

VirtuLocity VLN™ Software Acceleration Service

Virtualized acceleration wherever and whenever you need it

Bandwidth Optimization with Adaptive Congestion Avoidance for WAN Connections

VirtuLocity VLN™ is a software solution that accelerates WAN connection's bandwidth throughput and transit time for private, public, or hybrid cloud applications. Perfect for user-to-cloud, cloud-to-end-user, or cloud-to-cloud connections, the software can be pointed downstream or upstream to improve WAN performance without having to be bookend (run simultaneously at both ends). Our patented VLN technology can be supported on private and public clouds, traditional datacenters with bare-metal servers, as well as hyper scale cloud platforms including AWS EC2, Azure or Google GCP. If you have ever experienced Internet or private network conditions exhibiting packet loss, requiring many hops, travel long distances with excessive latency, or simply are bandwidth challenged, (e.g. slower speed bandwidth connections via copper or 2G/3G infrastructure), VLN™ can accelerate your application's overall efficiency and WAN data payload transit time. VirtuLocity's VLN™ enables complete flexibility as a Platform-as-a-Service (PaaS) business

model and supports most major Linux operating system environments such as Ubuntu CentOS, Red Hat (RHEL) and Amazon Linux Operating Systems. VirtuLocity VLN™ can be used on a one-ended basis (no book-ending required) so it can easily be deployed and used for connecting to public, private, and hybrid cloud services, inter-cloud communications, and/or edge based CDN sessions to end-users for maximum impact, regardless of your network architecture.

Why is this important? Recent data from Akamai, 2016, shows that on worldwide basis, Content Distributed Networks (CDN) to end-user network conditions typically exhibit significant (more than 1.67% packet loss) across the globe. So, whether you are trying to speed up your uploads, generate cloud-to-cloud communications, or are delivering rich media such as video streams, web conferencing, or big data from your servers to end-users or businesses, VirtuLocity VLN™ accelerates your connections whenever and wherever you need it.

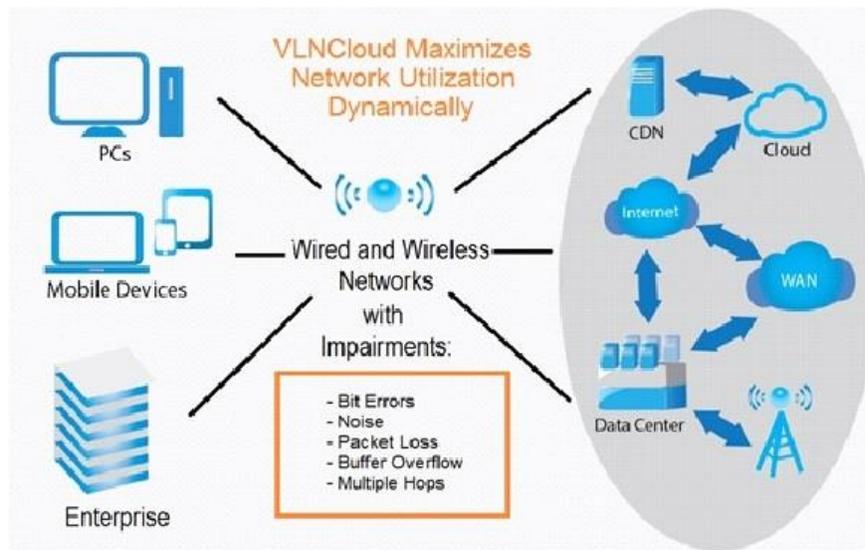


Figure 1: VLN is for bandwidth optimization and congestion control

Product Overview

VirtuLocity VLN™ is immediately available from VirtuLocity Networks as a stand-alone software solution or can be launched on Amazon AWS EC2 platforms merely with a few mouse clicks. We will also be offering support for most of the major cloud platforms such as Microsoft Azure¹ and Google GCP². VirtuLocity VLN™ is a Linux-operating system supported cloud service that can be quickly spun up as an on-demand, virtual instance and used in conjunction with your applications running on virtual machines, or can be installed on any Linux VM or bare-metal server in minutes.

¹ Azure, Azure Design, Windows Azure are trademarks of the Microsoft Corporation

² GCP is the trademark of Google Inc.

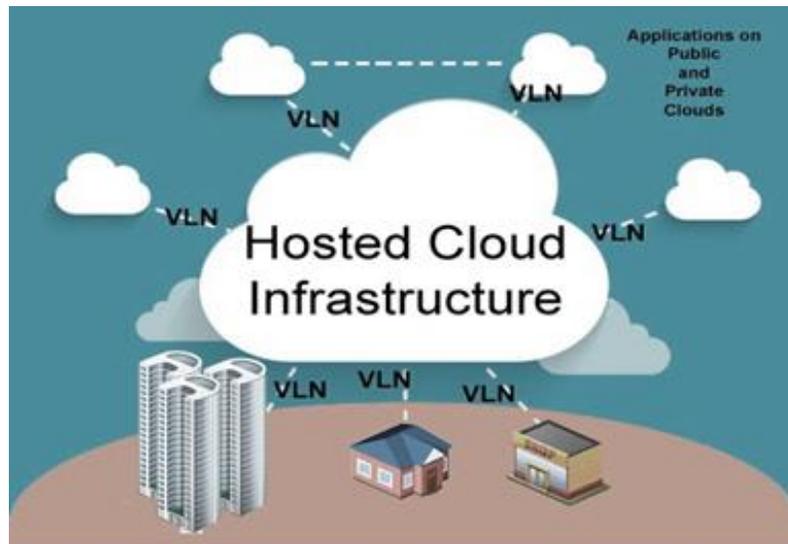


Figure 2: VLN optimizes private, public, or hybrid cloud-to-cloud and fixed-network-to-cloud connections

So why use VirtuLocity VLN? In worldwide performance tests, VirtuLocity VLN improves throughput and data payload transport time significantly (typically in excess of 80%), VLN™ enables you to improve cloud connectivity and end-user satisfaction with faster uploads, downloads, and improved latency across your WAN connection for smoother video and media streaming. VLN™ is also available as a turnkey cloud service on Amazon Marketplace and hosted by AWS EC2 compute platforms. The patented VLN software suite comes preinstalled on a variety of AWS EC2 virtual server platforms as an Amazon Machine Image (AMI), from which the user can spin their own instances using Amazon's various EC2 (elastic compute) instance types. Several types of instances are offered by AWS based on your applications' demands for compute power, network bandwidth, memory, geographic location, and storage size. Regardless of the Amazon AWS EC2 type, instances can be spun-up with a few clicks from your own AWS EC2 account dashboard from the VirtuLocity VLN AMI, offered on Amazon Marketplace. Once you decide to use VLN™ simply click on the EC2 platform you wish to use (e.g. rx4large, t2xlarge, etc.) and click on the buy button which automatically installs and activates VLN without any user involvement. Then any user application can be installed and deployed normally on the new EC2 instance with VLN. The VLN instances can be used whenever you need them wherever you need them and can be cancelled at any time. We also offer annual subscriptions with discounts if you want to integrate and use VLN across all of your various application workflows.

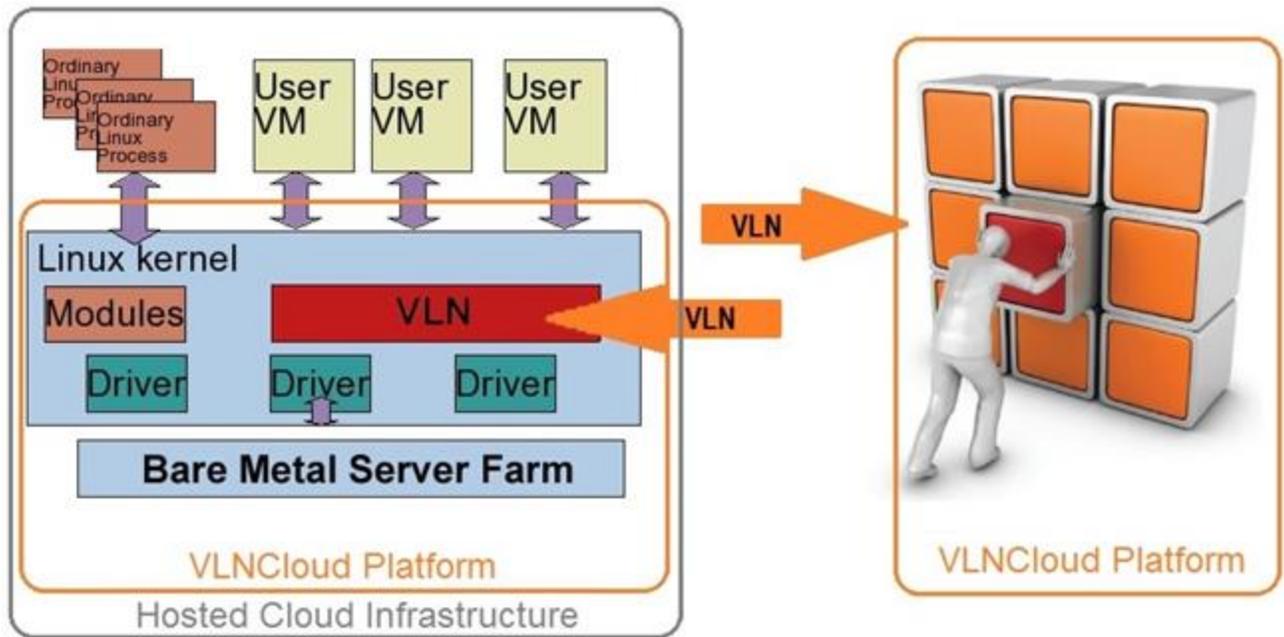


Figure 3: Installing and activating VLN on any Linux VM or bare-metal server or spinning EC2 from AWS AMI will enable application acceleration instantly

How does VLN work?

VirtuLocity VLN™ service is based on our best-in-class patented ‘VLN’ TCP congestion avoidance technology. VLN technology dynamically adapts to changing network conditions to deliver the maximum possible throughput. Depending on the severity of network impairments, VirtuLocity VLN will improve data transport efficiency up to 80% with better overall WAN throughput than typically achieved over your usual native TCP and current WAN connections. The VirtuLocity VLN solution is targeted for stern bandwidth and latency demands of rich media and direct data feeds such as live event, video conferencing, remote VDI, telehealth, and gaming applications, where applications are highly dependent on reasonable network conditions.

VLN™ service maximizes your connection’s data throughput, especially for latency sensitive applications that can be particularly prone to packet loss and delay over wired and (typically 1-3%) packet loss prone wireless mobile connections. It is also a complementary, additive solution with SD-WAN routing, and edge caching solutions designed for data center, corporate WAN, carrier, CDN, or mobile RAN optimization applications, as it works at different layers of the TCP stack. VirtuLocity VLN™ is ideal for agile service introduction as a performance differentiator, for immediate revenue realization and improved user experience.

Key Benefits:

Within the U.S. and Canada alone, more than 50% of users experience significant packet loss, causing video buffering and lower quality streams over their Internet connections. Our patented VirtuLocity VLN™ technology enables higher bandwidth efficiency across wired, wireless, static or mobile networks, regardless of application, payload size, or connection type.

VirtuLocity VLN differentiate your service offerings by:

- *No special requirements for purpose-built equipment or additional infrastructure*
- *No book-ending required for ease of deployment (either up, downstream, or both)*
- *No up-front costs: Runs-on-demand over any Linux VM, bare-metal server, or hosted-cloud-based virtual machines on AWS (Azure and Google GCP to be added)*
- *Complementary, additive performance with existing SDN/NFV applications, performance analytics, and SD-WAN offerings over copper, fiber or wireless Internet connections*
- *Little to no OSS integration required via turnkey cloud services/ APIs for easy billing, tracking, scalability, and rapid service launch without upfront CAPEX spend*
- *Flexible business model support with pay-as-you-go hourly or annual subscriptions*

Networks, and particularly TCP/UDP based protocols which are used in the majority of data transmissions today, are reliable but inherently inefficient. They fail to deliver full bandwidth due to a number of potential issues such as: packet loss, multiple hops, user mobility, buffer overflows, noise, excessive and redundant retransmissions or acknowledgements, and many other factors limiting your throughput. VLN technology solves many of these inefficiencies with an easy to install and very low cost per bit software suite that runs on existing Linux based virtual server infrastructure.

The VLN technology is single-ended, which does not require any changes on the receiving nodes making deployments easy to control and deploy without having to add special widgets or device endpoint software. By using the power of cloud computing and virtualization, VLN enables user flexibility of deploying applications anywhere and anytime with merely a few clicks on an easy to use cloud account dashboard or tightly integrated with your own equipment or service offering.

Typical Applications

VLN™ can be installed in any private source virtual or bare-metal server, or hosted virtual machine sessions to accelerate Ethernet traffic utilization and manage congestion of the TCP sessions across the WAN network. By accommodating congestion on varying network use cases, VLN™ minimizes packet loss and redundant acknowledgements while maximizing bandwidth throughput and thus transit time.

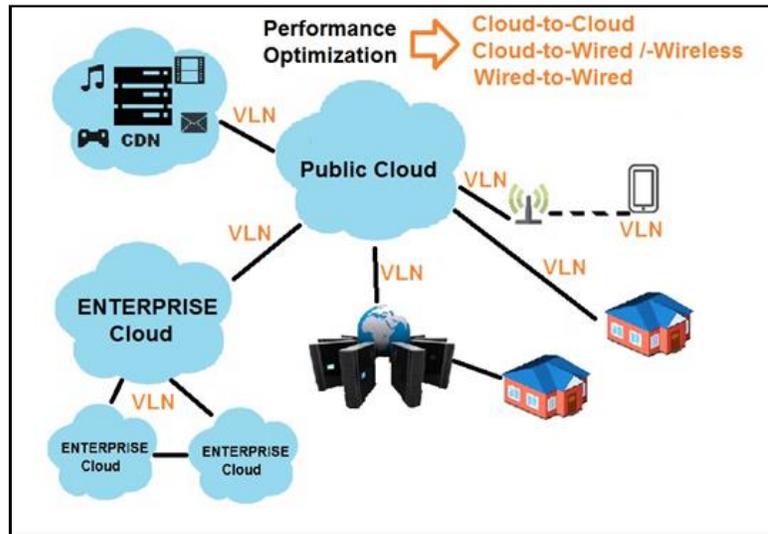


Figure 4: VLN is a patented cloud service and software suite to improve the performance of any network

VLN runs on layer 4 of the ISO stack and is transparent to your higher layer applications, while optimizing packet protocol performance on the WAN side or egress path. Therefore, it can be deployed as a single ended configuration that is agnostic to the far end equipment. However, should you require both downstream as well as upstream acceleration, VLN can also be deployed in a book-ended configuration to achieve bandwidth optimization in both directions. Typical applications include on demand acceleration for CDN edge video caching distribution, operator SD-WAN services, remote VDI desktop, enterprise back-up and recovery, remote telehealth, live event streaming, and mobile RAN or WiFi optimization.

Unparalleled Performance

VirtuLocity maximizes network efficiency even in the presence of high network impairment conditions versus typical TCP congestion control mechanisms.

VirtuLocity VLN™ provides optimization over wired (fiber, copper) or wireless (2G/3G/4G/5G or 802.11) networks and has demonstrated consistent performance improvements regardless of packet size or amount of non-zero packet loss, or type of cloud connections as shown by the global case studies and performance charts below.

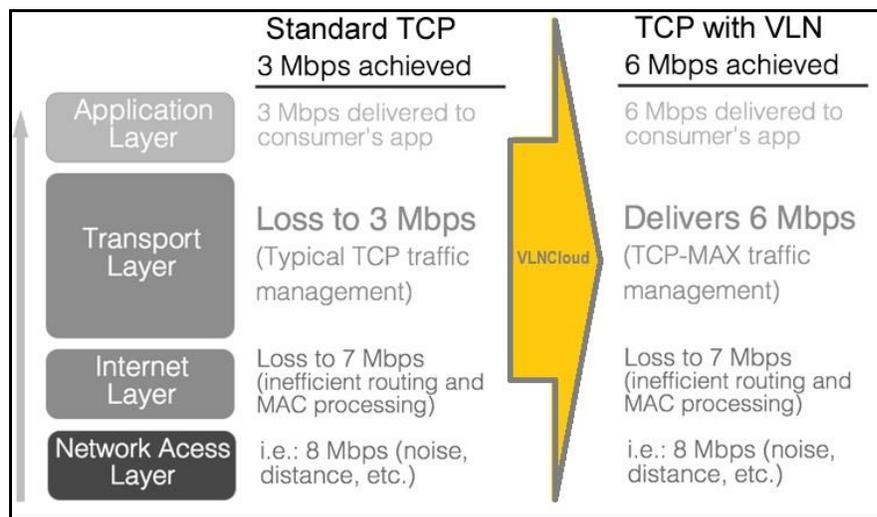


Figure 4: Standard TCP versus VLN performance comparison

FIGURE 5: Add in bandwidth performance by packet loss chart

VLN utilizes the latest developments in TCP congestion avoidance by employing an algorithm which is ideally suited to the media rich dominant data traffic in wired and wireless high-speed networks, and fully exploits network bandwidth.

Monitoring network conditions such as round-trip delay, number of queued packets, and loss rate, the algorithm dynamically adapts the congestion control mechanism in real-time to ensure fairness and maximum bandwidth for any given network condition.

VLN's algorithm improves bandwidth utilization, resulting in faster download speeds or upload speeds. Below graphs list compare VLN versus other standard congestion control protocols followed by two charts showing typical improvement for various network conditions and payload sizes.

Throughput Increase Percentage Normalized to VLN								
	Wired Network			WiFi			Mobile	
	Europe	USA	Asia	Europe	USA	Asia	City	Town
VLN	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
CUBIC	23.6%	34.1%	33.8%	47.4%	34.0%	22.1%	61.5%	28.6%
CTCP	15.7%	27.6%	28.6%	36.8%	34.0%	17.6%	53.8%	42.9%
RENO	13.5%	25.5%	28.6%	36.8%	43.7%	17.1%	53.8%	42.9%
TCPW	x	x	x	31.6%	39.8%	14.4%	38.5%	28.6%
VENO	x	x	x	31.6%	36.9%	16.2%	46.2%	35.7%
ILLINOIS	23.6%	37.9%	28.6%	x	x	x	x	x
HSTCP	11.2%	19.3%	26.0%	x	x	x	x	x
SPEEDUP	65.2%	4.0%	441.6%	142.1%	25.2%	167.6%	153.8%	200.0%
BSR	1.3%	0.1%	24.7%	3.7%	0.9%	1.5%	0.0%	0.0%

Figure 5: VLN algorithm Performance Comparison to other Algorithms

Payload Size (kBytes)	Europe-Australia --- Cloud BW Improvement Percentage	US-Europe --- Cloud BW Improvement Percentage	US Small Business --- Cloud BW Improvement Percentage
128	49%	49%	171.3%
512	65%	47%	151.3%
1000	49%	34%	37.7%
1500	67%	36%	37.6%
2000	59%	18%	51.2%
2880	70%	23%	51.5%
4880	45%	18%	174.1%

Figure 6: VLN - File Download Bandwidth Efficiency Improvement Percentage, tested on Ubuntu 14.04.3, baselined using CUBIC

Payload Size (kBytes)	Europe-Australia --- Cloud Data Transit Time Improvement Percentage	US-Europe --- Cloud Data Transit Time Improvement Percentage	US Small Business --- Cloud Data Transit Time Improvement Percentage
128	31.2%	33.3%	63.3%
512	37.5%	32.0%	63.6%
1000	35.0%	11.8%	28.8%
1500	41.3%	16.7%	44.2%
2000	35.0%	17.9%	38.0%
2880	40.8%	14.3%	42.3%
4880	39.6%	17.4%	64.4%

Figure 7: VLN - File Download Transit Time Improvement Percentage, tested on Ubuntu 14.04.3, baselined using CUBIC

Note: VIRTULOCITY's VLN also comes as a software suite that can be installed on any white box server, X86 or ARM based appliance, running Ubuntu, CentOS, RedHat, or any other version of Linux OS including Android OS for phone, tablet or IoT devices.

So, if you are experiencing slow, inconsistent cloud connections due to packet loss, bandwidth challenged connections, distance and/or many hops to get to your destination, give us a chance to accelerate your cloud connections using VirtuLocity VLN™. Contact us to sign-up for our free trial or via Amazon Marketplace at: www.awsmarketplace.com/virtulocity.VLN

We think you will never go back to the old way of connecting to the cloud!

For more information, demos, and trial application support, please contact:
info@VirtuLocityNetworks.com