



SILVER PEAK EDGECONNECT
SD-WAN SOLUTION
OVERVIEW
FOR SERVICE PROVIDERS

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www.silver-peak.com

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1 Introduction: SD-WAN Market Drivers

Enterprise Market Drivers:

- Geographically distributed enterprises increasingly view the cloud and Wide Area Network (WAN) as critical to connecting users to applications.
- Global Enterprises continue to accelerate the move to the cloud and unshackle from rigid legacy IT infrastructure
- Small and Medium-sized Enterprises are seeking turnkey IT solutions to focus on business growth and expansion mandates
- Application migration from the corporate data center to the cloud continues to accelerate, driving the need to reevaluate networking requirements, including broadband connectivity options to connect users in branch offices to cloud-based applications
- Greater reliance on the internet is redefining the economics of networking and fueling the need for ubiquitous and always-on user connectivity - at a fraction of the cost of traditional private MPLS networks (Internet connectivity is typically 1/10th the cost on a per-bit basis)
- Today's users have been conditioned by high performance residential broadband to expect the same level of real-time performance and quality of service when accessing business applications from the corporate network

Service Provider Market Drivers:

- Service providers must address the ever-increasing requirement for a managed SD-WAN service as a more agile alternative to existing managed WAN services to address the accelerating migration of enterprise applications to the cloud
- Incumbent service providers are under increasing pressure as enterprises evaluate new managed services offered by OTT service providers
- Internal pressure to utilize new network and software virtualization technologies to lower capital outlays and operational costs – communications service providers need to look more like cloud service providers
- Service Providers need to expand managed service offerings to become more customer-centric and identify new revenue streams
- Service providers need become more application aware and align with the enterprise customer's core business values rather than being a "pipe provider"

2 Silver Peak SD-WAN architecture

Silver Peak’s Unity EdgeConnect Portfolio creates a SD-WAN fabric that is used to provide secure connectivity with private line performance interconnecting enterprise locations with public clouds, private clouds, and service provider hosted services. Unity SD-WAN fabric virtualizes the underlying transport networks, whether they be private MPLS or public internet, and is completely independent of access technologies, whether it be carrier Ethernet, broadband Internet, or 4G/LTE. EdgeConnect SD-WAN provides the capability to best align the application requirements of a given enterprise to the underlying transport resources. WAN reliability and availability is greatly enhanced through the Silver Peak’s technologies as described in this document.



Figure 1: Silver Peak Unity Fabric

2.1 Unity EdgeConnect for Service Providers (EC-SP)

Silver Peak's Unity EdgeConnect Portfolio for Service Providers (SP) is comprised of following primary products:

- Unity EdgeConnect for Service Providers (EC-SP)
- Unity Boost – built-in WAN Optimization
- Unity Orchestrator-SP Multi-Tenant Management System

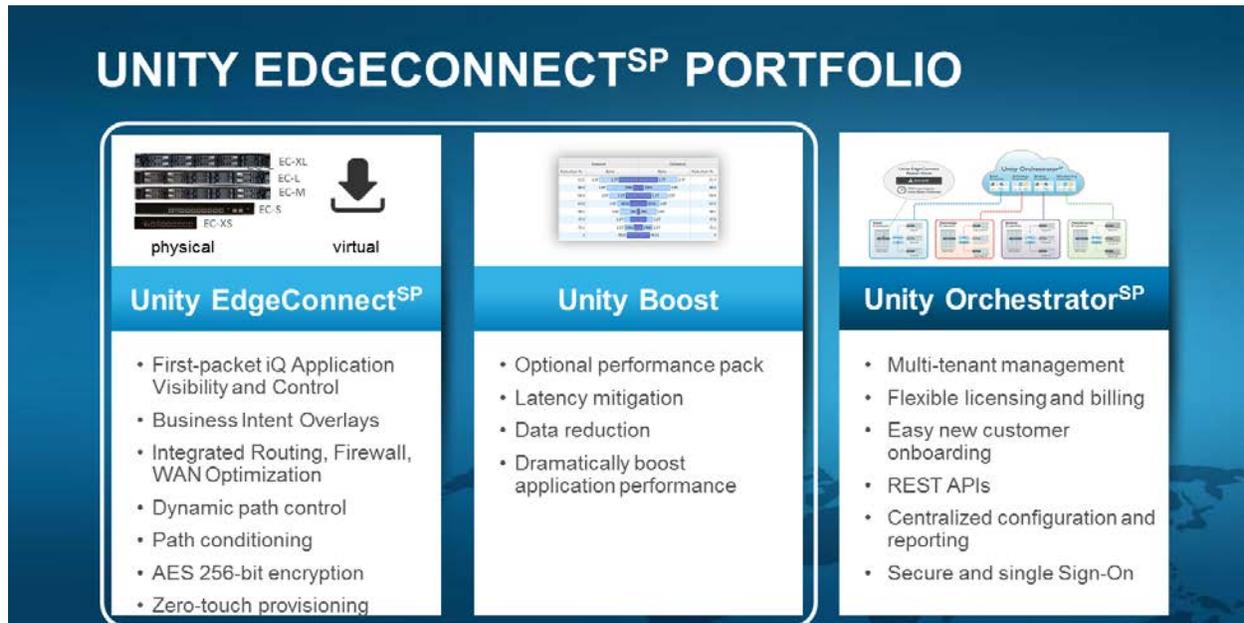


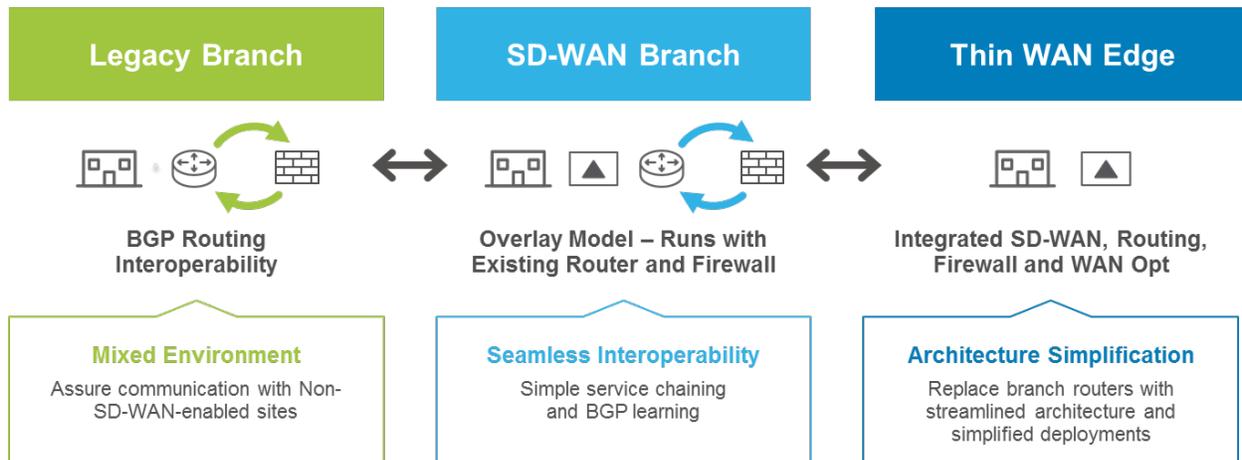
Figure 2: Unity EdgeConnect-SP Portfolio

Edge Connect (EC-SP) appliances ship in various form factors that cover Hybrid WAN needs of small, medium, large deployments required by service providers, for enterprise branch and data center locations. These appliances can be deployed with dedicated hardware or as a Virtualized Network Function (VNF) running over all the market leading hypervisors on Commercial Off-The-Shelf (COTS) x86 hardware. It is important to note that while licensed as a separate feature, Unity Boost integrated with SD-WAN in the same software image or same VNF.

2.1.1 EdgeConnect as a Thin Branch

In thin branch applications, EdgeConnect is deployed as a stand-alone element replacing legacy functions such as customer edge routers and firewalls. In brownfield deployments, EdgeConnect can sit behind existing routers and firewalls if desired. However, in many cases the maintenance costs associated with the existing equipment makes their retention prohibitive. EdgeConnect contains the necessary routing and firewall functions to be deployed single network function thereby enabling both resource and cost efficiency.

SEAMLESS INTEGRATION OR BRANCH ROUTER REPLACEMENT



2.1.2 EdgeConnect Software Capabilities

The base SD-WAN license includes the following features:

- 1 Zero Touch Provisioning
- 2 Routing (BGP and OSPF)
- 3 Stateful Firewall
- 4 256 AES IPsec VPN
- 5 Path Conditioning
- 6 Dynamic Path Control
- 7 Application Visibility and Control with First-packet iQ™
- 8 Business Intent Overlays
- 9 QoS
- 10 SaaS Optimization
- 11 High-Availability Branch Deployments

These capabilities are explained in detail below.

EDGECONNECT^{SP} FEATURE OVERVIEW

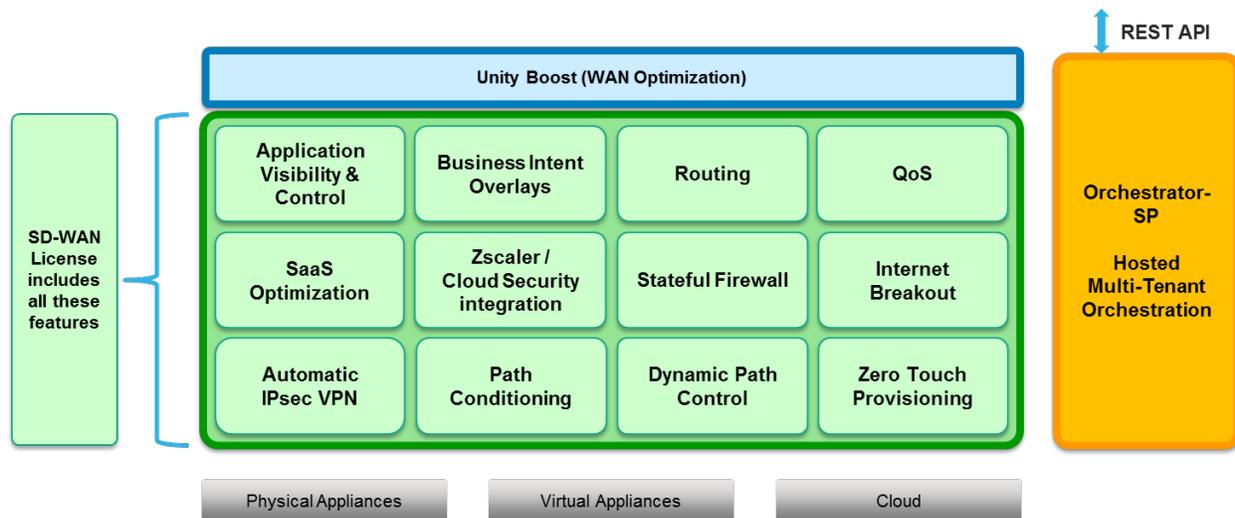


Figure 3: EdgeConnect-SP Feature Overview

2.1.2.1 Zero Touch Provisioning

Silver Peak Unity provides Zero Touch Provisioning for both physical and virtual appliances. This dramatically simplifies deployment and reduces configuration errors by enabling remote appliances to automatically download key configuration settings once plugged into a network such as IP addresses, QoS policies, optimization instructions, and predefined configuration templates.

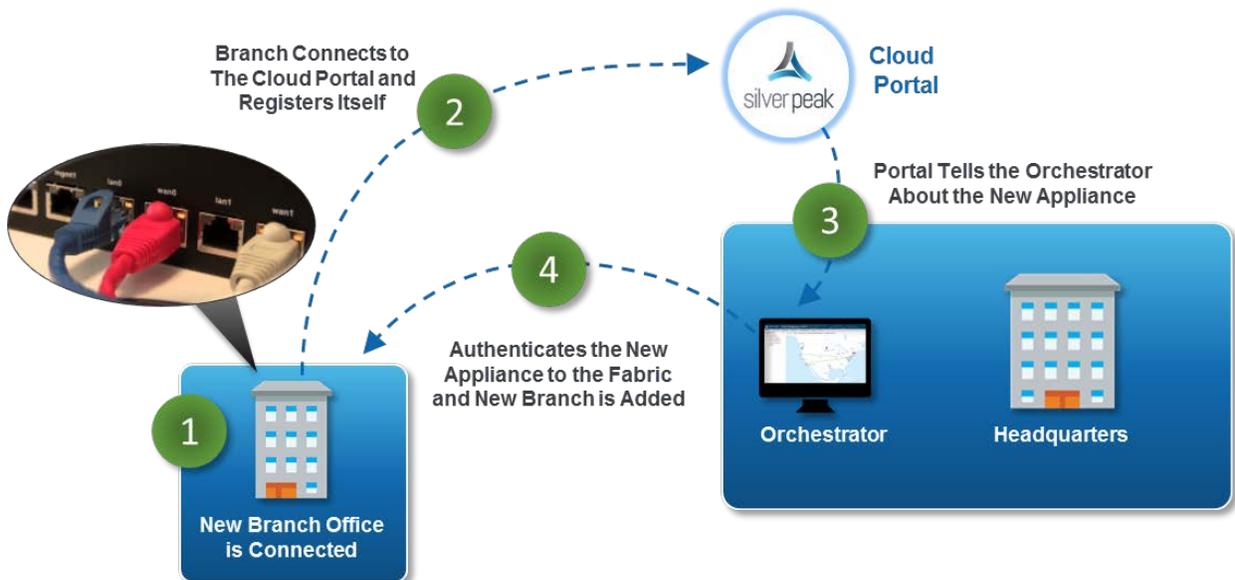


Figure 4: Zero Touch Provisioning Process

When an appliance is plugged into the network, it will automatically look for a DHCP address and will then connect via TLS to the cloudportal.silver-peak.com address. Once the appliance has successfully connected and authenticated with the Silver Peak Cloud Portal, it will share its serial number which is already associated with the customer account (or service provider account) in Silver Peak's system.

After the appliance is registered, the Silver Peak Cloud Portal will notify the Silver Peak Orchestrator that the new appliance is online, and it will also send a notification email (to anyone listed) that a new appliance is available. After the Orchestrator has been notified of the new appliance, it will allow an administrator to authenticate the new appliance (either through the GUI or through the REST API) and push policies down to join it to the appropriate end-customer's Unity Fabric. At the point, the appliance is service ready, and traffic will flow.

2.1.2.2 Routing: BGP and OSPF

EdgeConnect supports BGP with two primary functions

1. Advertise subnets to peers. Assuming there are multiple subnets within the enterprise (on the LAN side of the appliance), EdgeConnect can advertise those subnets to all peers on the SD-WAN fabric
2. Peer with Service Provider PE router. As an end-customer rolls out SD-WAN to their branch locations, there will be some sites with SD-WAN appliances, and others that do not – either as a transitory state, or perhaps may never get a SD-WAN appliance. eBGP on the WAN side enables reachability between EdgeConnect sites and non-EdgeConnect sites.

EdgeConnect supports OSPF for LAN-side routing.

2.1.2.3 Stateful Firewall

Silver Peak appliances support stateful firewall and "WAN hardening". With WAN hardening, data is secured edge-to-edge via 256-bit AES encrypted tunnels. No unauthorized outside traffic is allowed to enter the branch. With the option to deploy EdgeConnect directly onto the Internet, WAN hardening secures branch offices without the appliance sprawl and operating costs of deploying and managing dedicated firewalls.

EdgeConnect includes a stateful firewall feature for local Internet breakout support. In addition, tunnel termination with 3rd party devices such as Zscaler is supported. The figure below illustrates the various options available. In upcoming releases, more 3rd party firewall vendors will be supported.

Traffic Forwarding Options with Stateful Firewall

- Business Intent Overlay to Silver Peak Peer
- Peer to PE via eBGP for traffic to non-SD-WAN sites
- Direct-to-Net for select Internet applications
- Service Chaining to Cloud-based Firewall

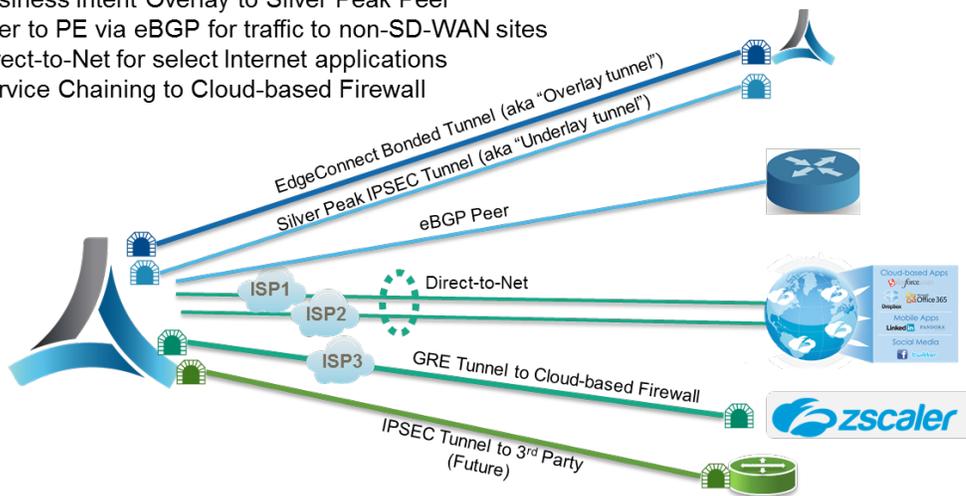


Figure 5: Traffic Forwarding with Stateful Firewall

2.1.2.4 256 AES IPsec VPN

The Silver Peak Unity EdgeConnect solution utilizes 256 bit, IPsec AES encryption tunnel encapsulation to interconnect EC-SP nodes to automatically create secure, virtual private networks that virtualize the physical underlying networks. In certain scenarios, GRE and UDP encapsulation is used to connect to 3rd party devices such as cloud-based firewalls.

As new nodes are installed and accepted into the Unity SD-WAN fabric, Unity Orchestrator is responsible to build underlay and overlay tunnels as required. There is a process by which that given node is permitted to join one or more Business Intent Overlay networks, which defines which tunnels need to be built. This includes the ability to build out and continually maintain a flexible fabric of mesh, partial mesh, or hub-and-spoke architectures as required by each independent Business Intent Overlay. Generic labels are used to define which ports on a pair of nodes needs to be connected. For example, ports can be labeled "Internet" or "MPLS". Orchestrator builds the underlay tunnels connecting ports of the same label. Overlay tunnels are built based on the link-bonding policies as defined by the Business Intent Overlays.

As an IPsec-based overlay, performance of the hybrid WAN is optimized while maintaining complete independence of the underlying infrastructure. Optimal path choices are based on application requirements, geo-location, and packet-level determination of link quality, including line characteristics such as delay, loss, and jitter.

2.1.2.5 Path Conditioning

One challenge that an SD-WAN can address is how to best use higher bandwidth internet connections that are often one-tenth the cost of private line services. In general, internet (and also wireless) connections are not as reliable as private services like MPLS. Internet and wireless links often suffer

from packet loss and are more likely to experience outages. Silver Peak’s Forward Error Correction reconstructs lost packets which avoids TCP re-transmissions, substantially increasing the performance of broadband links. The ratio of FEC packets to data packets is configurable depending upon the business-criticality and real-time requirements of the application. Packet Order Correction (POC) algorithms re-order packets that arrive out of order at their destination. This is a fairly common occurrence when load balancing across different service providers’ networks. With FEC and POC, EdgeConnect can make internet connections perform as well as or better than private lines.

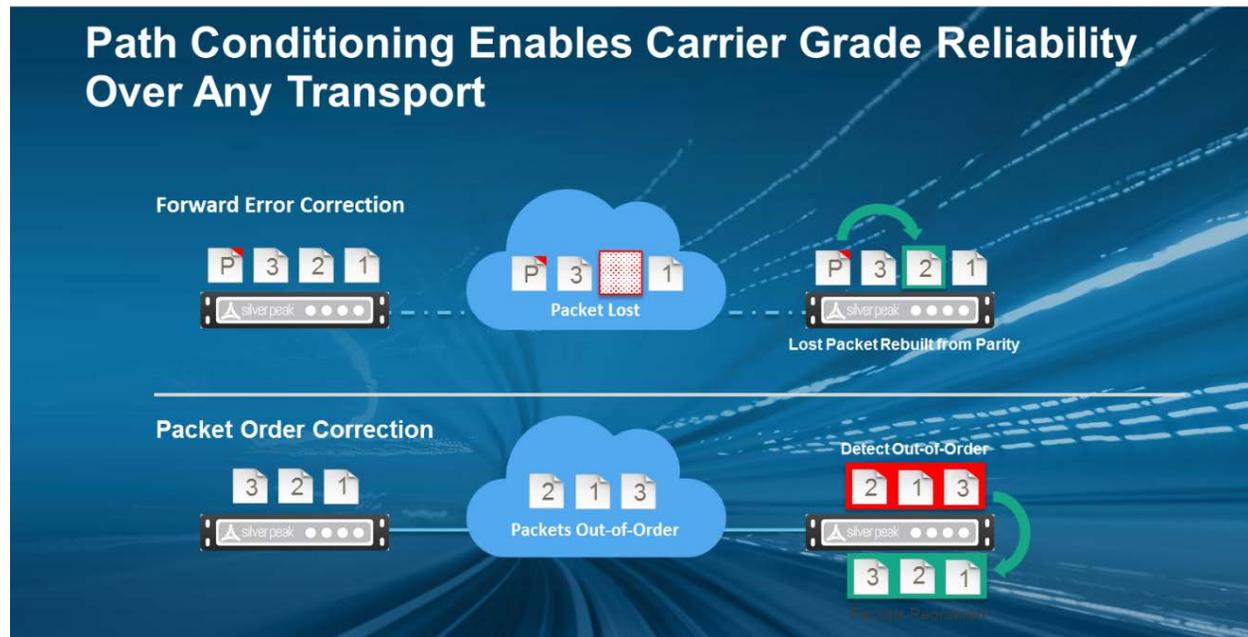


Figure 6: Path Conditioning

2.1.2.6 Dynamic Path Control

Tunnel Bonding provides several benefits including optimizing the SD-WAN for availability, throughput and efficiency. Bonded tunnels may be configured from two or more physical WAN links to form a single logical overlay connection. As an example, bonded tunnels can be configured with two MPLS connections to create a primary bonded tunnel. For this example, one MPLS connection can be provided by “Carrier A” and the other by “Carrier B”. In another scenario, a single tunnel (logical connection) can be configured with an MPLS link and an internet link, even if the speeds of these services are not the same. Depending upon application requirements that are mapped into a virtual WAN overlay policy, EdgeConnect can load share traffic across both physical links or can map data traffic to one and Forward Error Correction (FEC) packets to the other. If one link were to fail, the remaining link would continue to carry all the traffic including FEC packets to keep the connection active and the application alive, avoiding any interruption or data loss

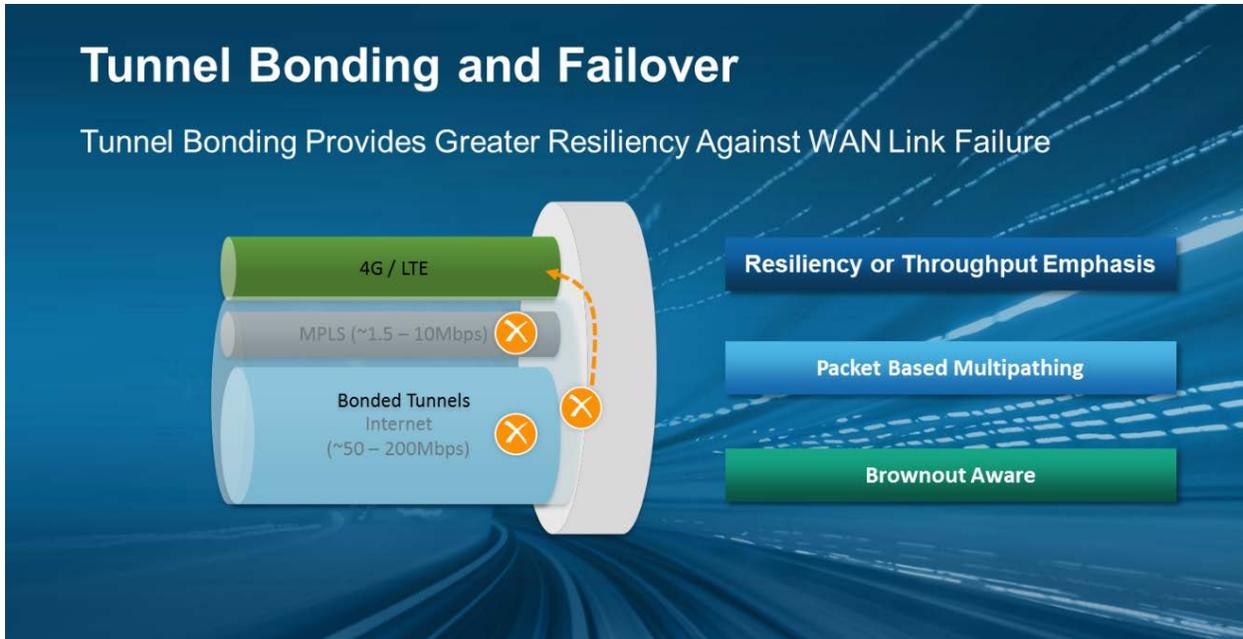


Figure 7: Dynamic Path Control

2.1.2.7 Application Visibility and Control with First-packet iQ

Silver Peak provides robust capabilities for Application Visibility and Control (AVC) which allow for route policies to be easily established based on applications or domains. Rapid classification is critical to make traffic forwarding decisions. Silver Peak has focused development that allows for **first-packet classification**. When different groups of applications are mapped to Business Intent Overlays, the decision on which overlay to place the flow needs to be done correctly on the 1st packet, otherwise application performance will suffer.

ADVANCED APPLICATION VISIBILITY AND CONTROL

First-packet iQ enables granular internet breakout

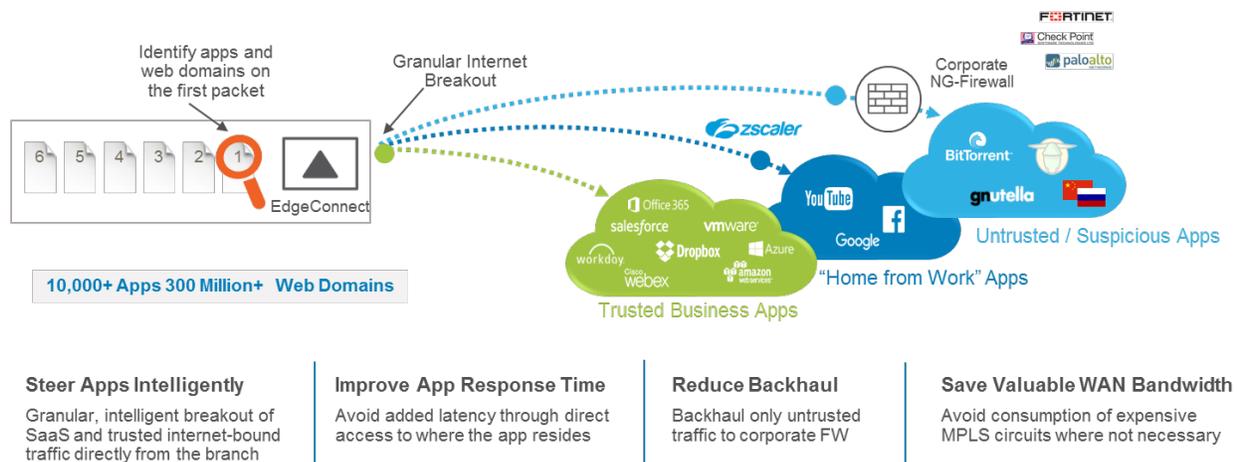
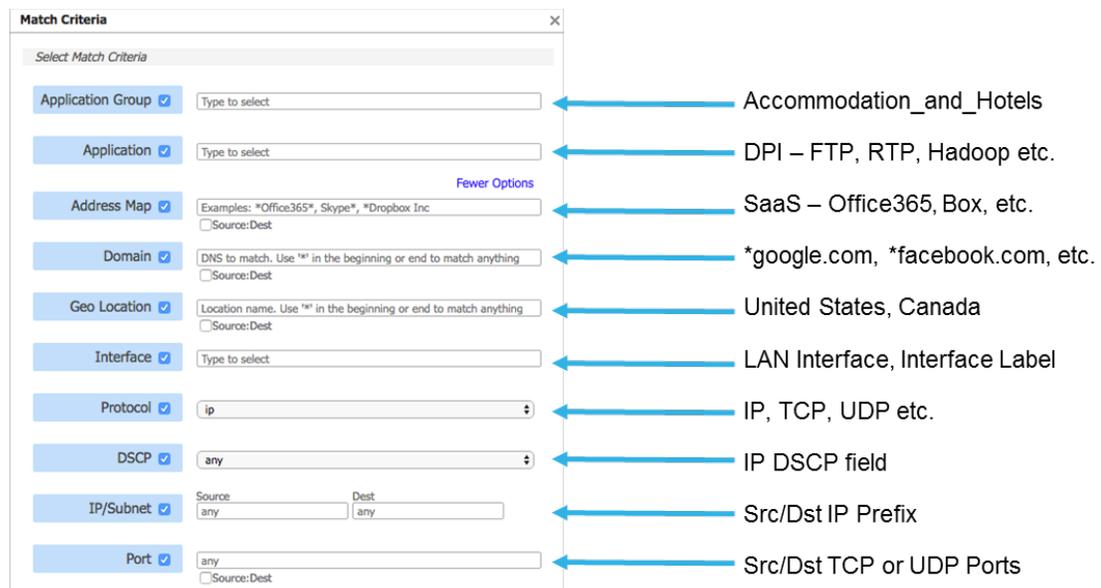


Figure 8: Application Visibility and Control

Silver Peak’s First-packet iQ application visibility covers a wide spectrum of match criteria for traffic classification:

- Application Groups with 200+ application and content based categories
- Approximately 300M Internet domains (Internet)
- Approximately 174K Internet domains matched through IP Intelligence
- SaaS applications dynamically updated through Cloud Portal
- Approximately 7000 built-in applications
- Out-of-band application definition updates
- Enhanced user-defined apps: define applications based on domain, IP/subnet, not just port/protocol
- Scalable ACL infrastructure based on string match

OVERLAY MATCH CRITERIA



The screenshot shows a 'Match Criteria' configuration window with various fields and checkboxes. Blue arrows point from text labels on the right to specific fields in the window:

- Application Group** (checkbox checked) → Accommodation_and_Hotels
- Application** (checkbox checked) → DPI – FTP, RTP, Hadoop etc.
- Address Map** (checkbox checked) → SaaS – Office365, Box, etc.
- Domain** (checkbox checked) → *google.com, *facebook.com, etc.
- Geo Location** (checkbox checked) → United States, Canada
- Interface** (checkbox checked) → LAN Interface, Interface Label
- Protocol** (checkbox checked) → IP, TCP, UDP etc.
- DSCP** (checkbox checked) → IP DSCP field
- IP/Subnet** (checkbox checked) → Src/Dst IP Prefix
- Port** (checkbox checked) → Src/Dst TCP or UDP Ports

Figure 9 Match Criteria for Traffic Classification

2.1.2.8 Business Intent Overlays

Silver Peak’s Unity SD-WAN solution builds virtual network overlays that can be mapped to business intent policies. Each Business Intent Overlay is provisioned with its own access policy, virtual topology (full mesh, hub-and-spoke, dual-hub-and-spoke), underlying transport mechanism, and QoS policies. Each EdgeConnect SD-WAN fabric can support up to seven (7) Business Intent Overlays.

BUSINESS INTENT OVERLAYS

Virtual WAN overlays built for applications based on business priority

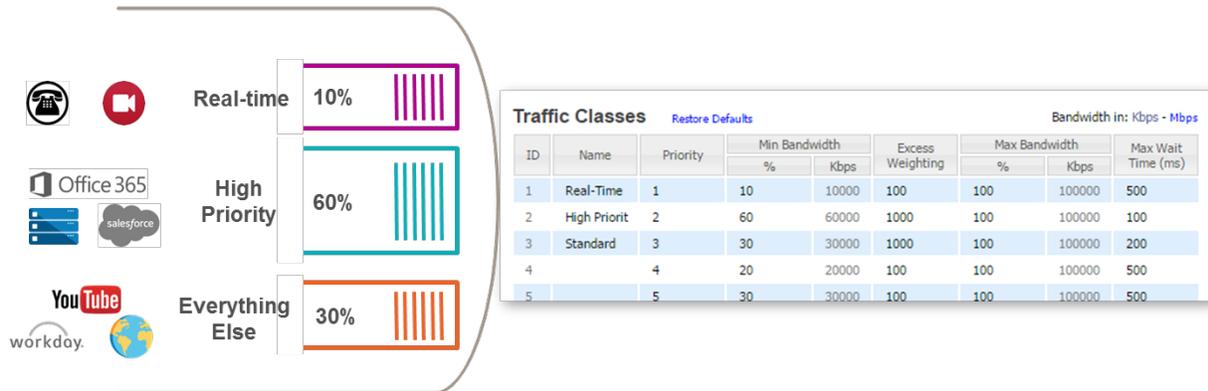
OVERLAY	APPLICATION	ROUTING	WAN PATH	SLA	PATH CONDITIONING	QOS	SECURITY POLICY	BOOST
REAL-TIME	REAL-TIME 	Mesh	MPLS Internet LTE (Backup)	1% Loss 150ms Jitter 300ms Latency	High Availability	Real-Time	Trust	<input checked="" type="checkbox"/>
CREDIT CARD PROCESSING	CC PROCESSING 	Hub and Spoke	MPLS Internet (Backup)	2% Loss 200ms Jitter 500ms Latency	High Throughput	Real-Time	Trust	<input checked="" type="checkbox"/>
ENTERPRISE WEB APPS	ENTERPRISE 	Local Internet Breakout	MPLS Internet LTE (Backup)	2% Loss 200ms Jitter 500ms Latency	High Throughput + Quality	High Throughput	Send to Firewall	<input checked="" type="checkbox"/>
GUEST WIFI	INTERNET 	Local Internet Breakout	Internet Drop	None	High Efficiency	Best Effort	Send to SWG	<input type="checkbox"/>

Figure 10: Business Intent Overlays

2.1.2.9 QoS

Different applications have different QoS and end-user experience requirements. For example, voice and video traffic requires zero packet loss and extremely low delay while file transfers need large amounts of bandwidth but some amount of delay is acceptable. Silver Peak lets customers define logical or virtual WAN overlays that reflect application QoS requirements relevant to the business. EdgeConnect maps applications to the appropriate overlay which enables the SD-WAN to optimize routing decisions – automatically. EdgeConnect continuously monitors bonded tunnels and physical WAN links, factoring real-time data about delay, jitter, packet loss to make intelligent routing decisions. A Silver Peak SD-WAN learns and adapts to optimize and dynamically change paths if necessary based on actual performance with no application disruption. When link conditions change, the SD-WAN can revert back to the original path. EdgeConnect performs both egress and ingress traffic shaping. IT can program minimum and maximum bandwidth limits on the egress traffic shaping engine per traffic class to ensure no single application consumes all of the WAN bandwidth. Ingress shaping can be programmed to ensure that low-priority traffic does not override higher priority traffic. An example is to prevent video streaming or social media applications from compromising the performance of higher-priority business applications.

QOS PROVISIONING ENSURE PRIORITY FOR CRITICAL BUSINESS APPS



- Ingress shaping assures low priority apps do not compromise business critical apps
- Egress shaping assures no single app can consume all WAN bandwidth
- Up to 10 unique traffic classes (QoS profiles) may be defined

Figure 11: QoS Provisioning and Traffic Shaping

2.1.2.10 SaaS Optimization

The SaaS Optimization feature ensures lowest-latency routing to well-known SaaS applications. In a given EdgeConnect deployment, certain nodes may be designated as SaaS gateways. The SaaS Optimization feature measures latency from each gateway node to the SaaS hosts. Within the SD-WAN fabric, the gateways then advertise their transit times to the fabric. All EdgeConnect nodes will use this information to determine the best egress gateway to reach a individual SaaS application.

SAAS OPTIMIZATION CLOUD INTELLIGENCE

Calculates the closest egress point to SaaS based on latency

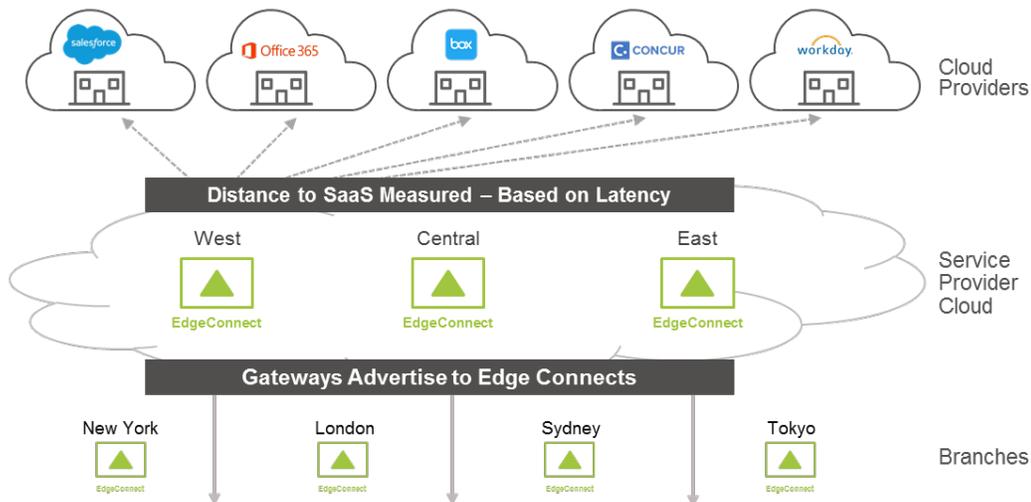


Figure 12: SaaS Optimization

2.1.2.11 High Availability

High Availability is achieved by providing fault tolerance on both the network side (WAN) and on the equipment side. The classic SD-WAN use case of “hybrid WAN” allows customer traffic to flow over multiple underlay networks – MPLS, Internet, wireless, etc. with the benefit being that if an underlay network has issues – whether degraded or totally down – the customer traffic is maintained. In addition to WAN resilience, EdgeConnect offers active/active system availability – both in physical network function (PNF) as well as Virtual Network Function (VNF) deployment scenarios.

In the diagram below, a branch deployment is shown with two EdgeConnect instances, each connected with a single WAN link to two different underlay networks. Note, no WAN-side switches are required. The EdgeConnects are inter-connected with a HA link that allows tunnels over each underlay to connect to both appliances. On the LAN side, Virtual Router Redundancy Protocol (VRRP) is used to direct customer traffic to the EdgeConnect appliances.

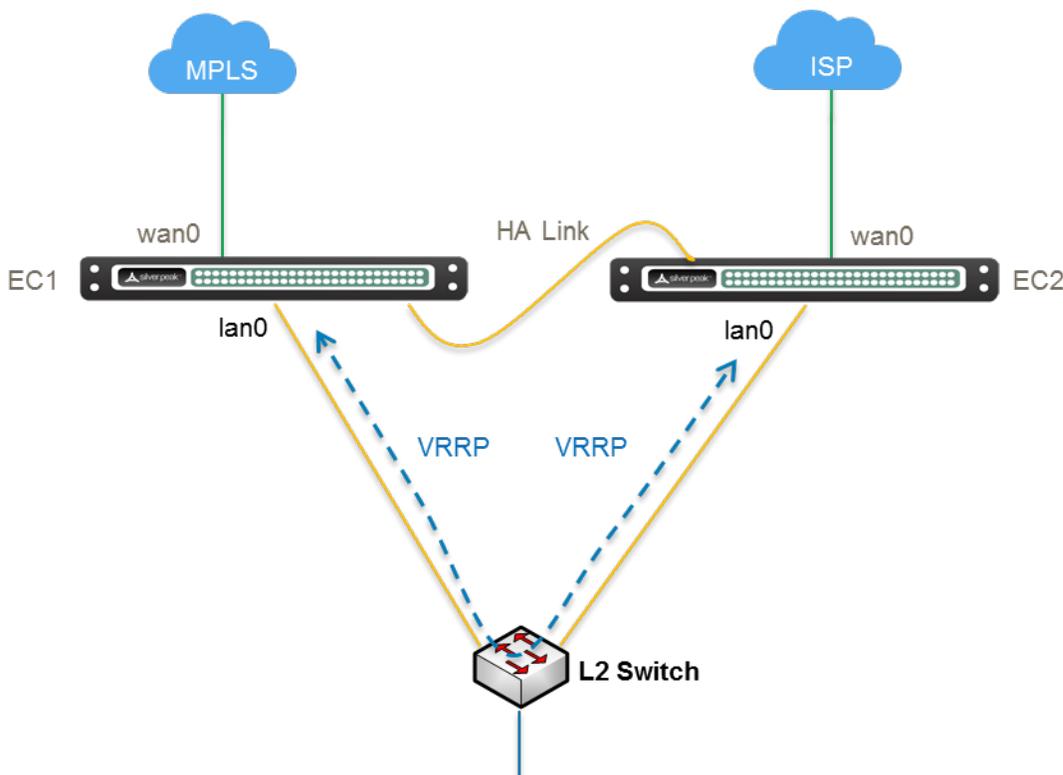
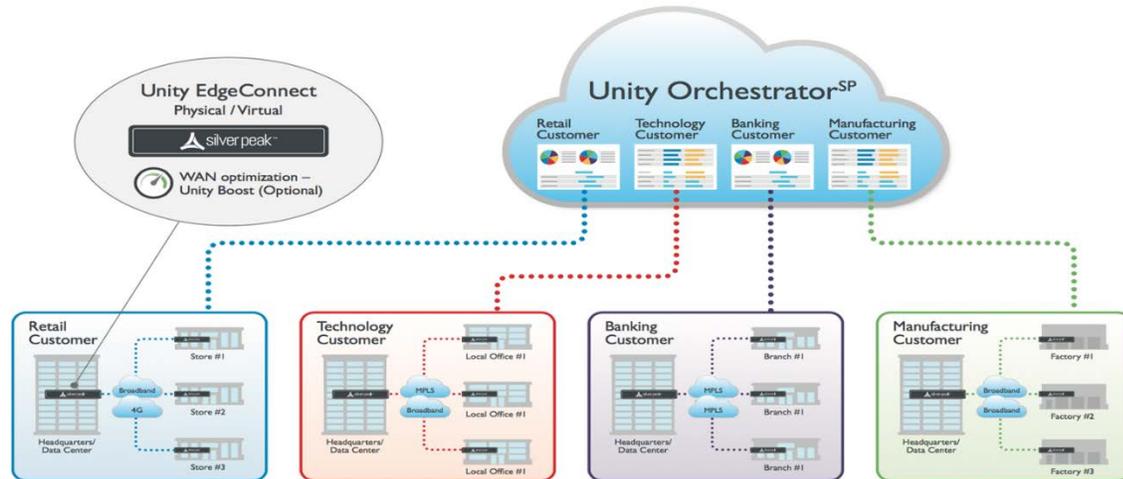


Figure 13 EdgeConnect Branch High Availability Deployment

2.2 Unity Orchestrator-SP

Silver Peak’s multi-tenant management and orchestration system, Unity Orchestrator-SP, is a centralized platform that provides extensive orchestration, configuration, reporting, visibility and troubleshooting capabilities, at both the service provider level and the end-customer level. Orchestrator-SP is a cloud-hosted solution which uses underlying web-scale technologies including hosting each end-customer in its own container, enforcing complete independence between end-customers.



Unity Orchestrator-SP provides a single sign on for service providers which gives immediate visibility to network statistics and state for all end-customers. Orchestrator-SP is also used to administrate the allocation of HW and SW assets to end-customers as directed by the service provider. For Metered (post-pay) applications, Orchestrator-SP provides the required usage statistics for billing.

For each end-customer, a container-based sub-Orchestrator provides centralized fabric control including tunnel configuration and maintenance and implementation of business intent policies. Customers can view and generate extensive reports.

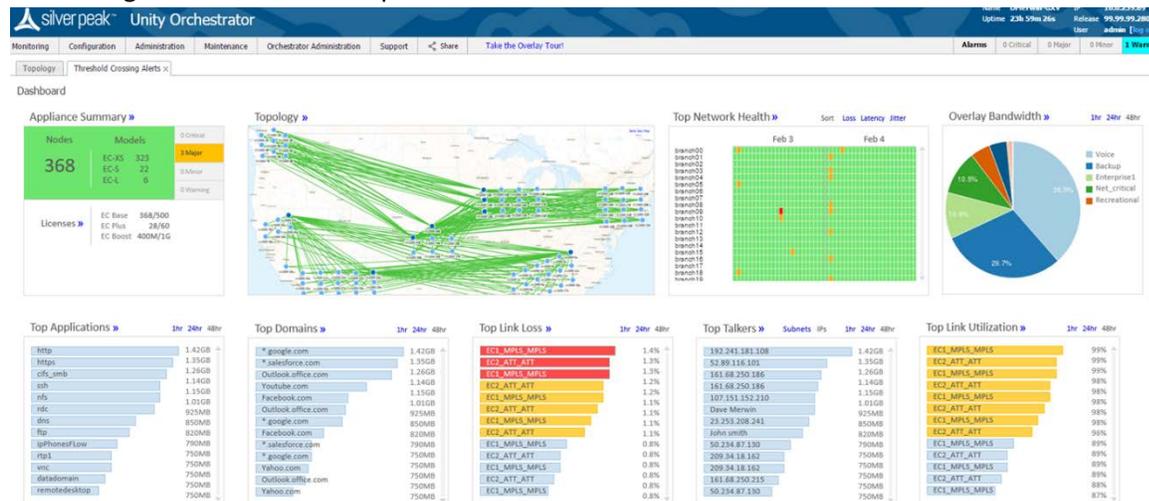


Figure 14: Orchestrator Dashboard

2.3 Unity Boost

Silver Peak takes SD-WAN performance even further for latency-sensitive applications or applications where large amounts of data must be transferred across the WAN. With the optional Unity Boost software performance pack, EdgeConnect integrates Silver Peak's field-proven WAN Optimization features in a single SD-WAN solution. By having Boost integrated with SD-WAN, it can be provisioned after the initial SD-WAN roll-out for a given end-customer without having to service-chain an additional VNF for the sole purpose of WAN Optimization. Boost is enabled at the business intent overlay level enabling Boost on critical applications while not requiring it for less-sensitive applications.

HIT THE ACCELERATOR WITH UNITY BOOST

Optional performance pack to accelerate applications when and where needed



Unity Boost key features include:

- 1 Application Acceleration (Latency mitigation) which improves application response times over distance
- 2 Data reduction (compression and deduplication) which eliminates the transmission of redundant data. This capability is also referred to as “Network Memory”.

2.3.1 Latency mitigation

TCP Acceleration uses techniques such as selective acknowledgements, window scaling, and message segment size adjustment to mitigate poor performance on high-latency links.

2.3.2 Data reduction (Network Memory)

This technology addresses limited bandwidth through advanced fingerprinting algorithms to examine all incoming and outgoing WAN traffic. Network Memory localizes information and transmits only modifications between Boost-enabled SD-WAN nodes.

IP Header Compression is the process of compressing excess protocol headers before transmitting them on a link and uncompressing them to their original state at the other end. Payload Compression uses algorithms to identify relatively short byte sequences that are repeated frequently. These are then replaced with shorter segments of code to reduce the size of transmitted data.

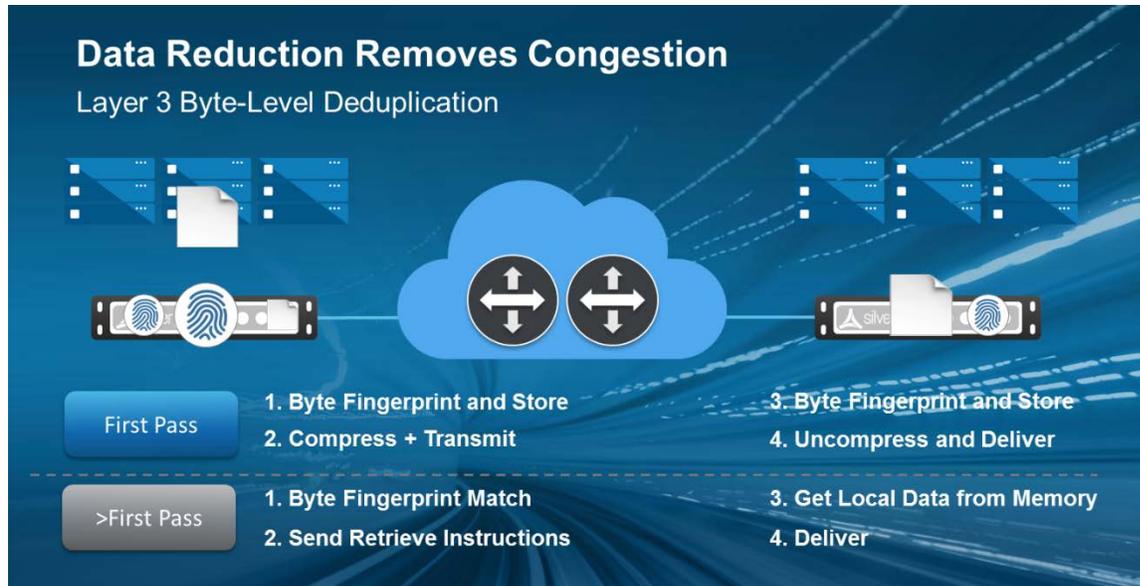


Figure 15: Data Reduction Through Deduplication

3 Silver Peak Solution Summary

Silver Peak enables service providers to bring new, differentiated, managed SD-WAN services to market quickly and cost effectively, to drive new revenue streams, expand market reach, and deliver SLAs both in and out-of-region.

Managed SD-WAN offer benefits to service providers include:

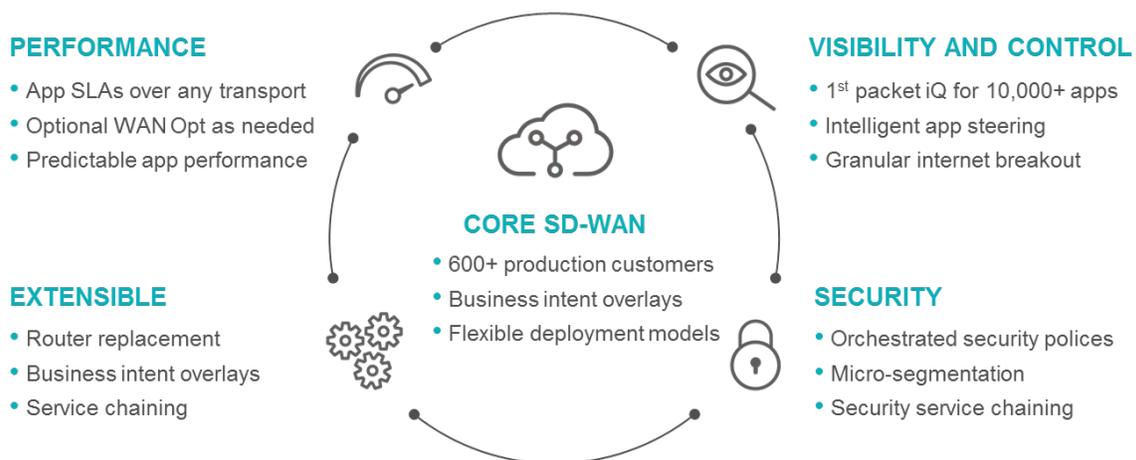
- Grow revenues and customer retention
- Expand managed service footprint across new regions and geographies
- Enable new differentiated service offers with application-based SLAs over hybrid networks
- Maintain customer satisfaction even when an underlying transport is provided by third parties and/or experiences impairments
- Create upsell opportunities for new managed application visibility and control and WAN optimization software services
- Deliver greater service agility
- Decrease time to design, build and deploy managed services
- Enable on-net, off-net and cloud service integration for applications across the enterprise customers

Silver Peak’s Unity EdgeConnect Portfolio is market leading:

- **Performance:** Path Conditioning/Forward Error Correction, WAN Optimization, System scalability
- **Application Visibility and Control:** First-packet iQ is unique in the industry providing granular Internet breakout policies
- **Security:** Stand-alone Thin Branch deployments or service chaining to next-generation firewalls
- **Extensibility:** interworking with routing protocols (BGP, OSPF), API integration with 3rd party systems

THE SILVER PEAK ADVANTAGE

The mature, premier solution for an application-driven WAN edge



With approximately 3000 WAN Optimizations customers, over 600 SD-WAN customers (and growing rapidly), and over ten years of company growth, Silver Peak is the ideal partner for to offer a managed SD-WAN service.

4 Additional Orchestrator Capabilities

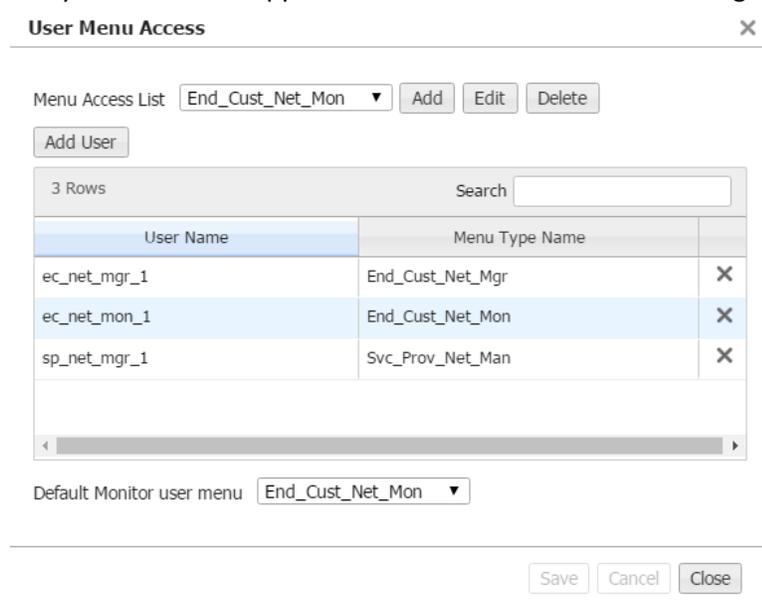
4.1 Role-Based Access Control (RBAC) / User Menu Access Provisioning

EdgeConnect appliances and Unity Orchestrator can be completely managed with REST APIs. It's important to note that any feature / capability that is available on the Orchestrator GUI is available via the REST API.

Depending on the managed service being offered by the service provider, there will be activities carried out by different parties with distributed responsibilities. The follow list includes examples:

- Service provider administrator (administer service provider user logins, system backups, software updates)
- Service Provider network planning (install new nodes into the network, administer Business Intent Overlays associated with the managed service)
- All the above could be driven by a northbound service orchestration system which may be driven by the service provider's OSS/BSS
- End-customer administrator (administer end-customer user logins and privileges)
- End-customer network manager (set up end-customer-specific policies, for example access control lists associated with enterprise-specific applications)
- End-customer network monitor (has network monitoring read-only privileges)

Unity Orchestrator supports customizable menu access for a given user/login permissions and privileges.



User Menu Access

Menu Access List: End_Cust_Net_Mon Add Edit Delete

Add User

3 Rows Search

User Name	Menu Type Name	
ec_net_mgr_1	End_Cust_Net_Mgr	X
ec_net_mon_1	End_Cust_Net_Mon	X
sp_net_mgr_1	Svc_Prov_Net_Man	X

Default Monitor user menu: End_Cust_Net_Mon

Save Cancel Close

In the example above, three access types have been defined:

- End Customer Network Manager
- End Customer Network Monitor
- Service Provider Network Manager

Menu Item Configuration x

Allow users associated with this list to access the selected menus below.

Name:

<p><i>Overlays</i></p> <p><input type="text" value="Overlay Prerequisites"/></p> <p><input type="checkbox"/> Deployment Profiles</p> <p><input type="checkbox"/> Business Intent Overlays</p> <p><input type="checkbox"/> Interface Labels</p> <p><input checked="" type="checkbox"/> IPsec Key Rotation</p> <p><input type="checkbox"/> Apply Overlays</p> <p><input type="text" value="Discovery"/></p> <p><input type="checkbox"/> Discovered Appliances</p> <p><input type="checkbox"/> Configuration Wizard</p> <p><input type="text" value="Licensing"/></p> <p><input type="checkbox"/> Licenses</p> <p><input type="checkbox"/> Silver Peak Cloud Portal</p> <p><input type="text" value="SSL"/></p> <p><input checked="" type="checkbox"/> SSL Certificates</p> <p><input checked="" type="checkbox"/> SSL CA Certificates</p> <p><input checked="" type="checkbox"/> SSL for SaaS</p>	<p><i>Templates & Networking</i></p> <p><input checked="" type="checkbox"/> Templates</p> <p><input type="text" value="Networking"/></p> <p><input checked="" type="checkbox"/> Deployment</p> <p><input checked="" type="checkbox"/> Subnets</p> <p><input checked="" type="checkbox"/> Interfaces</p> <p><input checked="" type="checkbox"/> Bridge Interfaces</p> <p><input type="text" value="DHCP"/></p> <p><input checked="" type="checkbox"/> DHCP Server Defaults</p> <p><input checked="" type="checkbox"/> DHCP Leases</p> <p><input type="text" value="Tunnels"/></p> <p><input checked="" type="checkbox"/> Tunnels</p> <p><input checked="" type="checkbox"/> Tunnel Groups</p> <p><input type="text" value="Routing"/></p> <p><input type="checkbox"/> VRRP</p> <p><input type="checkbox"/> WCCP</p> <p><input type="checkbox"/> BGP</p>	<p><i>Policies</i></p> <p><input checked="" type="checkbox"/> Route Policies</p> <p><input checked="" type="checkbox"/> QoS Policies</p> <p><input checked="" type="checkbox"/> Schedule QoSMap Activation</p> <p><input checked="" type="checkbox"/> Optimization Policies</p> <p><input checked="" type="checkbox"/> NAT Policies</p> <p><input type="text" value="ACLs"/></p> <p><input checked="" type="checkbox"/> Access Lists</p> <p><input type="text" value="Shaping"/></p> <p><input checked="" type="checkbox"/> Shaper</p> <p><input type="text" value="Applications & SaaS"/></p> <p><input checked="" type="checkbox"/> User Defined Applications</p> <p><input checked="" type="checkbox"/> Built-in Applications</p> <p><input checked="" type="checkbox"/> Application Groups</p> <p><input checked="" type="checkbox"/> SaaS Optimization</p> <p><input type="text" value="TCAs"/></p> <p><input checked="" type="checkbox"/> Threshold Crossing Alerts</p>
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In the example of End Customer Network Manager, they can configure many attributes as indicated by the check boxes, but can't provision new nodes, deployment profiles, business intent overlays, etc. Unity Orchestrator-SP provides full flexibility on a "menu-by-menu" basis.

4.2 Manageability and visibility to performance of network and applications

Unity Orchestrator-SP provides a rich and robust set of monitoring / reporting instrumentation. Both Orchestrator and the appliances support SNMP for data collection. NetFlow statistics are collected today by both the appliances and Orchestrator, and can be exported to any 3rd party device. Silver Peak's Network Monitoring Capabilities include:

- Network Health Map provides a key resource for mapping network events to service issues. Locations are shown by row, and time by column. By clicking on a given pixel, one can easily determine that state of the network in time.

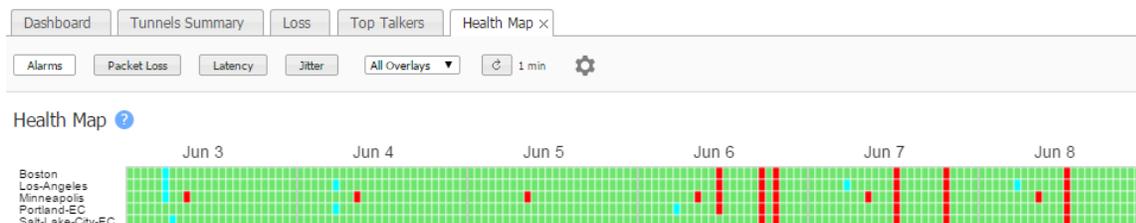


Figure 16: Network Health Map

- Top talkers. Identify which applications are using the most bandwidth across the WAN
- Bandwidth Utilization. Observe the total amount of bandwidth being utilized for both optimized and un-optimized traffic. An example of bandwidth consumption by application is shown below. Note the light blue represents LAN bandwidth, and the dark blue represents WAN bandwidth (Boost enabled).

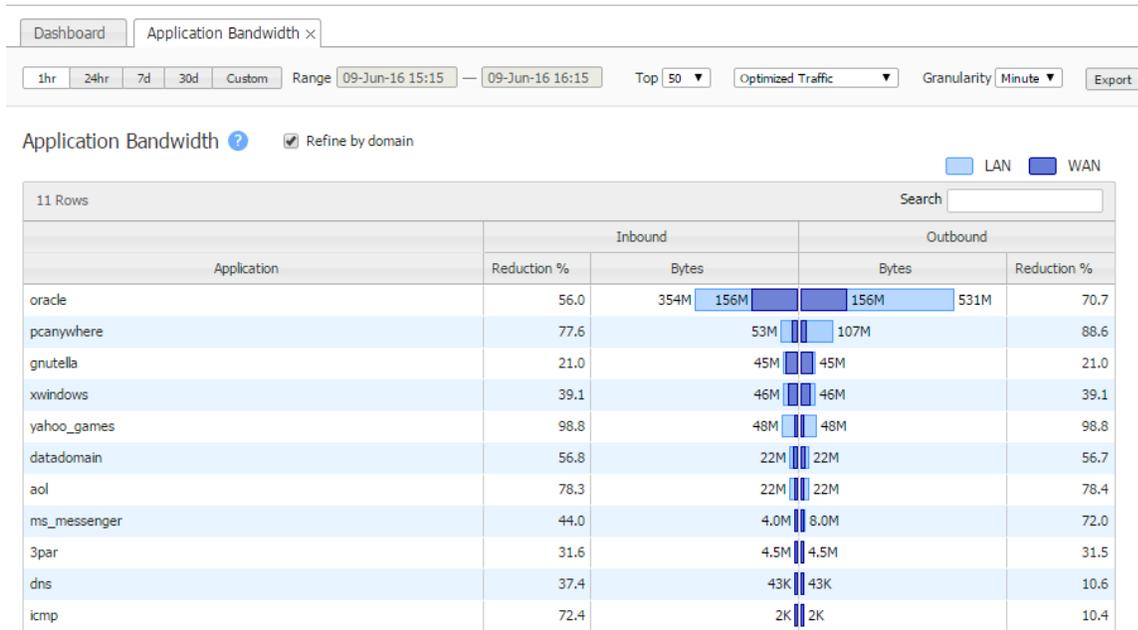


Figure 17: Application Bandwidth with Boost

- Bandwidth by application trends shows bandwidth consumption by application over time

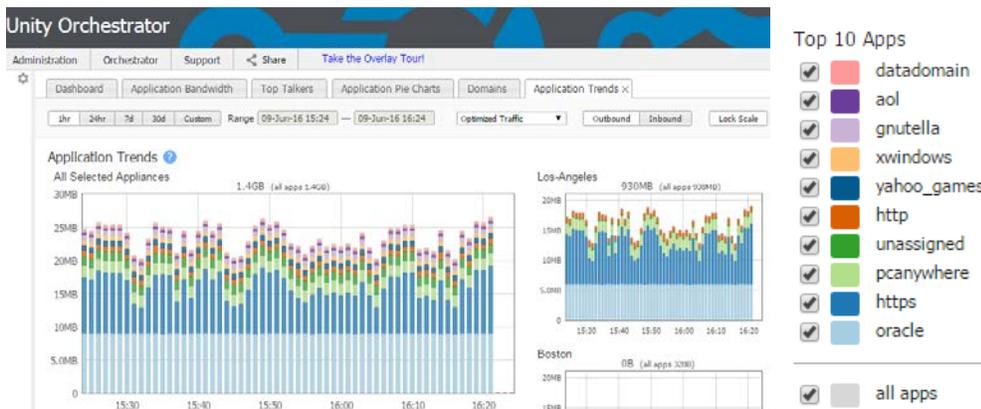


Figure 18: Bandwidth by Application Trends

- Network performance. Measure (in packets per second) the performance being achieved across the WAN for both optimized and non-optimized traffic.
- Flow count. Track the number of TCP and UDP flows generated across the WAN for both optimized and un-optimized traffic.
- Latency. Measure average and peak latency in real-time. Drill down into the portions of the WAN with the highest latency, and observe the impact of Silver Peak's Network Acceleration.

- Packet Loss. Measure average and peak packet loss in real-time, in aggregate and on individual WAN connections. Observe the impact of Silver Peak’s Network Integrity features. The graphic below shows loss summary for an example network link. This graphic shows pre-FEC error rate (light green) and post-FEC error rate (orange). Note, FEC may be disabled on certain links (all Orange).

Appliance	Tunnel	Pre-FEC		Post-FEC		Average Loss %		Average Loss %		Pre-FEC		Post-FEC	
		%(Max)	%(Max)	%(Max)	%(Max)					%(Max)	%(Max)	%(Max)	%(Max)
Los-Angeles	to_Portland-EC_Low_Priority	5.13	5.13	2.02	1.47	0.48	0.1	1.96	4.55	4.55			
Portland-EC	to_Los-Angeles_Guest_Wifi (8	4	2.01	0.1	0.04	0.05	1.75	2.4	0.68	5.26	2.3	
Los-Angeles	to_Portland-EC_Voice (FEC:)	2.34	0.22	1.77	0.04	0.05	1.75	1.67	3.85	3.85			
Los-Angeles	to_Portland-EC_Email (FEC:)	5.6	5.6	1.75	0.04	0.01	1.73	1.73	2.2	0.09			
Los-Angeles	to_Portland-EC_youtube (FE	2.47	0.36	1.74	0.04	0.01	1.73	1.73	2.2	0.09			
Portland-EC	to_Los-Angeles_Web (FEC: c	2.96	1.08	1.74	0.14	0.35	1.7	1.7	3.81	2			

Figure 19: Pre-FEC and Post-FEC Packet Loss Monitoring

- Live View shows brown out conditions on the individual links, but error-free performance on the bonded link.

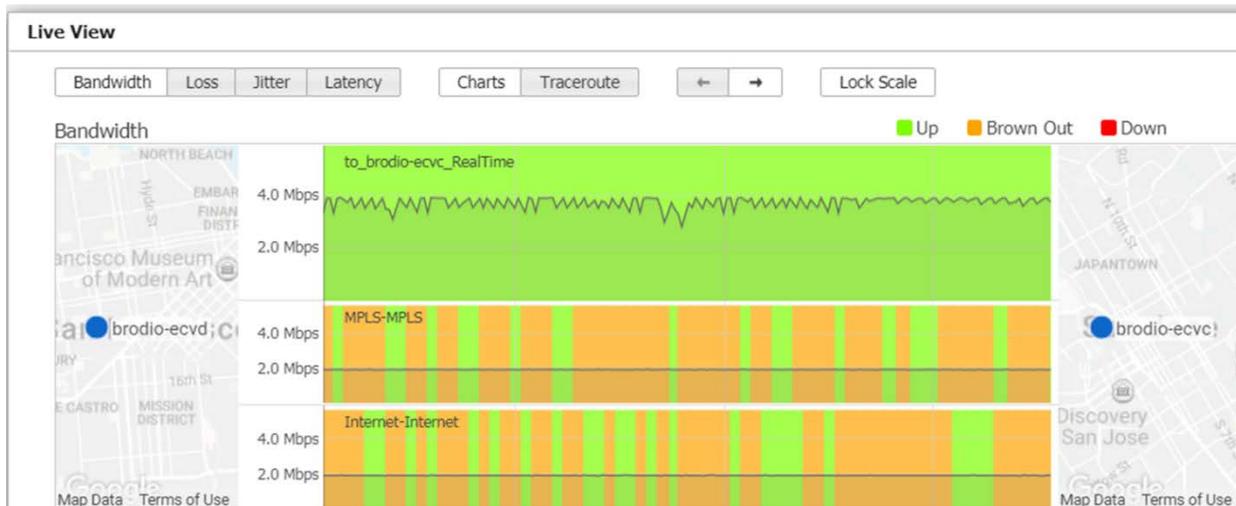


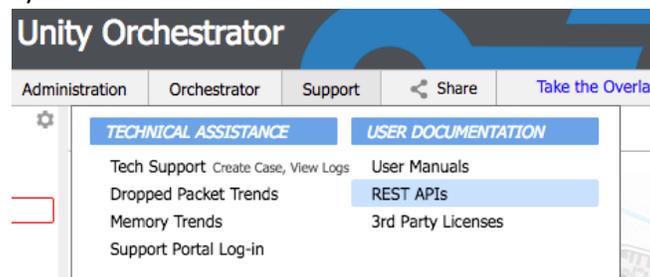
Figure 20: Orchestrator Live View

- Out of Order packets. Measure how many packets are delivered out of order across the WAN, on average and during peak periods.
- Data reduction. Compare LAN side throughput to WAN side throughput to determine how much data is being eliminated across the WAN using Silver Peak’s Network Memory™.
- Silver Peak Application Monitoring:
 - Optimized vs Un-optimized. Determine which applications are benefiting from Silver Peak’s WAN optimization and which are in “pass-through” mode.
 - Trends. Silver Peak helps network managers discover and analyze trends in application behavior, including performance during a specific time of day or time of week
 - Data reduction by application. Silver Peak reports on both LAN and WAN side data being sent on an application by application basis. This demonstrates the value being received by Silver Peak’s Network Memory technology on specific types of WAN traffic.

- Virtual Bandwidth (i.e. data reduction). Silver Peak shows which applications experienced the highest levels of data reduction. Average and peak data reduction can be shown across the top ten applications.
- Daily Traffic Mix. Applications with the highest LAN side throughput
- Simultaneous flows. Summarize the quantity of accelerated and non-accelerated flows in a given time period. Summarize TCP flows vs non TCP flows.
- Network Integrity (i.e. SLA enforcement). Silver Peak shows how much loss was seen before and after FEC is enabled, on a tunnel-by-tunnel basis. It also shows the “peak” loss for a given tunnel during the timeframe. Similar metrics are provided for out-of-order packets. This report helps enterprises keep their service providers “honest” with respect to WAN Service Level Agreements (SLAs).
- WAN Utilization. Identify the aggregated bandwidth utilized by the top 10 applications
- BOOST bandwidth savings show how much the appliances are saving in WAN bandwidth (Mbps).
- Latency. Silver Peak shows average and peak latency across a specified period of time

4.3 REST API Integration

Silver Peak integrates with service provider OSS/BSS and/or northbound orchestration systems via REST API. The complete API may be viewed via the Orchestrator as follows:



Orchestrator REST APIs

This page provides documentation about the REST APIs provided by Orchestrator software. You can interact with Orchestrator software directly using this page.

Created by Silverpeak API Team. For further help, send email to eng-ux@silver-peak.com

login : Login and logout - authentication for REST APIs		Show/Hide	List Operations	Expand Operations	Raw
POST	/authentication/login	Authentication for REST API HTTP session			
GET	/authentication/logout	Logout of current HTTP session			
GET	/authentication/loginStatus	Get the current authentication status of the HTTP session			
gmsLicense : Orchestrator Licensing		Show/Hide	List Operations	Expand Operations	Raw
GET	/gmsLicense	Get current license key and information			
POST	/gmsLicense	Set Orchestrator license key			
GET	/gmsLicense/validation	Validate a new license key			
appliance : Add, delete and modify appliances		Show/Hide	List Operations	Expand Operations	Raw
group : Manage appliance groups		Show/Hide	List Operations	Expand Operations	Raw
aggregateStats : VXOA aggregate statistics		Show/Hide	List Operations	Expand Operations	Raw

Figure 21: REST API

5 Data Sheets and User Documentation

<https://www.silver-peak.com/resource-center>

<https://www.silver-peak.com/support/user-documentation>