VirtuLocity VLNCloud™ Software Acceleration Service

Virtualized acceleration wherever and whenever you need it

Bandwidth Optimization with Adaptive Congestion Avoidance for Cloud Connections

Virtulocity VLNCloud™ is a virtualized cloud service that accelerates your cloud connection's bandwidth throughput and transit time for user-to-cloud, cloud-to-end-user, or cloud-to-cloud connections. Our patented VLN technology can be supported on several of the major hyper sale cloud platforms including AWS EC2, Azure or Google GCP, When your Internet or private network conditions exhibit packet loss, require many hops or travel long distances with excessive latency, or simply are bandwidth challenged (e.g. slower speed bandwidth connections via copper or 2G/3G infrastructure), VLNCloud™ enables one-click access to virtually use our acceleration service and enhance your application's overall efficiency and WAN transit time. VirtuLocity's VLNCloud™ enables complete flexibility as a pay-as-you-go 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 VLNCloud™ can be used on a one-ended basis (no book-ending required) so it can easily be deployed and used for connecting to cloud services, inter-cloud communications, and/or edge based cloud 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 both large and small countries. 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 VLNCloud™ accelerates your connections whenever and wherever you need it.

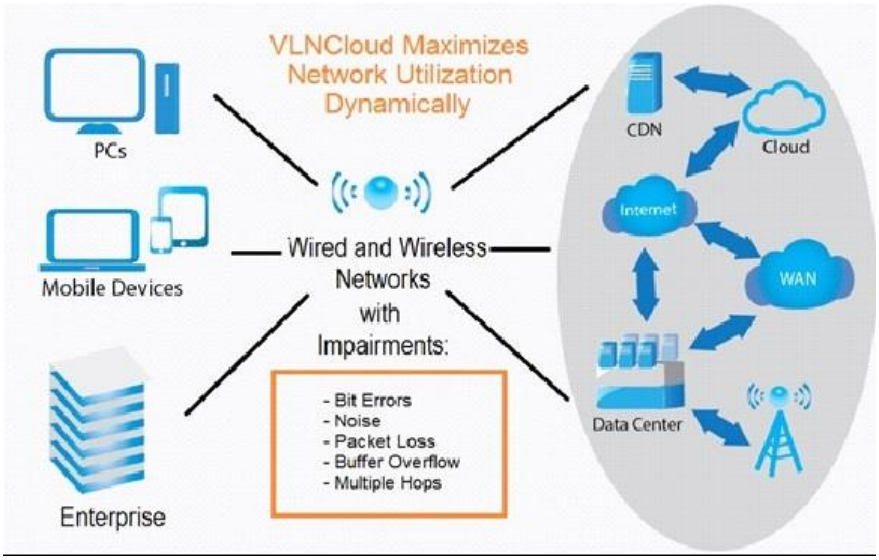

Figure 1: VLNCloud is for bandwidth optimization and congestion control

Product Overview

Virtulocity VLNCloud™ is immediately available on Amazon AWS EC2 platforms and we will be also adding support for most of the major cloud platforms such as Microsoft Azure[1] and Google GCP[2]. VirtuLocity VLNCloud™ 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.

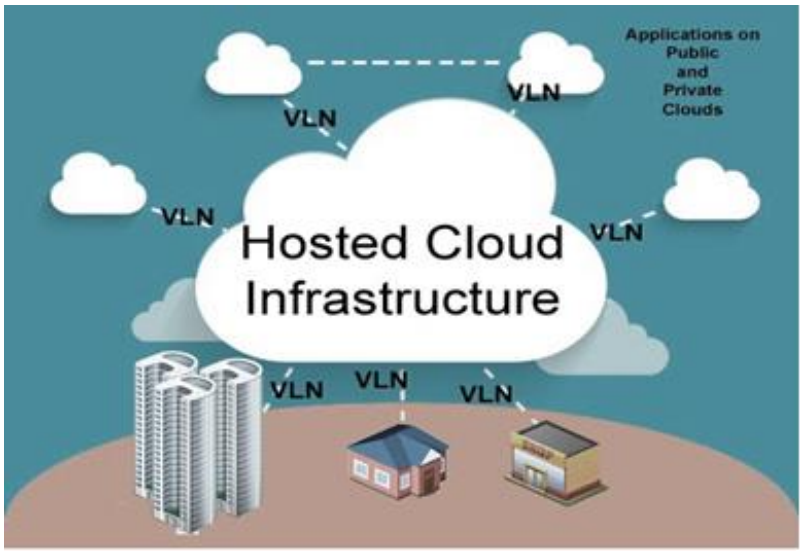

Figure 2: VLNCloud optimizes cloud-to-cloud and fixed-network-to-cloud connections

By improving throughput and data payload transport time significantly (typically in excess of 80%), VLNCloud™ 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. VLNCloud™ is available as a cloud service hosted by AWS EC2 running on Linux operating systems. 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 VLNCloud™ 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 VLNCloud without any user involvement. Then any user application can be installed and deployed normally on the new EC2 instance with VLNCloud.

[1] *Azure, Azure Design, Windows Azure are trademarks of the Microsoft Corporation*
[2] *GCP is the trademark of Google Inc.*

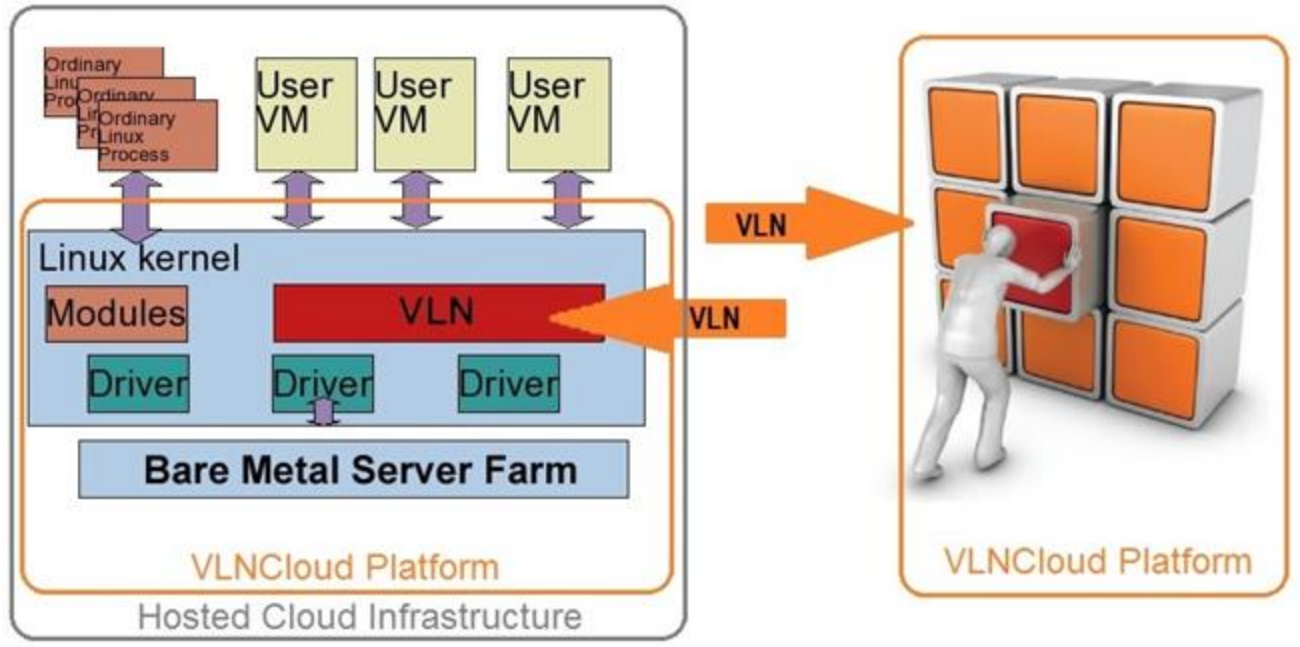

Figure 3: Spinning any EC2 from AMI installs and activates VLNCloud Automatically

How does VLNCloud work?

VirtuLocity VLNCloud™ 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 VLNCloud 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 VLNCloud 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.

VLNCloud™ 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 wireless mobile connections. It is also a complementary solution with SD-WAN routing, and edge caching solutions designed for data center, corporate WAN, carrier, CDN, or mobile RAN optimization applicationsVirtulocity VLNCloud™ 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 low quality over their Internet connections. Our patented VirtuLocity VLNCloud™ technology enables higher bandwidth efficiency across wired, wireless, static or mobile networks, regardless of application, payload size, or connection type.

VirtuLocity VLNsCloud differentiates your service offerings by:

- *No special requirements for purpose-built equipment or additional infrastructur*
- *No book-ending required for ease of deployment (either up, downstream, or both)*
- *No up-front costs: Runs-on-demand over hosted-cloud-based virtual machines on AWS (Azure and Google GCP to be added)*
- *Complementary 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/API's 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. VLNCloud 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 VLNCloud technology is single-ended, which does not require any changes on the receiving nodes making deployments easy to control and deploy.By using the power of cloud computing and virtualization, VLNCloud 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

VLNCloud™ can be installed in any private source 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, VLNCLoud™ minimizes packet loss and redundant acknowledgements while maximizing bandwidth throughput and thus transit time.

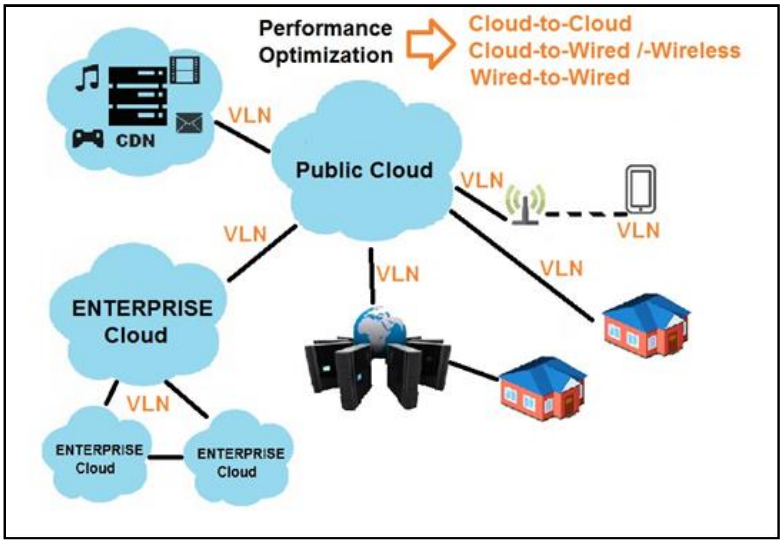

Figure 4: VLN is a patented cloud service and software suite to improve the performance of any network

VLNCloud runs on layer 4 of the ISO stack and is transparent to your higher layer applications, while optimizing packet prototcol 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, for maximum benefit, it 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 VLNCloud™ 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.

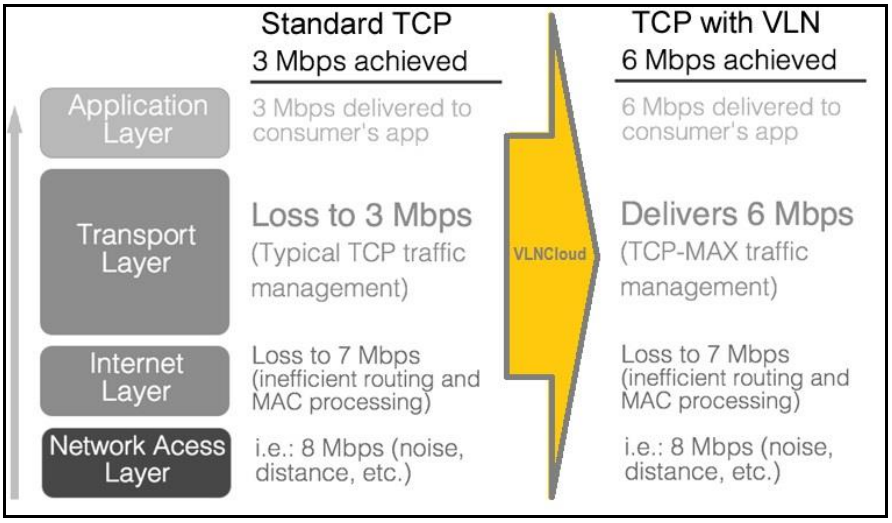

Figure 4: Standard TCP versus VLNCloud performance comparison

FIGURE 5: Add in bandwidth performance by packet loss chart

VLNCloud utilizes the latest developments in TCP congestion avoidance by employing an algorithm which is greatly 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.

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

VLNCloud's algorithm improves bandwidth utilization, resulting in faster download speeds or upload speeds. Below graphs list typical improvement for various network conditions and payload sizes.

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

Note: VIRTULOCITY's VLNCloud 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 VLNCloud™. Sign-up for our free trial via Amazon Marketplace at: www.awsmarketplace.com/virtulocity.VLNCloud

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