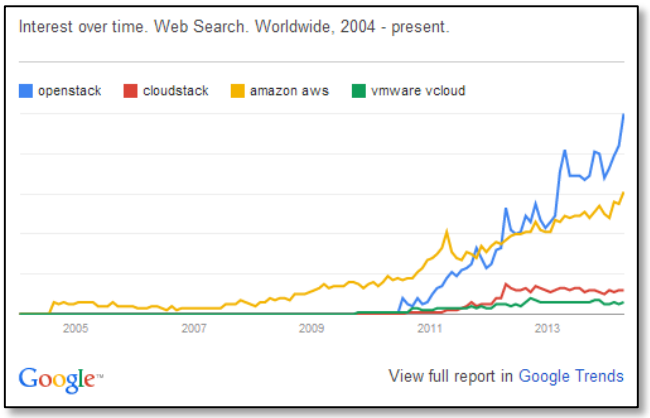
CPLANE NETWORKS

Production-ready OpenStack® Networking

White Paper

Executive Summary



OpenStack is Hot!

Large enterprises and cloud service providers are faced with a huge challenge – the delivery of agile *and* cost effective IT services to meet the increasing demands of lines of business and customers. These services must not only be responsive, they must also be secure, elastic and most importantly, easy to consume.

Public clouds have transformed the way businesses of all sizes can gain access to infrastructure on demand. Amazon Web Services, Microsoft Azure and Google Cloud Platform are examples of public clouds that offer a wide variety of compute, storage and networking services. But public clouds are typically designed around a "one size fits all" model, making them somewhat inflexible when it comes to the specialized application and security requirements of many enterprises.

OpenStack® - Enabling the Private Cloud

Many enteprises and cloud service providers are building private and hybrid clouds to provide the economic benefits of public clouds while meeting their specific business and operational requirements. These clouds are typically built from open source components which provide flexibility and lower cost while avoiding vendor lock-in. Along with cloud computing many enterprises are transforming their service delivery models – moving away from vertically aligned services to new cross-organizational and cross-functional DevOps (Development/Operations) models.

Providing a consistent, easy to use service interface is key to delivering reliable and repeatable cloud services. OpenStack is the rapdily growing, widely accepted open source solution for cloud service orchestration and administration. Companies such as AT&T, Cisco WebEx, Comcast, Dell, eBay/PayPal, Ericsson, The Gap, NASA, NTT Docomo, Rackspace, Red Hat, Sprint, Symantec, Time Warner Cable, Verizon and Walmart have adopted OpenStack as their primary service delivery mechanism.

As with any new technology or service, there are some "growing pains", and OpenStack is no different. Deployment, manageability, performance and migration are key areas that IT managers must consider before making the choice to implement OpenStack on a large scale.

This white paper examines how CPLANE NETWORKS is addressing each of these areas to ensure that the networking component of the OpenStack orchestration service model enables users to take full advantage of their private and hybrid clouds.

Key Business and Operational Requirements

Cloud computing has created a new consumer mindset – services should be readily accessible, easy to consume and easy to use. The open source movement has clearly demonstrated that large, monolithic, vendor-controlled solutions are no longer required, or preferred to deliver those services. But, at the same time IT managers must be able to ensure the solutions they provide are reliable and meet both service level and operational cost commitments.

OpenStack is rapidly evolving and significant improvements are being made with each new release. However, there are still challenges to overcome when deploying OpenStack in either a "greenfield" or existing "brownfield" operational environment.

Key Business and Operational Requirements

For any system to be successful it must address five key business and operational needs. It must:

- Be easy and non-disruptive to deploy
- Be easy to use and operate
- Perform and scale to meet business demands
- Be easy to maintain and upgrade
- Support workload agility and mobility

OpenStack is no different. It must meet these requirements to ensure that it provides the same user experience and delivers the same operational benefits found in public cloud services.

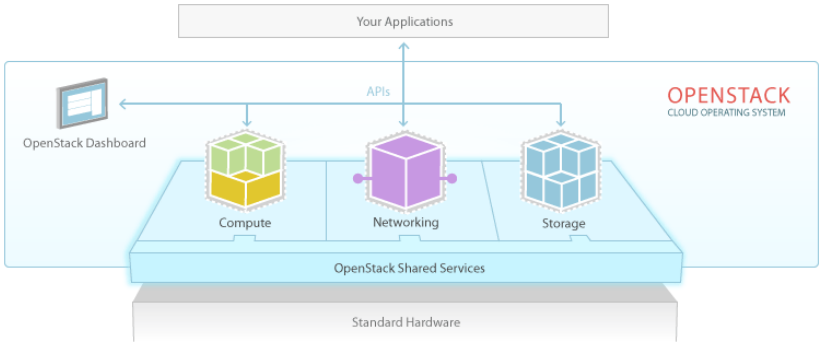
Compute and storage virtualization have become mainstream for the majority of IT services. Networking has lagged. The same holds true for OpenStack networking services. Compute and storage services within OpenStack have rapidly advanced, but networking services are still very basic.

CPLANE NETWORKS **Dynamic Virtual Networks – Data Center (DVNd)** brings OpenStack networking on par with OpenStack compute and storage. By solving the four key service and operational requirements outlined above, DVNd enables OpenStack to provide the full range services required to deliver the public cloud experience within the confines of the enteprise or cloud service provider.

DVNd is ***Built for OpenStack™***. This means that it is specifically designed to deliver optimized OpenStack services according to the OpenStack specifications and application programming interfaces (APIs). This in turn ensures that customers who deploy DVNd to deliver OpenStack networking services can rest assured that those services will meet the high standards of quality and performance outlined by the OpenStack Foundation and the broad community of OpenStack contributors.

A Quick Look at the OpenStack Framework

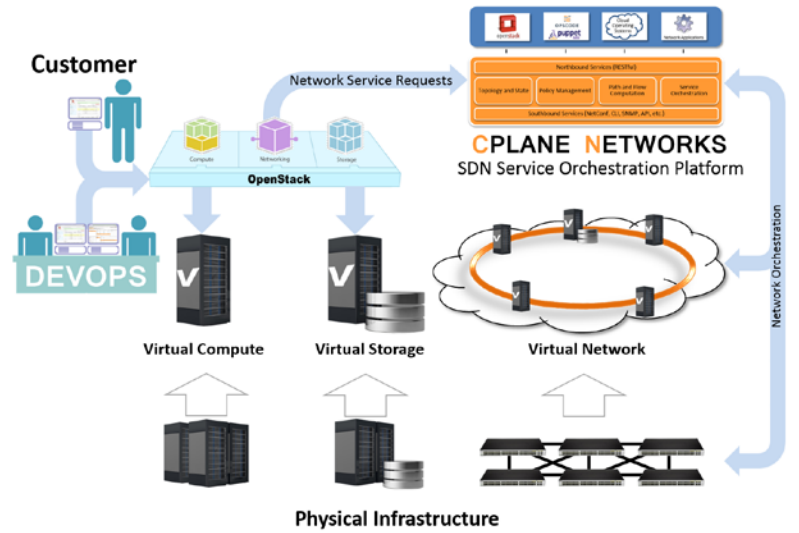
Before examining how DVNd satisfies the key business and operational requirements it is useful to take a quick look at the OpenStack Framework. OpenStack consists of five major components: Compute, Networking, Storage, Dashboard and Shared Services.



The OpenStack Framework (Source: OpenStack Foundation)

The three components that DVNd relies upon are the Shared Services User Interface (Horizon), Compute (Nova) and Networking (Neutron). DVNd replaces the basic VLAN-based Neutron services with easy to use, high-performance network virtualization services.

As shown in the following diagram, users submit requests for cloud services via Horizon. DVNd provisions network services on behalf of compute and storage orchestration requests, leveraging without change existing physical network infrastructure to create flexible virtual overlay networks. This protects existing technology investments and allows orderly migration to new technologies or vendors.



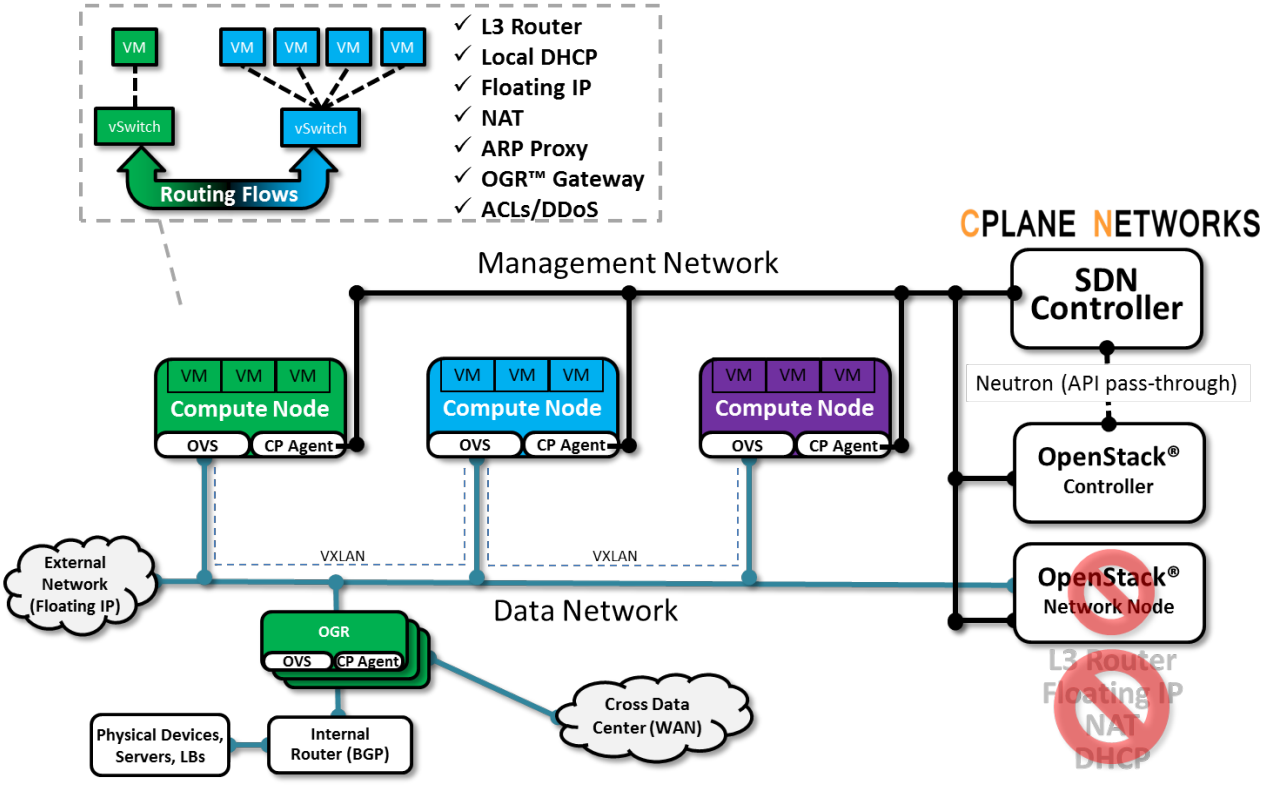
CPLANE NETWORKS OpenStack Integration

Seamless OpenStack Integration

In the following section we'll take a look at how DVNd seamlessly integrates with the OpenStack framework to ensure maximum flexibility, performance and maintainability.

OpenStack is a self-contained ecosystem that essentially comes complete with everything required to create service orchestration for a private or hybrid cloud environment. CPLANE NETWORKS Dynamic Virtual Networks – Data Center is comprised of four software-only components that complement and work seamlessly with and extend the functionality of the OpenStack framework components:

- **SDN Service Orchestration Platform ("the Platform")** – the software-defined networking (SDN) controller that performs all network service orchestration on behalf of OpenStack.
- **Open vSwitch (OVS)** – the open source virtual switch that performs all network services on behalf of the hypervisor in the compute nodes.
- **CP Agent** – a lightweight plug-in for OVS that provides communications with between the Platform and OVS. CP Agent also enables local network services to improve network performance.
- **OpenStack Neutron plug-in** – a lightweight plug-in that handles the communication between OpenStack and the Platform. The Neutron plug-in simply acts as an API pass-through and performs no service orchestration processing.



CPLANE NETWORKS OpenStack Architecture

Production-ready OpenStack Networking

By replacing the basic native OpenStack networking capabilities with CPLANE NETWORKS' high performance network services, the key business and operational requirements described above can be satisfied.

Easy, non-disruptive deployment

CPLANE NETWORKS' Dynamic Virtual Networks - Data Center is fully self-contained and requires no external or third-party products to be installed. The SDN Service Orchestration Platform controller and Neutron plug-in are built using industry-standard tools (Java, Red Hat Linux, Open vSwitch, etc.) and are easily installed using standard installation methods and tools (e.g., OpenStack Community TripleO and Red Hat Director). Minimal configuration of the Platform is required upon initial install, and since DVNd leverages existing physical IP-routable infrastructure without change, no configuration of physical routers or switches is required to deploy and operate a DVNd-enabled OpenStack networking environment.

The CP Agent and Open vSwitch are also installed as part of the standard compute node "build" process. No server-specific configuration is required so installation across a large number of compute nodes requires no additional intervention, streamlining deployment process, reducing manpower requirements and eliminating costly rework due to configuration errors.

DVNd is a highly scalable and highly available solution, but initial installation can be as small as a single physical or virtual machine instance. Unlike other SDN solutions that require a minimum of at least three nodes, DVNd mitigates the need for large upfront investment and allows controlled deployment of the SDN Service Orchestration Platform resources in concert with cloud expansion.

Easy to use and operate

Once deployed, DVNd requires no additional intervention or configuration. DVNd utilizes a "phone home" feature, so as compute nodes are initialized (booted) the pre-installed CP Agent automatically discovers and connects to the SDN Service Orchestration Platform. All necessary configuration and communication information (bridges, ports, cross-connects, etc.) is automatically "pushed" to the CP Agent, once again eliminating the need for any manual configuration. This "zero touch" approach enables the rapid deployment of large numbers of compute nodes in a very cost effective manner. More importantly it reinforces the

CPLANE NETWORKS focus on service improvement while reducing operational costs.

Interface to DVNd services is accomplished through several methods. The easiest way is through the standard OpenStack Horizon user interface. Horizon provides a unified service orchestration solution for compute, storage and networking, but it provides limited insight into the topology and state of the underlying components that make up a solution for a customer, tenant or project. The DVNd Console provides a consistent one-to-one data mapping between Horizon and the underlying virtual network topology. But DVNd goes much farther, providing detailed state and connectivity information. Most importantly, it provides direct insight into the flow rules that control network traffic routing between endpoints in each virtual network – a critical aspect of problem determination and resolution.

Access to DVNd can also be accomplished by using its open application programming interfaces (APIs). This enables other automation solutions (e.g., Opscode Chef, Puppet Labs, OSS/BSS, etc.) to work in conjunction with OpenStack to utilize DVNd for virtual network services.

Performance and scale to meet business demands

Out of the box, DVNd provides secure, scalable and highly-available multi-tenant networking. Utilizing the scalable architecture of the SDN Service Orchestration Platform, DVNd easily expands and contracts to meet both planned and unexpected demands for virtualized network services. A unique feature of the Platform is its ability to independently scale different service components (e.g., communications processes) to handle exceptionally heavy demands for specific services. This eliminates the need to scale the whole system just to meet a specific performance need. And unlike other systems that use complicated consensus algorithms (e.g., Paxos) that require a minimum of three processing nodes, the Platform be deployed on a single node, and easily expand as the demand for virtualized networking grows.

DVNd utilizes a “push” model for the creation and deployment of flow rules for virtual networks. As compute nodes are initialized (booted), they automatically report to the Platform via the CP Agent, providing all pertinent information to build a complete network topology. Each compute node is load-balanced across a number of communication adapters in the Platform, ensuring balanced and predictable controller performance.

When a request is received from OpenStack (or some other orchestration system) to create a virtual network, DVNd quickly calculates all the necessary flow rules based on the complete and accurate network topology. The rules specific to each compute node are then quickly and efficiently "pushed" to its corresponding virtual switch (OVS). This eliminates the need for costly broadcast traffic between compute nodes to discover the network topology and results in a much more efficient use of compute node resources and processing power.

Once the flow rules have been pushed to the compute node it can essentially act independently of the controller. If the connection to the Platform is lost, the data plane in the OVS remains in a "fail open" state. That is, it can continue to function without the control plane. There are some limitations to this scenario, but unlike other virtualization approaches (e.g., OpenFlow), the loss of connectivity the control plane is not a catastrophic event and the network can continue to function, providing an increased level of service assurance and availability.

In the event that a compute node fails, recovery of the virtual network connectivity is fast and easy. Since the Platform maintains complete topology and state information, upon re-initialization of the compute node and re-establishment of connectivity between the CP Agent and the Platform, all pertinent state and flow rule information is then pushed back to the compute node. This ensures fast recovery of services without the need to rediscover and recalculate the complete network topology.

One of the most important features of DVNd is the "localization" of key network capabilities. In a traditional OpenStack model, these features, such as Layer 3 routing, DHCP, Floating IP and NAT are provided by an external Network Node. DVNd provides all of these features "locally" within the CP Agent and OVS, significantly improving network performance and eliminating a single point of failure for network services. For example, in a typical OpenStack implementation, to route traffic between virtual machines on two different compute nodes would require at least four "hops". With DVNd, there is only virtual one hop between any two virtual machines! DVNd also provides local services such as ARP Proxy, which eliminates costly discovery broadcast traffic and significantly improves the responsiveness of virtual network services.

CPLANE has incorporated additional features into CP Agent that provide even higher levels of security and protection. Access Control Lists (ACLs) can be defined for each VM supported by CP Agent to control different types of ingress and egress traffic. CP

Agent also includes Distributed Denial of Service (DDos) protection, which recognizes and prevents attacks against or generated by one or VMs on a compute node.

Easy to maintain and upgrade

One of the big challenges with OpenStack has been the migration to new releases. Changes to the OpenStack data model and database schemas have been frequent and can cause problems for solutions that utilize them. DVNd uses a lightweight Neutron plug-in that has no dependencies on the OpenStack data model or database. The DVNd Neutron plug-in simply provides a "pass through" of service calls to the Platform. All of the pertinent service definition, configuration, network topology and state information are maintained in the Platform. Thus migration between releases is much easier, faster and less expensive.

DVNd is designed to work with existing network architectures and infrastructure models, as well as new and emerging technologies. This is accomplished through powerful service and device abstraction capabilities built in to the Platform. This abstraction allows for the introduction of new technologies with minimal effort and disruption. For enterprises that want to migrate to new network topologies and services in an orderly and controlled fashion, this ensures a smooth transition with minimal impact on existing customer or tenant installations.

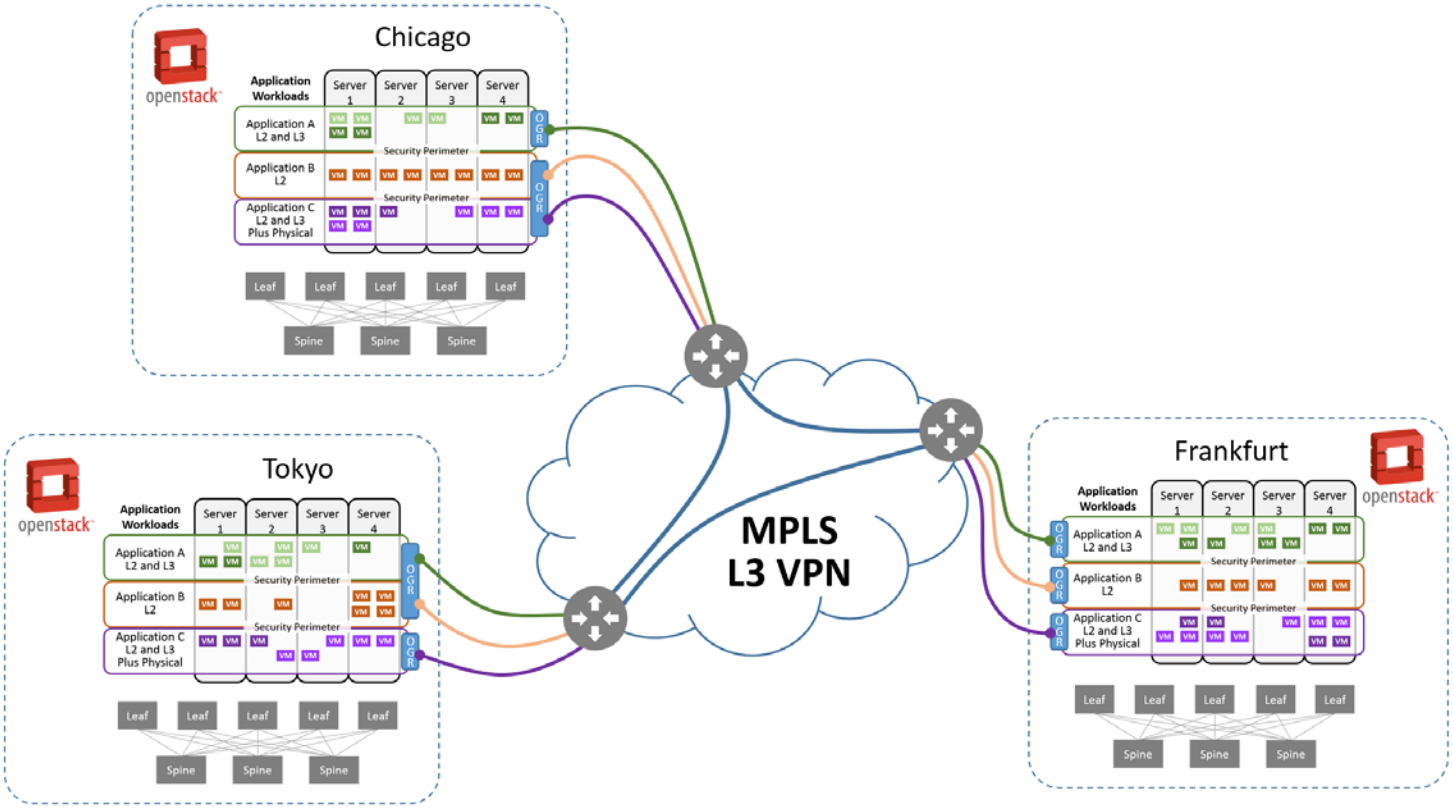
Multi-site OpenStack Networking for workload agility and mobility

Today's application model is significantly different than the historical monolithic "stack" architecture. Application components may be distributed to take advantage of resource and operational optimization strategies. Many times, applications need to consume services provided by external service providers. New application roll-out is very rapid and granular. To accommodate this new paradigm, OpenStack must support fast, integrated deployment of virtual resources in multiple locations.

DVNd, working in conjunction with CPLANEs' Dynamic Virtual Networks – Interconnect (DVNi) product seamlessly provisions VXLAN and Multiprotocol Label Switching (MPLS) networks together to support multi-site OpenStack clouds. The Layer 3 networks supported by CPLANE's CP Agent and OVS are extended inside the data center and across leaf-spine underlays. Data center VXLAN virtual networks are extended into MPLS Layer 3 Virtual Private Networks (VPNs) with

CPLANE's Overlay Gateway Router (OGR). Using Intel's advanced Data Plane Development Kit (DPDK), OGR delivers high throughput on a standard white-box server platform, eliminating the need for expensive specialized gateway platforms. OGR provides all the necessary boundary translation between VXLAN and MPLS, so no manual intervention or configuration is required. Creation of Layer 3 VPNs is provided through Application Programming Interface (API) extensions to OpenStack's Neutron networking services. New VPN service requests are passed directly to CPLANE's DVNi platform for secure and reliable provisioning.

Through seamless deployment of integrated data center and wide area network services, CPLANE's Multi-site OpenStack Networking solution dramatically improves the application deployment life cycle.



CPLANE NETWORKS Multi-site OpenStack Networking

OpenStack Cloud Bursting for on-demand public cloud resource integration

Application workload requirements are becoming more unpredictable. Seasonal business demands and flash-crowd spikes are introducing significant variations in what was once a fairly predictable capacity planning model. Rapid development and test cycles for new applications are driving the need for short term compute, storage and networking resources. And often partner or supplier systems and services and located in public clouds to provide a broad reach to their consumers.

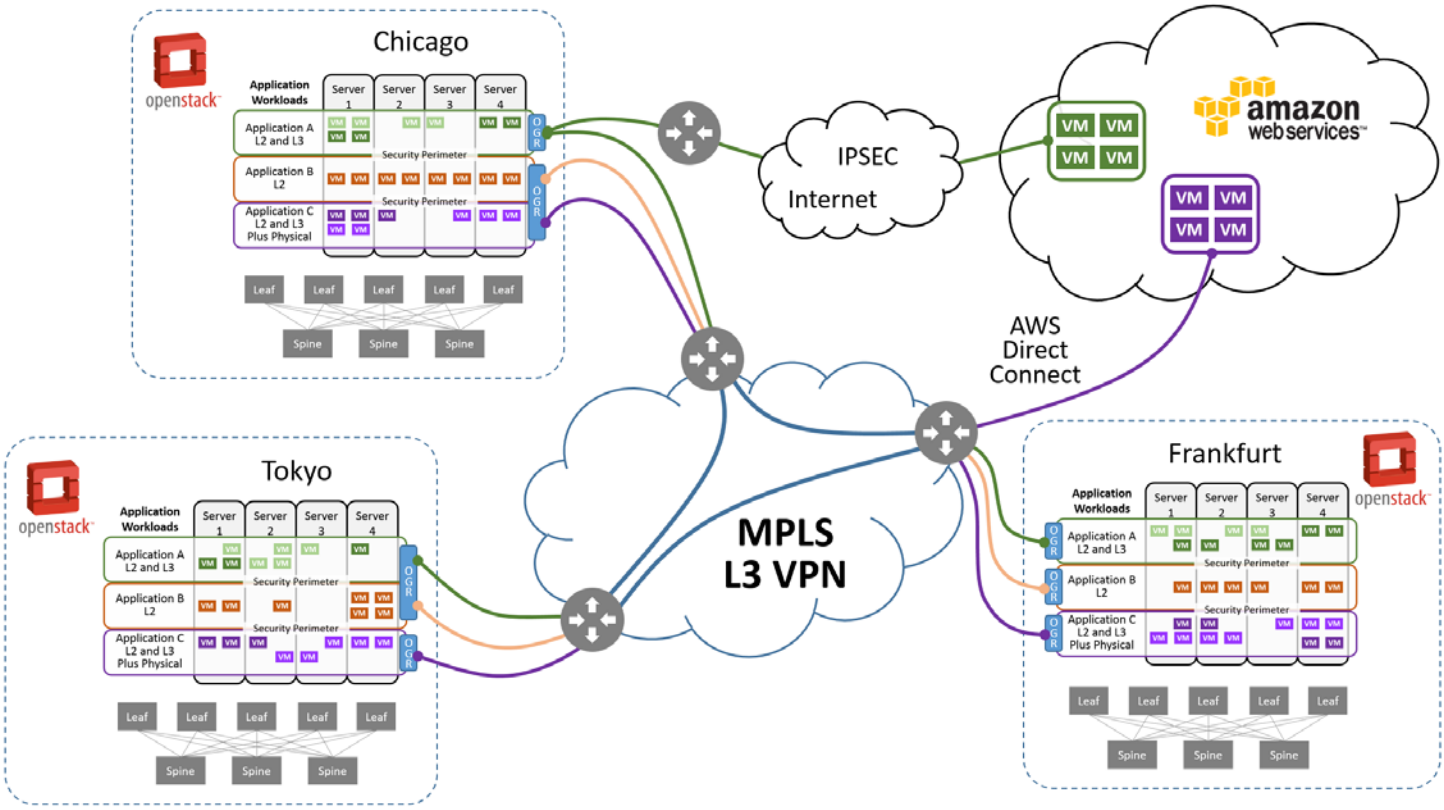
OpenStack delivers service virtualization and orchestration for dedicated IT resources. But as shown above, enterprises and service providers often need to integrate public cloud resources to deliver new services or meet business and operational demands.

CPLANE NETWORKS provides seamless integration of OpenStack and Amazon Web Services™ (AWS). Leveraging the same Overlay Gateway Router that delivers quick and easy deployment of Multi-site OpenStack Networking, CPLANE's OpenStack Cloud Bursting enables secure and reliable connectivity to AWS.

OGR provides the gateway between data center VXLAN networks and either public or private AWS connections. Customer who want a lower-cost connectivity solution can connect to AWS using widely deployed and standards-based Internet Protocol Security (IPSEC) tunnels over the public Internet. For customers who prefer a private connection with enhanced security and performance guarantees, OGR provides connectivity to *Amazon Direct Connect*.

In both cases, CPLANE's SDN Service Orchestration Platform handles all of the service configuration and automated provisioning. Creation of cloud bursting connections between OpenStack and AWS is a matter of just a few clicks in the SDN Service Orchestration Platform UI. No tedious scripting (and associated cutting, pasting and time-consuming debugging) is required. OGR handles all of the end-point translation between VXLAN and the target AWS connection, and provides complete route management via Border Gateway Protocol (BGP) route advertisement and distribution. Full visibility of all configuration and topology information is available through the UI.

CPLANE's OpenStack Cloud Bursting provides fast and easy extension of OpenStack networks to public clouds to enable true workload agility. With multiple connectivity choices, customers can enjoy the optimal combination of cost, performance and reliability.



CPLANE NETWORKS Multi-site OpenStack Networking with OpenStack Cloud Bursting

Benefits of Production-Ready OpenStack Networking

OpenStack is the open source software solution for cloud orchestration. With its broad community support and strong backing by major industry players, it is poised to dramatically transform the IT services industry.

OpenStack provides a framework for the creation of an agile services ecosystem. The fundamental elements of the framework provide basic services, but don't provide the scalability and reliability needed for enterprises and cloud service providers. And thus don't provide the full benefits of the production-ready solution that CPLANE NETWORKS offers. **Dynamic Virtual Networks – Data Center** delivers high performance, OpenStack-enabled network services out of the box!

Feature	Benefit
Easy to install with minimal to configuration	Faster time to production with less disruption at a lower cost.
Easy to use and intuitive	Shorter time to OpenStack productivity. Eliminates need for costly network expertise. Closes the gap between DevOps and NetOps.
Scale out with feature-independent scalability	Start small with an easy, non-disruptive OpenStack solution that seamlessly grows in step with business and operational demands. Support thousands of nodes and millions of virtual machines.
Zero-touch, industry standard network virtualization	Fast network setup with no intervention. Elimination of unnecessary network broadcasts that adversely affect normal network traffic.
Utilizes widely-used open source services	Ensures interoperability with broad ecosystem of cloud orchestration solutions and minimizes vendor lock-in.
Lightweight plug-ins with open application programming interfaces (APIs)	Easier integration with current and future releases of OpenStack as well as other cloud orchestration and automation solutions.
Leverages existing physical network infrastructure	Protects current investment and enables smooth integration with existing and new network technologies and services.
Localized network services in compute nodes	Dramatically improved network performance, better availability and elimination of single points of failure.
Consistent data, state and topology views	Faster recovery from failures. Improved visibility for problem determination and resolution.
Integrated deployment of multi-site OpenStack networks	New levels of workload agility and mobility to take advantage of resource and operational optimization strategies
Integration of public clouds such as Amazon Web Services	Create on-demand public cloud resource integration for planned and unplanned business and operational requirements.

About CPLANE NETWORKS

CPLANE NETWORKS delivers the industry's most comprehensive and flexible OpenStack network virtualization solution. We simplify virtual network creation and reduce network complexity through end-to-end software-defined networking service orchestration.

Combining open source innovations with our rich system capabilities we offer a solution that not only protects the investment in your current networking infrastructure, but enables a smooth transition to future networking architectures and technologies.

DVNd is part of the **Dynamic Virtual Network (DVN)** family of products that provides network service orchestration within the data center, across the WAN and at the network edge. To learn more about Dynamic Virtual Networks – Data Center (DVNd), Dynamic Virtual Networks – Interconnect (DVNi) and Dynamic Virtual Networks – Edge (DVNe) visit our website at www.cplanenetworks.com

CPLANE NETWORKS DVNd V1.3 is Red Hat Enterprise Linux OpenStack Platform 7 Certified

CPLANE NETWORKS DVNd is a member of the Canonical OpenStack Interoperability Lab (OIL)

Contact Us

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