwidth values as references to establish the initial traffic distribution through path weighted round-robin.

5. Domain 1: Eligibility

An SLA profile defines the measured conditions under which a path is eligible for traffic [1]. As shown in Table 2, the tests used latency, jitter, total loss, and forward-loss thresholds, with different loss tolerances for different traffic classes.

SLA profile	Latency	Jitter	Total loss	Forward loss	Used for
L2-COS-SLA-EF	150 ms	40 ms	15%	1%	CoS1, CoS2, default L2 traffic
L2-COS-SLA-AF	150 ms	40 ms	30%	1.5%	CoS3 (AF) traffic
L2-COS-SLA-BE	150 ms	40 ms	30%	30%	CoS4 best-effort traffic

Table 2. SLA thresholds used for each traffic group.

During the testing, test traffic was classified into four classes of service (CoS1–CoS4). Versa used three service-level agreement (SLA) profiles to apply different performance thresholds: one shared by CoS1 and CoS2 (Expedited Forwarding, EF), one for CoS3 (Assured Forwarding, AF), and one for CoS4 (Best Effort, BE). Each profile defined acceptable latency, jitter, and packet loss to support differentiated traffic steering.

5.1 Rationale for the SLA thresholds

The tests used 150 ms latency and 40 ms jitter thresholds as engineering starting points. These values were intended to accommodate expected LEO network variation, including satellite propagation delay, terrestrial backhaul delay, and processing delays, while identifying significant path degradation.

Packet-loss thresholds were differentiated by traffic class. Higher-priority traffic used stricter loss thresholds, while best-effort traffic was allowed greater tolerance to reduce unnecessary traffic redistribution.

These values were selected for controlled interoperability testing and should not be considered universal recommendations. Production thresholds should be validated against actual network measurements and application requirements.

5.2 Thresholds versus observed conditions

SLA thresholds are eligibility boundaries, not application-performance targets. In the equal-capacity CIR/EIR run, the Versa SLA monitoring view (Figure 2) showed steady path latency at about 50 ms on all four paths, jitter generally below 3 ms, and no packet loss. Latency and jitter reported per stream by the test traffic generators in the CIR-only run were consistent with average latency of 51 to 53 ms and a high of around 136 ms, and average jitter below 1 ms with peaks up to about 22 ms. The measured latency and jitter remained below the configured SLA thresholds of 150 ms and 40 ms, respectively. This demonstrates that the thresholds accommodated the network conditions observed during testing, although they may require adjustment for production deployments.



Figure 2. Versa SLA monitoring view for the four LEO paths in the equal-capacity CIR/EIR run: bandwidth, latency, jitter, and packet loss per path.

5.3 Understanding loss thresholds

Loss thresholds provided differentiation across traffic classes. CoS1/CoS2 used 1% forward loss, CoS3 used 1.5%, and CoS4 permitted 30%, while total-loss thresholds were 15% for the first group and 30% for the others. A path can therefore be unacceptable for a more sensitive traffic class and remain eligible for best-effort traffic.

This class-specific treatment is why selecting appropriate thresholds matters as much as selecting a distribution algorithm. The values were specific to the interoperability tests and require production validation.

6. Domains 2 and 3: Distribution and reaction

With three SLA profiles defining path eligibility for different traffic classes, three corresponding forwarding profiles were configured to control traffic distribution and respond to changing network conditions. Path weighted round-robin provided the baseline traffic distribution, while continuous evaluation, recompute timers, and gradual migration helped manage traffic during link degradation, failure, and restoration. Table 3 summarizes the key parameters used.

Parameter	Testing value	Description of parameter effect
Eligible circuit tags	Local LEO, remote LEO	Restricts steering to the intended LEO circuits
Circuit priority	Priority 1 for LEO circuits	Puts all eligible LEO paths in one priority group
Unmatched priority	Avoid	Prevents paths without the expected tags from being used
Connection selection	Path weighted round-robin	Shares load across unequal-capacity paths
Evaluate continuously	Enabled	Re-evaluates active flows as path conditions change

Recompute timer	L2-COS-FP-EF: 5 seconds L2-COS-FP-AF: 8 seconds L2-COS-FP-BE: 12 seconds	Class-specific responsiveness to changed path conditions; these are not measured failover times
SLA violation action	Forward	Avoids a blackhole if all candidate paths violate the SLA
Gradual migration	Enabled	Avoids moving all traffic at once when a path returns
SLA smoothing / dampening	Disabled	Keeps path-state changes visible and responsive

Table 3. Versa forwarding parameters.

6.1 Path weighted round-robin

Path weighted round-robin used the configured Versa circuit bandwidth values as the baseline for traffic distribution across eligible paths. Observed traffic shares in the mixed-capacity test were broadly consistent with the configured bandwidth proportions.

During an additional engineering exercise, Telesat changed the emulated available bandwidth without modifying the Versa circuit configuration. Traffic automatically redistributed across the available paths in response to the changing network conditions. This adaptive behavior is particularly valuable in satellite environments, where available bandwidth may fluctuate over time. By adapting traffic distribution without requiring manual configuration changes, Versa Secure SD-WAN can help service providers make more effective use of available capacity, reduce operational intervention, and maintain service resilience as network conditions change.

6.2 Recompute timers and continuous evaluation

The tests enabled continuous evaluation and used different recompute timer values for each forwarding profile, as shown in Table 3. Shorter intervals were configured for higher-priority traffic to support faster responses to changing path conditions, while longer intervals were used for lower-priority traffic to reduce sensitivity to temporary fluctuations. Shorter intervals can react sooner to sustained degradation but can also increase sensitivity to transient changes. In production, configure the responsiveness of each class based on real path characteristics and application tolerance, and validate observed recovery time separately.

6.3 Gradual migration

Gradual migration was enabled to avoid moving all traffic back to a recovered link at once. Together with continuous evaluation, it allowed the tests to demonstrate return and rebalancing without prolonged aggregate throughput disruption.

7. Testing observations

7.1 Equal-capacity aggregation and failover

The objective of this test was to validate whether Versa Secure SD-WAN could maintain aggregate throughput when one of four equal-capacity LEO paths failed.

Each of the four emulated LEO links was configured on Versa with a bandwidth reference of 150 Mbps forward and 40 Mbps return. The CIR-only test generated approximately 310 Mbps of aggregate traffic. While below the combined configured bandwidth of the four links, the objective was to validate traffic redistribution during a simulated terminal failure rather than measure maximum aggregate capacity.

Initially, traffic was distributed evenly across all four paths, with each carrying approximately 78 Mbps for a total of 310 Mbps. UT1 was then intentionally disabled to simulate a link failure.

As shown in Figure 3, traffic from the failed path was automatically redistributed across the remaining three paths, each increasing to approximately 105 Mbps. Aggregate throughput remained broadly stable at around 310 Mbps, demonstrating the solution's ability to maintain the offered traffic load despite losing one of the four links.



Figure 3. Telesat Lightspeed Network Emulator Throughput monitoring dashboard, equal-capacity test, CIR only - single-UT failure.

Figure 3 shows UT1 traffic dropping to zero following the simulated failure, while the remaining three paths absorb the redistributed traffic. Aggregate throughput at the POP remains broadly stable throughout the event and continues to operate within the defined SLA.

7.2 Mixed-capacity distribution

Figure 4 shows traffic distributed unevenly across the four LEO paths during the mixed-capacity CIR-only test. Based on the monitoring dashboard, the estimated throughput was approximately 40, 78, 147, and 11 Mbps for UT1 through UT4, respectively, totaling approximately 276 Mbps. These approximate measurements are compared with the configured Versa circuit bandwidth proportions in Table 4.



Figure 4. Telesat Lightspeed Network Emulator Throughput monitoring dashboard, mixed-capacity test, CIR only.

Table 4 compares the approximate traffic shares from the test with the Versa configured-bandwidth shares from table 1. Note that plot readings are approximate, not exact exported measurements.

Path	Observed (Mbps)	Observed proportion	Versa bandwidth [TO1.1][CW1.nfigured
UT1	40	14.5%	15%
UT2	78	28.3%	30%
UT3	147	53.2%	50%
UT4	11	4%	5%
Total	**276**	**100%**	**100%**

Table 4. Traffic shares per UT versus final Versa circuit-bandwidth settings. Values calculated from the graphs and rounded, so percentages may not total exactly 100%.

Estimated traffic shares broadly followed the final circuit-bandwidth weights. This supports the baseline for weighted path selection but is not a controlled isolation of every path-selection variable.

7.3 Mixed-capacity failure, restoration, and adaptation

The monitoring dashboard shown in Figure 5 shows the failed path UT1 dropping to zero in the mixed-capacity CIR-only run. The remaining paths accepted redistributed traffic, with larger paths taking a greater redistribution of the additional load while aggregate throughput stayed broadly stable.



Figure 5. Telesat Lightspeed Network Emulator Throughput monitoring dashboard, mixed-capacity test, CIR only - UT1 failure.

7.4 CIR plus EIR runs

Tests were conducted with simultaneous CIR and EIR traffic using both equal-capacity and mixed-capacity distributions to evaluate aggregation and resilience under higher offered loads. Table 5 summarizes the aggregate and per-path rates in the higher-rate direction as approximate values read from the monitoring dashboard.

Scenario	Traffic	Aggregate at POP (Mbps)	Per-path rates (Mbps)
Equal capacity	CIR only	310	78 each
Equal capacity	CIR and EIR	600	150 each
Mixed capacity	CIR only	276	40 / 78 / 147 / 11
Mixed capacity	CIR and EIR	525	92 / 170 / 265 / 2.5

Table 5. Aggregate and per-path throughput in the higher-rate direction, estimated from monitoring dashboard graphs.

In the equal-capacity CIR and EIR run, the four paths carried similar shares, with a POP aggregate throughput of approximately 600 Mbps. In the mixed-capacity CIR and EIR run, a simulated outage of UT1 was performed as shown in Figure 6. UT1 fell from roughly 92 Mbps to zero. UT2 rose from roughly 170 to 200 Mbps and UT3 from roughly 265 to 300 Mbps, while the POP aggregate throughput total stayed near 525 Mbps. Similar to the CIR-only runs, the surviving paths absorbed the load in rough proportion to their capacity.



Figure 6. Telesat Lightspeed Network Emulator Throughput monitoring dashboard, mixed-capacity CIR/EIR test - UT1 failure.

7.5 Path transition observations

During some simulated link failures and restorations, temporary increases in jitter and packet loss, along with brief traffic dips, were observed. Despite these fluctuations, aggregate throughput remained broadly stable.

These observations reinforce the importance of the SLA thresholds discussed in Section 5, which help distinguish acceptable network variations from conditions requiring traffic redirection, and the forwarding policies in Section 6 which control how traffic is redistributed when paths fail or recover.

8. Practical tuning guidance

For a real production deployment, the following sequence of steps is suggested to align configuration decisions to observable behavior:

Step 1 - Set SLA profile eligibility thresholds from healthy measurements

Collect representative latency, jitter, and packet-loss measurements from healthy network paths using Versa Analytics. As a starting methodology, collect at least seven days of data, including peak and off-peak periods, and analyze measurements separately by path, direction, and traffic class where available.

Calculate typical values and the 95th and 99th percentiles for latency and jitter. Use these measurements to select thresholds above normal healthy-path variations, while remaining below the point where application performance becomes unacceptable.

For example, the healthy 99th percentile plus an appropriate operational margin can provide an initial threshold candidate. Apply differentiated loss limits based on application sensitivity.

Finally, validate the selected thresholds through controlled latency, jitter, and packet-loss impairments to confirm that traffic is redirected when intended, without unnecessary switching during normal fluctuations.

Step 2 - Establish the capacity baseline for distribution

Define accurate bandwidth references for each Versa circuit and use path weighted round-robin across the intended, equally prioritized LEO paths. Confirm that each path is eligible and compare its actual share against the configured baseline. If the smallest link is overloaded while a larger one is idle, check circuit values and path eligibility before changing SLA thresholds.

Step 3 - Choose the reaction speed for each forwarding class

Enable continuous evaluation as appropriate and configure recompute intervals based on application requirements. Tests in this document used 5, 8, and 12 seconds for its respective forwarding profiles. Shorter intervals allow faster responses to network degradation but may also trigger unnecessary traffic redistribution during brief fluctuations in latency, jitter, or packet loss. Actual failover and recovery times should be validated separately.

Step 4 - Validate failure and restoration under load

Test steady state, a single-path failure, and path restoration with both equal and unequal capacities. Observe aggregate and per-path throughput, loss, latency, and jitter at both ends. Keep the parameter gradual migration enabled where return surges are a concern and decide explicitly whether forwarding on an SLA-violated path is preferable to dropping traffic if every path is impaired.

9. Conclusion

The Versa and Telesat solution interoperability testing in this document demonstrates aggregation can be achieved for workloads across four LEO paths, with redistribution after single-path failure, and rebalancing when the path is restored. In addition, the Versa three-layer model provides a practical tuning path for the solution: SLA profiles to govern eligibility, path weighted round-robin establishes a bandwidth-aware baseline for distribution, and continuous evaluation, recompute timers, and gradual migration shape the reaction to changing path conditions.

The takeaway for network teams when using this solution is to tune these controls separately, verify both steady-state distribution and transitions, and then validate the settings under production link behavior.

References

1 - Versa Networks, Configure SLA Profiles for SD-WAN Traffic Steering.

2 - Versa Networks, Configure SLA Monitoring for SD-WAN Traffic Steering.

3 - Versa Networks, Configure SD-WAN Traffic Steering.

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About Versa

Versa, the global leader in unified networking and security, enables organizations to create self-protecting networks that radically simplify and automate their network and security infrastructure. Powered by AI, the VersaONE Universal SASE Platform delivers converged SSE, SD-WAN, and SD-LAN solutions that protect data and defend against cyberthreats while providing a superior digital experience. Thousands of customers globally, with hundreds of thousands of sites and millions of users, trust Versa with their mission-critical networks and security. Versa is privately held and funded by investors such as Sequoia Capital, Mayfield, and BlackRock. For more information, visit https://www.versa-networks.com and follow Versa on LinkedIn and X (Twitter) @versanetworks.

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