F5 Technical Brief

Enabling Long Distance Live Migration with F5 and VMware vMotion

F5 Networks® and VMware partner to enable live application and storage migrations between data centers and clouds, over short or long distances.

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Introduction

Cloud computing has become an important technology to consider for organizations that are looking to optimize their IT operations and reduce operating costs. Until now, leveraging the cloud involved either setting up and running applications in the cloud and managing them long-term off-premises, or running services as a one-time event. Migrating existing services, applications, and virtual machines to the cloud presented immense networking complexities, and if performed outside a local data center, was a non-trivial challenge. Moving live services without user interruption was virtually impossible.

F5® and VMware have developed a joint solution to this overcome these limitations and enable enterprise customers to migrate application services between clouds without affecting users.

Live virtual machine (VM) migration—moving a VM from one physical server to another while the machine is running and processing transactions—has been one of the core technologies propelling virtualization's mass adoption in the data center. Live migration enables a more dynamic and agile environment as virtual systems flow between hardware devices based on planned migrations—such as migrating a running virtual machine to a new or secondary data center—or unplanned movement due to usage, consumption, availability, and so on. VMware has been both a technological innovator and market leader in live system migration. Until recently, however, even this advanced technology was generally relegated to use within a local data center, staying confined to one physical network.

The F5 and VMware cloud migration solution moves vMotion™ from the binds of the local data center and enables live migration of both VMs and the back-end storage across the WAN between data centers and clouds. F5 has created a workflow that allows the administrator to automate the majority of the migration, making it possible to execute these migrations with a minimum of manual configuration.

VMware vMotion Basics

VMware's vMotion is a unique technology that moves running virtual machines from one physical server to another without interrupting the VM or the applications running on that VM. During a vMotion event, active memory and CPU running state (which combined include the current state of the network and any applications

running on the VM) are transferred between physical systems as needed based on resource constraint, disaster avoidance planning, or functional changes (such as bringing down a physical server). The storage back-end associated with that virtual machine—the VMDK and configuration files located on the storage network—can also be migrated between storage networks with VMware Storage vMotion.

Design Factors: vMotion Between Networks

One of the primary design considerations for vMotion is network topology. During a vMotion migration, a snapshot of the running systems is transferred from one server to another. Since the running state of a system is a "moment in time" snapshot, there is no way to change anything in the running state, including the IP address of the virtual machine or any other network settings.

For the VM to resume operations and keep running on the new server, the destination network must be exactly the same as the original network housing the VM, as must the network configuration of the VM itself. The virtual machine and physical server network configurations include the IP address of the VM, the IP network settings such as subnet mask and gateway address, and VLAN configurations on the VMware ESX™ server. The VM must stay within the same broadcast domain in order for the virtual network to resume without application data loss.

Design Factors: vMotion Over Distance

Beyond local network topology issues, one of the common questions when deploying VMware as part of a cloud or high availability/disaster avoidance scenario is "Can I move virtual machines between data centers?" Some of the challenges with long distance live migration are the WAN bandwidth, latency, and packet loss limitations that are outside the control of most IT organizations. Many applications, including vMotion live migration, are susceptible to network issues across the WAN that can be exacerbated by distance and network quality. Although not as time-sensitive as VM live migration, Storage vMotion can also suffer from latency issues over the WAN. If the conditions are bad enough, attempted vMotion events will simply fail.

62% of IT organizations reported that the ability to move virtual machines between data centers (e.g. long distance vMotion) is valuable when choosing a cloud provider.

Source: TechValidate
TVID: A6D-C70-242

Other challenges with external data center vMotion events include managing user connections and application data during the migration, and IP management and reclamation. In a LAN migration, user connections are moved from one physical switch port to another. The VM and active user connections never leave their

configured network nor is there a need to manage or change the VM IP address because that IP address stays within the local network. With a long distance or cloud vMotion move, however, the VM must traverse multiple networks without losing any user or application state information. The user connections are routed to a geographically removed location and IP addresses need to be managed between the two data centers.

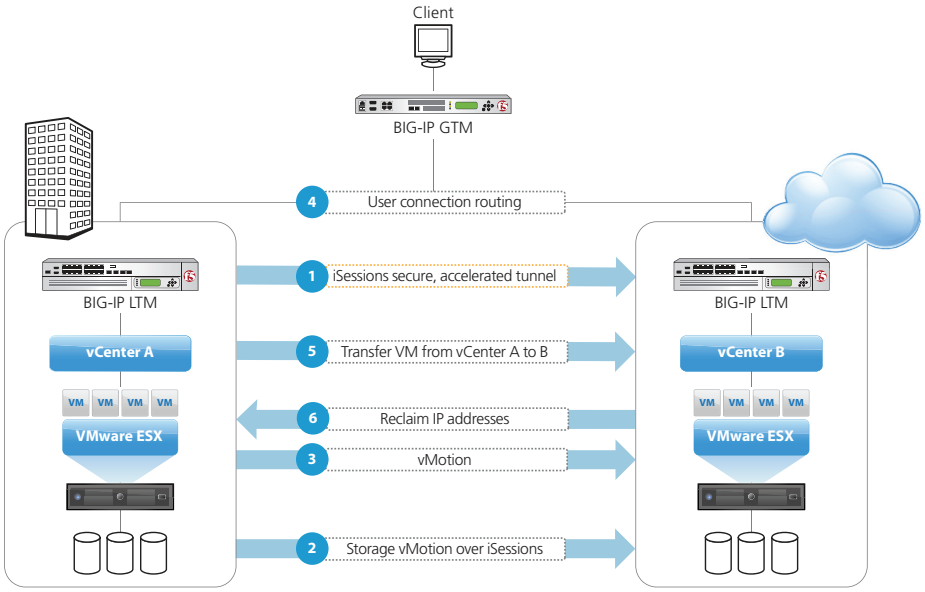
Each of these long distance challenges—WAN constraints and user connection management—become more of an issue with "sticky apps": applications that have a very intensive user experience, such as web 2.0 applications.

Connecting Clouds with BIG-IP Solutions

F5 has been an Application Delivery Networking pioneer in managing traffic across distributed data centers and the cloud, as well as in optimizing application traffic in and out of the data center. By working with VMware to address the difficulties inherent in migrating an application to the cloud automatically and seamlessly, F5 has created a solution that optimizes, secures, and manages VM migration and user connections between data centers, effectively "connecting clouds." Beyond network optimizations and security, transitioning user connections from one cloud to another is the key element in moving VMs between data centers. User experience is paramount, and it's critical that the application does not suffer any significant downtime or loss of application data during or after a cross-site live migration.

Building a Successful Data Center-to-Cloud Network

When designing a solution for vMotion over distance, F5's goal was to create a system that enables secure live migrations between multiple cloud-based data centers without any interruption in the application service or user downtime. F5 has accomplished this goal using a suite of existing F5 products and technologies that already plug into vCenter™ for VM application networking management: BIG-IP® Local Traffic Manager™ (LTM), BIG-IP® Global Traffic Manager™ (GTM), BIG-IP® integrated WAN optimization services, iSessions™ tunneling between data centers, and iControl®, the open API used to manage the migration through vCenter.



Cloud-based live VM migration with F5 and vMotion

Step-by-Step Solution Walkthrough

1. iSessions Tunnel

   The first step in building an infrastructure to support secure live migration between clouds and data centers is to symmetrically connect each data center using a feature of F5 BIG-IP LTM: iSessions tunnels. Using SSL and advanced data compression techiques, BIG-IP LTM creates secure and optimized tunnels between each data center to carry the vMotion traffic. This enables applications within each data center to communicate efficiently over the private connection and creates the infrastructure to support the storage and VM migrations.

2. Storage vMotion

   Once the iSessions infrastructure is in place, initiating a Storage vMotion event is the first step in actually moving the VM from one data center to the other. Different trigger mechanisms are possible (e.g. VMware vCenter Orchestrator™); however, ultimately vCenter will trigger a Storage vMotion event and begin migrating the virtual disks between the primary and secondary data centers. All application traffic will continue to flow to the VM located in the primary data center and vCenter in that data center will still retain control over the VMs tied to the Storage vMotion event. The storage data is passed through the secure and optimized iSesssions tunnel over the WAN connection.

3. VM vMotion
   Once the Storage vMotion event finishes, vCenter in the primary data center will trigger a standard vMotion event to move the running VM to the secondary data center. vMotion will be moving the VM over the iSessions tunnel to an ESX server located in the secondary data center which, due to the iSessions tunnel, is part of the same network as the primary data center. During the migration event, vCenter at the primary data center will remain in control of the transplanted VM.

4. Data Center Connection Redirection
   After successful completion of the vMotion migration event to the secondary data center, BIG-IP LTM at the secondary data center will recognize that the application is up and available. BIG-IP LTM at the primary data center will start routing existing connections through the iSessions tunnel to the VM now running at the secondary data center. BIG-IP GTM will also begin sending any new connections directly to the migrated VM in the secondary data center. As the existing user connections naturally terminate, all application traffic will be routed natively to the secondary data center.

5. vCenter VM Re-registration
   After the migrated VM is up and running in the secondary data center and all application traffic is being routed to that machine, BIG-IP LTM will send an instruction to the vCenter consoles at both data centers, turning over VM management to vCenter in the secondary data center. vCenter in the primary data center will stop managing the migrated VM, thus completing the long-distance vMotion event. The entire VM bundle, from storage up through management, is now live and serving users out of the secondary data center, and the VM in the primary data center can be shut down.

6. IP Reclamation
   In the event of a one-way move where the vMotion migration is a more permanent relocation—such as with a planned migration from one data center to another, or to a cloud deployment—the original IP space for the VM in the primary data center can be reclaimed and reused for other applications. Once the migration is complete—vCenter in the secondary data center has assumed control of the VM and all user connections are being routed to the secondary data center—the IP addresses in the primary data center (both local/internal and external) can be reclaimed and reused for other applications.

Live Migration Use Cases

There are two primary use cases for migrating a running virtual machine between data centers using live migration: planned and unplanned. Planned migrations between data centers is more common; however the F5 solution enables both planned and unplanned migrations over distance based on need.

Planned Migrations

As enterprises simultaneously scale out their data centers (either by building additional physical data center resources or by looking at off-premises cloud solutions) and consolidate the resources within those data centers, virtualization plays a major part in taking more control over existing resources. It is not uncommon for an enterprise to consolidate one data center by moving all the server resources to a virtual platform and then replicating that model out to additional data centers or cloud providers.

Long distance live migration enables IT to populate and replicate services to additional data centers without affecting the application or the user experience. A common example of planned migration is when one company buys another and acquires additional data center resources, and needs to move virtual machines and applications from the acquired data center to the existing primary corporate data center. Existing running virtual machines can be migrated with vMotion to the primary data center without downtime, allowing the administrators to move users and connections with those virtual machines to the new location. This model also holds true for scaling out to a new data center or a cloud provider. Planned long distance live migrations provide total flexibility for when both the applications and the users are moved, allowing migrations for scale out, disaster planning, or data center management to occur as needed.

Unplanned Migrations

Although not as common, the same infrastructure that enables planned long distance live migrations also supports unplanned migrations of running virtual machines without disruptions. Once a secondary or cloud data center has been

populated to mirror the primary data center, moving users to the new location becomes a feasible option for any reason. Cloudbursting is the act of dynamically scaling out resources based on need: as new resources are needed, new virtual machines are created and managed as part of the available application pool through BIG-IP LTM. Although it is possible to scale out for a cloudbursting event manually, it is typically an automated trigger that kicks off the event. For example, BIG-IP LTM may detect an application has reached 80 percent capacity and instruct VMware vCenter to provision a new virtual machine to accommodate the load. Once the new virtual machine is available, BIG-IP LTM can begin moving existing connections from the original virtual machine to the newly provisioned one.

In a distributed data center model, it becomes possible to dynamically provision the new virtual machine and migrate existing user connections to an off-premises location over distance using vMotion. Through a long distance live migration, the entire application workload can be migrated to the off-site data center while continuing to service user connections and without interruption to the application. This model becomes more compelling in the case of a hybrid cloud environment, where an off-premises cloud provider is hosting a private VMware cloud solution for the enterprise. By connecting the cloud provider with the existing data center, BIG-IP LTM and vMotion enable the enterprise to dynamically scale virtual machines over distance without manual intervention.

Conclusion

VMware has changed the way we build data centers, and cloud computing is changing how we think about local and remote data centers. Moving applications and running servers between hardware platforms enables us to create a very fluid and agile IT infrastructure to support new business needs. Yet these solutions are not seamless out of the box and often don't factor in the application needs and user experience.

Not only does F5 enable planned and unplanned long distance live migration events from cloud to cloud, but the same solution can be deployed within the local data center to migrate running VMs from one physical network to another physical network (assuming the VM network configuration remains unaltered). This solution can help move VMs from the dev/staging network into production, or move a running VM between security zones such as the DMZ and the private network.

Regardless of whether you're using F5 BIG-IP solutions to manage vMotion events within the data center, between private clouds, or between private and public clouds,

the application delivery technology remains the same. iSessions keeps the data secure in transit and optimizes the WAN for accelerated and reliable delivery of the storage and VM data. The VMware API enables BIG-IP solutions to request re-registration of the migrated VMs within vCenter in the destination cloud or data center. BIG-IP LTM and BIG-IP GTM manage user connections to the application to ensure that no user data is lost and that the applications remain online and available.

This integrated solution between F5 and VMware enables long distance live migration with vMotion for the first time between data centers and clouds. The solution works with your existing network and IT infrastructure; it does not require a re-architecture of your local or remote networks. This seamless solution uses existing technologies from both F5 and VMware to enable transparent live VM migration over long distances, guaranteeing the applications are migrated in a secure and optimized manner and always remain available before, during, and after the vMotion migration. Moving your applications and services transparently between clouds is now possible with F5 and VMware.

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