The Case For SD-WAN:

Business And Technical Benefits For IT Partners And Resellers

A Packet Pushers Whitepaper

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Overview and Introduction

When Scott McNealy said that the network is the computer, it's doubtful even he could foresee the explosion of connected devices, online XaaS services and network-based content delivery that the Internet has fostered. According to TELoIP's own experiences with customers, 70% of enterprise WAN traffic is now destined for, or comes from, the public Internet.

The dramatic shift in WAN traffic patterns is driven by burgeoning enterprise adoption of cloud services, with AWS, Azure and Google Cloud growing at high double-digit rates. It's also driven by the explosion of remote users and mobile clients, a result of ubiquitous wireless connectivity and pervasive smartphone use.

The cost, convenience and performance of cloud services are prompting organizations to build hybrid infrastructure that splits workloads between internal virtual servers and IaaS. Simultaneously, SaaS products increasingly displace in-house applications.

Collectively, these changes to network usage create bottlenecks, performance problems and service outages on enterprise WANs designed for an era of mostly self-contained infrastructure and users.

Organizations need a new, Internet-centric WAN design, but one that continues to deliver enterprise-grade service, security and control.

Although traditional enterprise WAN circuits like Carrier Ethernet and MPLS can be scaled to handle higher Internet flows, they are costly and designed for private networks, not as Internet gateways. Most WAN budgets are already stretched due to increasing usage and the high cost of traditional circuits, so throwing more money at a telco to buy bigger pipes isn't an option.

A modern, price-sensitive approach employs intelligent SDN software with centralized management and control to build private overlay networks over broadband Internet circuits. These combine the low-cost, universal availability and high bandwidth of broadband service with sophisticated software and a managed, CDN-like backend network with multiple POPs to deliver enterprise-grade networks as a service.

Known as software-defined WANs, this emerging market is poised to disrupt traditional WAN carriers. In fact, IDC estimates SD-WAN sales will reach $6 billion by 2020, a CAGR of more than 90%. By pairing commodity connectivity with value-added network services, SD-WAN offers an attractive opportunity for channel partners, MSPs and VARs to augment their portfolio, capture new customers and generate additional revenue from existing clients.

SD-WAN 101

Enterprises have been using network overlays for years in the form of VPNs. VPNs let organizations securely tunnel traffic between sites or let remote employees connect to internal resources over untrusted public networks. The foundation of a typical SD-WAN can be thought of as a cloud-like mesh of VPNs that can connect multiple sites and route traffic directly to the public Internet.

Yet enterprises need more than just secure connectivity. SD-WAN overlays have emerged to offer features that improve performance, network quality and reliability, control and traffic prioritization, and even add higher-layer network services that are delivered through Network Functions Virtualization (NFV).

And because it's a software overlay, SD-WAN works on *any public Internet circuit,* which means a single enterprise SD-WAN can operate over multiple link types, whether cable, DSL, 3G/4G or even MPLS.

Although SD-WAN is a relatively new concept, vendors and market analysts have identified the following key features:

• Traffic sharing and path steering across multiple links based on policy. Ideally, this includes delivering link aggregation with 100% network efficiency and the ability to automatically move traffic among links based on real-time performance monitoring for path selection.

• Centrally managed traffic and network policies over any WAN.

• Simple WAN order entry, configuration, deployment, monitoring and reporting with zero-touch provisioning of customer endpoints. A cloud management portal that collects traffic statistics and provides network analytics provides additional value.

• Support for a variety of network services including fully managed multipoint encryption, secure remote access, WAN optimization, and firewalls.

The result is lower costs for WAN connectivity, reduced dependence on expensive private MPLS networks, rapid provisioning of new circuits and the ability to change bandwidth capacity in minutes instead of days.

TELoIP™ Products and Technology

TELoIP has been developing innovative software-defined overlay networking technology since its inception over a decade ago. The company's current SD-WAN and SD-Internet™

products combine patented technologies into a turnkey, cloud-managed Virtual Intelligent Network Overlay (VINO™) that works with TELoIP's managed cloud infrastructure.

Built on multiple, foundational SD-WAN related patents, TELoIP's products deliver quantifiable improvements in WAN network performance, particularly for small, SOHO and ROBO sites.

One of TELoIP's first patents for Autonomous Network Aggregation (ANA) illustrates a key advantage of its VINO software: the ability to build overlay networks that aggregate multiple and diverse carrier circuits from any ISP into a single, virtual network. ANA means that enterprise WANs need not be tied to a specific service provider and can be easily expanded, either by increasing capacity on an existing circuit or adding another physical link.

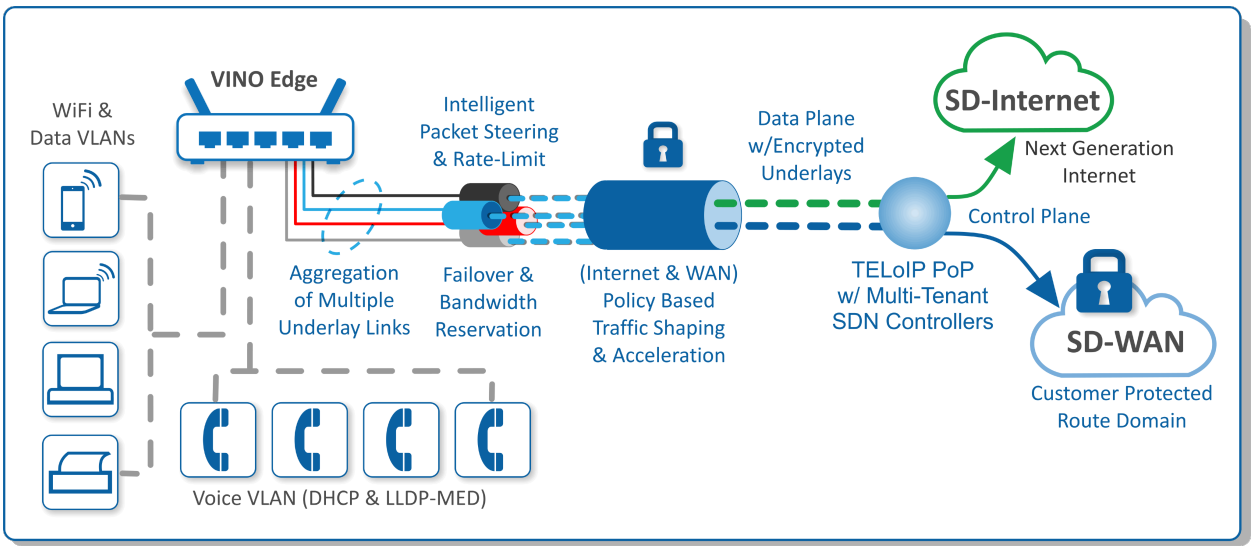


Figure 1: VINO Data Plane with optimization for SD-WAN and SD-Internet Traffic

Since there's more to a network than capacity, several other TELoIP patents provide the service quality, reliability and performance optimization necessary to turn commodity broadband into a robust enterprise WAN.

For example, its patent for multi-directional pathway selection (MDPS) allows pre-emptive fast failover between redundant links to ensure continuous availability with no disruption to network applications. Unlike other multi-WAN failover algorithms, MDPS monitors traffic packet by packet, not flow by flow, allowing it to react much faster to line problems or congestion.

Likewise, TELoIP's patented intelligent packet distribution engine (IPDE) provides bi-directional QoS on the raw underlay circuits for the software overlay network using an

advanced per-packet decision tree. This technology allows simultaneous voice and data communications over multiple links with traffic prioritization of real-time applications.

Together, fast failover and bi-directional QoS mean MPLS-like uptime and quality over broadband links with no disruption of real-time traffic such as VoIP calls.

Client Hardware and OS

TELoIP has developed an embedded OS for CPE appliances that enables the use of low-cost hardware that can be preconfigured, eliminating the need for local setup and administration. The appliances are centrally configured and managed, and are shipped ready for remote staff to connect and use.

For smaller branch locations, partners can deploy a highly affordable device capable of 50 Mbps aggregated bandwidth, or up to 10 Mbps with all SD-WAN features enabled. For larger networks, the TELoIP client OS powers switches that can scale up to 1 Gbps SD-WAN throughput, or can be run as a virtual appliance, with the same set of central management and control features, on any x86 VM server.

TELoIP offers four hardware endpoints spanning a broad range of price and performance. These include:

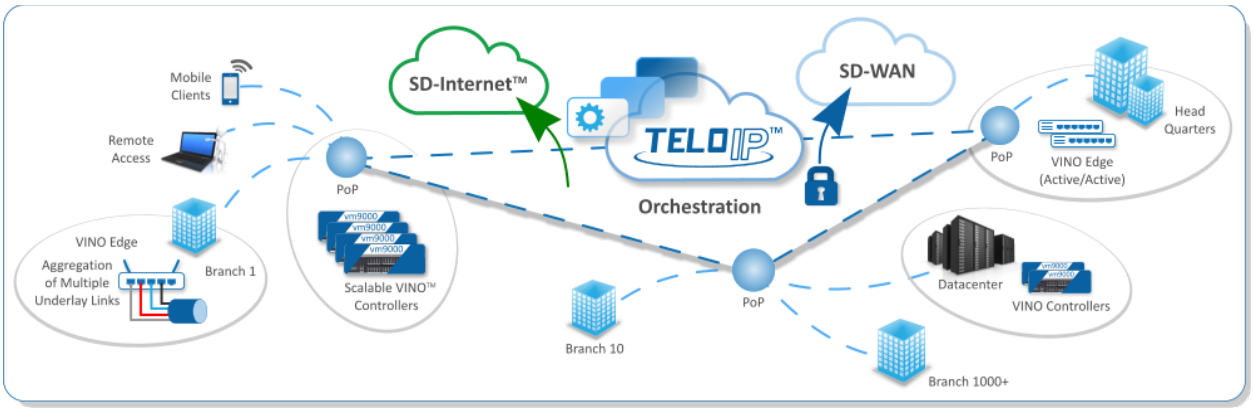
Table 1: VINO Edge CPE device descriptions

VINO Edge	*SD-Internet*	*SD-WAN*	*Ports*	*CPE Description*
Ai-100	*up to **50 Mbps***	*up to 10 Mbps*	*5 x 10/100/1000BaseT*	*Low cost, ideal for Entry to Small Branch*
Ai-400	*up to **200 Mbps***	*up to 50 Mbps*	*4 x 10/100/1000BaseT*	*Versatile for Small to Medium Branch*
Ai-600	*up to **500 Mbps***	*up to 300 Mbps*	*6 x 10/100/1000BaseT*	*More Power for Large Branch or HQ*
Ai-9000	*up to **1 Gbps***	*up to 1 Gbps*	*8 x 10/100/1000BaseT*	*For Data Center and HQ deployments*

The TELoIP Cloud Backbone

The foundation of TELoIP's SD-WAN is a network of distributed, carrier neutral Points of Presence (PoPs). TELoIP builds and operates its core SD-WAN network infrastructure with multiple PoPs that are strategically distributed to cover North America. The TELoIP Cloud backbone provides a more fully evolved SD-WAN overlay that manages data plane traffic on the network edge and control plane traffic moving through the network core. Remote sites connect to these PoPs using low-cost hardware or virtual appliances. The PoPs house the distributed backend SD-WAN overlay infrastructure where the virtual core network intelligence resides.

Figure 2: VINO customer network example with various sites connected to the TELoIP Cloud



Once connected to the TELoIP Cloud, individual circuits are subsumed into a centrally managed enterprise WAN that can aggregate, partition and control each physical link. Within the TELoIP Cloud, traffic is routed to its destination, whether to the public Internet or across TELoIP's backbone in a customer-protected route domain to another TELoIP PoP nearest the SD-WAN controlled remote office.

Via a central engine for network control and policy, various links in a TELoIP network can be aggregated and dynamically controlled to provide network redundancy, routing intelligence and long haul performance. Regardless of the throughput of local circuits, whether a 5 Mbps DSL circuit or Gigabit fiber connection, the TELoIP backend intelligently manages and directs traffic simultaneously across all links, controlling traffic prioritization and QoS, providing WAN and Internet optimization and other network services.

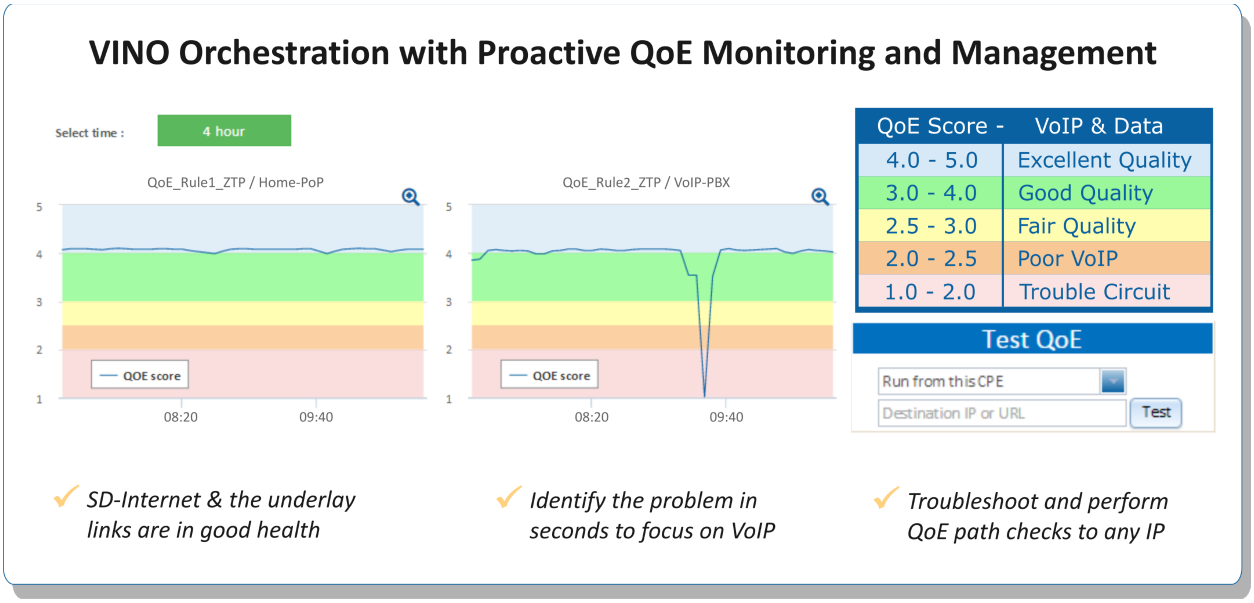
Network Management and Features

TELoIP's cloud-based admin portal centralizes and automates provisioning, management and performance monitoring. For example, managed service providers can build device templates that are used to automatically configure remote appliances when first connected to any DHCP-enabled link.

The cloud portal also aggregates performance and traffic statistics that are used to chart quality of experience (QoE) scores, SLA compliance and to predict performance for sites and key applications.

IT engineers know that network problems follow their own form of 80/20 rule: 80% (or more) of your time is spent just finding the problem. To reduce this time, TELoIP has built dashboards and visualizations into its portal that summarize network health and performance at a glance.

For example, the portal includes diagnostics and purpose-built VoIP management tools that facilitate troubleshooting and reduce the mean time to repair (MTTR) by grading network QoE on a 0 to 5 scale with a color-coded indicator of QoE score, which highlights links that are having problems.



In sum, TELoIP delivers an enterprise-grade network over any collection of broadband or private circuits. This includes the features businesses expect and that provide demonstrable improvements in performance, reliability and cost, such as:

- Link aggregation plus WAN and Internet acceleration

- Bi-directional QoS and fast link failover with no change in IP address

- Customer-protected route domain that allows partners and MSPs to provide customers with separate and individually controlled address spaces and route domains

• End-to-end IPsec class encryption with fully meshed dynamic point to multipoint over unicast control plane between PoPs

• Virtual network functions like Router, QoS, Firewall, Packet Scanner, and Troubleshooting Appliance

• Centralized management with an intuitive, user-friendly Web portal for order entry, provisioning, installation and monitoring

Partner-Centric Business Model

TELoIP relies upon channel partners, VARs and MSPs to deliver network services and support, and actively works with partners to deliver and customize solutions for their customers. TELoIP's business model is built around supporting partners and service providers, rather than selling directly to end users.

By relying on trusted partners to sell, deliver, customize and directly interact with customers, TELoIP can focus its resources on technology development that provides unique business value.

TELoIP provides white-label technology for resellers to package, customize and brand as a service. The admin portal is designed with service providers in mind, knowing that they manage many customers that have unique network needs and budgets. Its ingress PoPs are strategically distributed throughout North America, which means any location is within Proximal Aggregation range of TELoIP infrastructure.

Partner Business Value

Network services are a critical and increasingly important element of IT portfolios, as illustrated by the previously cited growth in WAN traffic and shift in usage patterns. For IT partners and service providers, TELoIP's products provide a compelling and profitable supplement to their existing service catalog with a leading edge network-as-a-service offering.

Combining low-cost, commodity broadband circuits with TELoIP software-defined infrastructure lets partners offer network services that deliver an order of magnitude or more speed improvement, yet save clients up to 70% over pricey carrier MPLS circuits.

As a cloud service requiring minimal investment in endpoint hardware, TELoIP SD-WANs allow partners to deliver enterprise-quality network services with little up-front costs, service commitments or on-site IT presence.

TELoIP provides partners with multiple service offerings, throughput capacities and price points. A universal, embedded TELoIP OS runs on a variety of hardware. What's more, TELoIP offers MSPs low-cost CPE, which makes it ideal for even the smallest organizations and sites.

The same software also works at scale, capable of forwarding in the gigabit per second plus range. The TELoIP OS can be deployed via pre-packaged hardware or software virtual appliances suitable for large enterprise data centers.

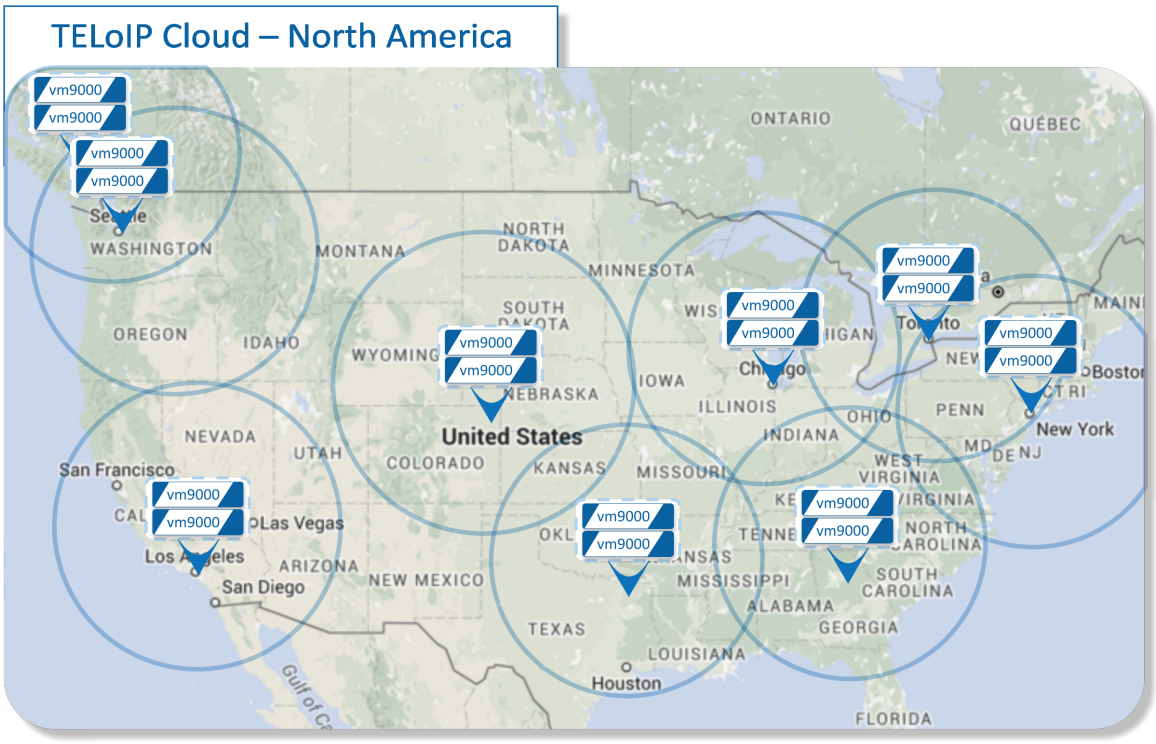
Using TELoIP, partners and MSPs can provide differentiated, high-performance network services with much better price/performance than traditional MPLS, carrier Ethernet or T-carrier circuits.

Unlike other SD-WAN offerings, TELoIP's wholesale, white-label distribution model lets partners customize and brand the services. Partners deal directly with TELoIP and maintain full control over the customer relationship. For qualifying partners, branding and customization extends to both CPE hardware and the management portal, which can be tailored for self-service operations by customers.

The management portal is built for the needs of partners serving many different clients. It includes real-time monitoring, network analysis and customer experience indicators including:

- QoE Visualizations with proactive QoE System Alerts and application QoE scores
- QoE for service destinations
- Customer network mapping
- CPE status
- Site availability and details
- Overall service status
- Real-Time traffic with NetFlow stats
- Link monitoring and visualizations
- Priority traffic rules and dynamic WAN route table
- Bandwidth reservations and usage details
- Speed tests and graphs

With local POPs throughout North America providing high-performance on-ramps to the TELoIP cloud, partners can deliver aggregated access to virtually any location or cloud-based application and provide SD-WAN service anywhere that broadband is available.



Indeed, TELoIP expands geographic reach by using SD-WAN technology with wireless LTE, which is becoming increasingly popular as a backup WAN or primary connection in remote locations.

Regardless of the last-mile connection, the combination of broadband availability and the TELoIP PoP network means partners can offer much wider network coverage than MPLS or Carrier Ethernet.

Partner Opportunities and Action Items

SD-WAN is a lucrative opportunity for partners that act fast and work with the right technology providers. As mentioned previously, IDC estimates a growth rate of more than 90% for SD-WAN by 2020. Furthermore, interest is broad, with IDC's survey of hundreds of companies finding that 70% plan to adopt some form of SD-WAN over the next 18 months.

For partners, SD-WAN provides a way to deliver enterprise features over low-cost, consumer-grade circuits. TELoIP can help partners deliver customized, branded services to

their customers with products and services that can scale from the smallest home office to largest enterprise data center.

When it comes to technology, words can convey only so much; seeing a product in action is much more convincing. Partners should arrange a technology demonstration and pilot test of the TELoIP solution and validate its performance, features and management interface.

Regardless of which SD-WAN technology ultimately used, partners and MSPs must have a plan for delivering enterprise-grade WAN services over commodity broadband network circuits; the price/performance benefits are too compelling to ignore. If your clients don't get it from you, they'll find a competitor that can deliver. Let TELoIP be your partner.