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Exploring VDI Architectures to Keep Both the Business and IT Agile

In this whitepaper, we'll take a look at VDI (Virtual Desktop Infrastructure) through the lens of an IT administrator as he takes a day to explore the benefits and challenges of traditional VDI solutions. As the IT administrator does his research, we'll also explore the architectural case for different types of solutions for addressing VDI, while he seeks out the ultimate VDI nirvana: an architecture that satisfies the benefits without sacrificing end-user experience and productivity—keeping both the business and IT, agile.

As IT administrators, we usually live in the world of catch-up, finger pointing and compromising decision making on a daily basis. Businesses, faced with today's competitive and always changing demands from customers and investors strive for agility, making swift turns on a moment's notice and always requiring more from less out of their assets. IT remains reactive and is always trying to keep up with these sudden changes. Tactical fixes and band-aid approaches are the norm in place of long-term strategic planning. Throughout all these fire drills, your CIO, looking to simplify and consolidate to save money, throws another initiative at you to go full VDI. She tells you to go figure it out, keep costs low and ensure the solution is congruent with the key initiatives around user productivity and IT efficiency.

VDI usually falls under the umbrella consolidation initiative pertaining to user desktops. As users interact with these desktops on a daily (and nightly) basis, taking this functionality farther away from them usually causes performance and productivity issues. On the other hand, bringing these services closer to IT, makes provisioning, protecting, compliance and support much easier. We all know consolidation chiefly favors IT, in cost savings as well as agility in management and support, hence it's usually a CIO-run initiative. Businesses do not benefit from IT consolidation, but are normally not opposed to it as long as on the front-end nothing changes. It's a constant tug of war between IT and business that usually ends up in a compromise of half consolidated, half distributed model.

Nirvana would be a design that would favor both the IT administrators and the business end user alike. It would enable 100% desktop consolidation with no impact to end user's performance, experience and productivity. Such an initiative would have mass appeal and support by both the CIO and the business. In this paper, we will discuss a day in the life of an IT administrator's decision making while architecting a VDI solution for the enterprise, and the journey to achieve VDI Nirvana.

Why VDI?

We live in a world of mobility, multiple devices and are always on the move. Yet, as consumers, we want accessibility to all services, on all of our devices, no matter where we are, and at all times. On average, a business user today carries two to three devices and accesses the same service on at least two of these fairly often. Use of desktops and laptops have taken a backseat to mobile phones and tablets. More services are consumed on mobile devices than laptops and that number is growing. From a CIO's perspective, VDI brings many benefits, both technical and business. As an IT administrator, lets weigh the pros of this VDI initiative.

Total Cost of Ownership

It is no surprise that the biggest driver of VDI in any enterprise is cost. Cost of laptops and desktops are a big chunk of an IT budget, not to mention annual refreshes can exponentially exacerbate this price tag. In addition to the hardware costs, operational and support cost savings are even more prevalent as all desktops are managed, patched and repaired centrally. Not requiring to ship laptops back and forth between user and head quarters results in efficient support and faster recovery times, resulting in greater user productivity. Much like how server virtualization abstracted that underlying hardware from the software and made better use of the server hardware, desktop virtualization provides similar benefits on the end user client side.

Agility

A user's productivity hinges on how quickly and efficiently an IT organization can get them set up with business critical services. If we treat desktop as any other service, it is one of the slowest to deliver as well as one of the slowest to support. If your laptop dies, not only do you lose valuable data, but you may need to ship it back and get a replacement. If all desktops are virtualized back at home base, it becomes very easy to push it out centrally so it can be accessed anytime on any device.

Security, Compliance and Governance

A friend of mine was working on special effects for a major animated movie from one of the top studios. He forgot his laptop on a flight—a laptop on which the highly anticipated movie script was stored. Luckily, he was able to recover the laptop. Had that not been the case, he would have been in deep trouble for losing a well-vaulted script. Security, data protection and governance become magnified when we think how many devices, including personal, on which our enterprise and personal data sits. Through VDI, we can centralize, control and protect all that data within the confines of our data center. We can use enterprise grade resources to house the data as well as enterprise capable tools to protect and manage it.
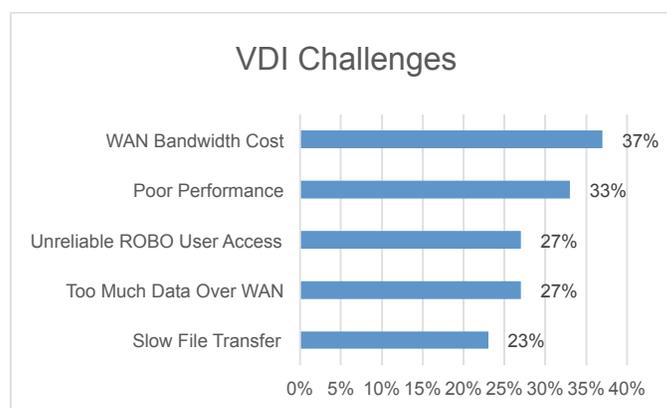
Technical Benefits

In addition to the aforementioned business benefits, there are also numerous technical ones. By using enterprise grade storage, we can use linked clones to serve the same image to many users. By pooling these users, we can minimize storage requirements, and make it very easy to spin up, say 50 or 100 desktops, quite easily. If a user receives the inevitable dreaded "blue screen of death" it's quite easy to move his or her persona and documents folder to another one of these golden image clones and voila, instant desktop. Also, most of the enterprises do not typically backup laptops and desktops. In virtualizing desktops, IT can treat them no differently than any other service at the data center, and protect this environment through any policy governance it may require, using enterprise grade data protection solutions. In short, moving your desktops and personas to the data center ensures that you never lose or break your desktop again.

With numerous benefits, it comes as no surprise that 68% – 77% are either currently using or evaluating VDI in some fashion. Typical industries where VDI is most prominent today are financial institutions, healthcare, education and government agencies. Almost all of these have a strict data governance and control policies and hence an easy decision to move to VDI.

VDI Challenges

There are numerous benefits of VDI. Most of these benefit me as the administrator. Safe for user mobility and quicker support, my users don't get much out of it. Looking at the challenges, they span both the user and the admin. According to an ESG survey done a few years back, below are the top five challenges faced by organizations while evaluating or implementing VDI.

Chart 1 Top 5 VDI Challenges taken by en ESG Survey

VDI Challenges

Challenge	Percentage
WAN Bandwidth Cost	37%
Poor Performance	33%
Unreliable ROBO User Access	27%
Too Much Data Over WAN	27%
Slow File Transfer	23%

Network Costs

Wide area network costs still remain some of the highest expenditures for enterprise networks. Huge WAN pipes are required to offset the need to stream multiple VDI streams to the end user. This typically results in high network costs, both at the data center as well as at the remote office.

Storage Costs

In a survey study conducted by Wikibon in 2011, for every $1 dollar spent on VDI deployment, $3 – $10 dollars are spent on backend storage. Storage is still not commoditized and enterprise storage is not cheap. Instead of using consumer-grade laptop disks, now we are storing these images on enterprise-grade storage arrays. This is due to the IO requirements to run VDI. Bootstorms and Antivirus scans can cause havoc during certain times of day and affect end-user experience. Moreover, the IO patterns are quite random with mixed read/write ratios and can cause the storage systems to behave erratically, causing system outages or worse—data corruption.

User Productivity

User productivity suffers in two major ways: first, due to latency, and second due to network outages. VDI drives real-time traffic and hence has low latency requirements. When I move a mouse or type an email, I want to experience immediate feedback on my screen. If my virtual desktop is sitting hundreds, even thousands of miles away, I may experience lag. Secondly, since VDI solutions are typically consolidated in the data center, these solutions are also completely WAN dependent. If the network connection is down, a user cannot access his or her desktop or any other service for that matter, and productivity suffers. Think back to the previously mentioned industries most inclined to use VDI; a loss of productivity can have serious ramifications.

Architectural Limitations

Branch users typically have branch peripherals they interact with, for example, local printers. In a VDI deployment, a simple print job is executed at the data center, traverses the WAN and then is sent to the local printer. PDF files tend to be quite thick and cannot only cause network congestion, but also delays in simple printing. Certain VDI solutions offer a "View Only" local mode to battle this, but that isn't suitable for most environments.

VDI Nirvana

The day is only half over and I have weighed both the pros and cons of my VDI solution. I see compromises on the horizon. But before I settle, I want to see if there is such a thing as VDI Nirvana. If I were to design a solution, what benefits would I want? I jot down the ultimate VDI holiday wish list.

Total Consolidation

I would want 100% consolidation of all desktop assets under one roof at the data center. This would give me the ease and agility to deliver desktops. It would empower me to provide quicker support. It would give me control and compliance over the entire company data. It would tick the security and protection initiatives along the way. And best of all, it would deliver me a better bang for the buck for my data center resources.

User Experience and Productivity

I would want the same or better experience for my customer—the end user. I would like for him or her to experience LAN speed performance no matter what the network latencies are. I would want them to be completely WAN agnostic. Whether the network is up, down or degraded, a consistent user experience is delivered. I would want them to interact with their local peripherals (i.e. local printers) with the same ease and speed as if they were sitting right next to them on their laptops. Lastly, I would want their productivity and performance to go up by giving them better up time and supporting them quickly, and not the other way around.

Storage and Network Costs

I would want both my backend storage and network costs to be unaffected or decrease. On the network side, I would like not to add additional latency-sensitive traffic at all, hence, no need to re-up my WAN pipes. And on the storage side, I would not want to rearchitect for certain scenarios like bootstorms or antivirus scans that cause spikes in storage IOs during certain periods.

Flexibility

According to TechNavio's latest Global VDI Market 2015-2019 report, VDI is expected to grow at a compound annual growth rate of 32.47% during this period. Key players in the global VDI market are Citrix Systems, Microsoft, Dell, Red Hat and VMware. Client virtualization is not a one-size-fits-all market with numerous vendors bringing their own unique benefits and capabilities to the table. Many enterprises use multiple hypervisor solutions to avoid vendor lock-in or take advantage of specific functionality provided by these solutions. I would want the flexibility to work with any, or even multiple, VDI vendor solution based on functionality and cost.

Solution Design

Now that I have evaluated the pros and cons, and what an ideal VDI solution might look like. Now it's time to draw out my design. The common choices for VDI solutions call for either an enterprise-grade backend storage solution, for example EMC, NetApp, Pure Storage etc. or an HCI solution i.e. Nutanix, Simplivity etc. Architecturally, they both work in identical fashion.

Let's examine this by taking a look at how a typical hyper-converged infrastructure (HCI) solution for VDI looks. Hyper-converged infrastructures combine the elements of network, storage and compute into manageable bite sized building blocks that scale horizontally giving you equal capacity and performance for all three resources. The HCI architecture abstracts the underlying infrastructure from the applications and services layer and gives administrators a single pane of VDI. At the app layer, resides the VDI compute that is projected out over the WAN to the end-user client. VDI platforms vendors like VMWare or Citrix have done their best to thin out and optimize the protocols for desktop streaming. There are a few other components that deal with management, orchestration and delivery. For the sake of simplicity, let's assume all these reside in the data center. All of these tools use non real-time protocols to communicate with each other. A typical VDI over hyper-converged infrastructure would look something like Figure 2.

It's a good design for non real-time data center based application delivery but fails to deliver the same promise for VDI. The challenges are both at the data center and the client sides.

At the data center, high-grade storage is required to deal with daily bootstorms and virus scans. All WAN capacities must also be increased to make way for the glass to manage it—a proverbial one ring to rule them all.

**Figure 1** HCI running Application
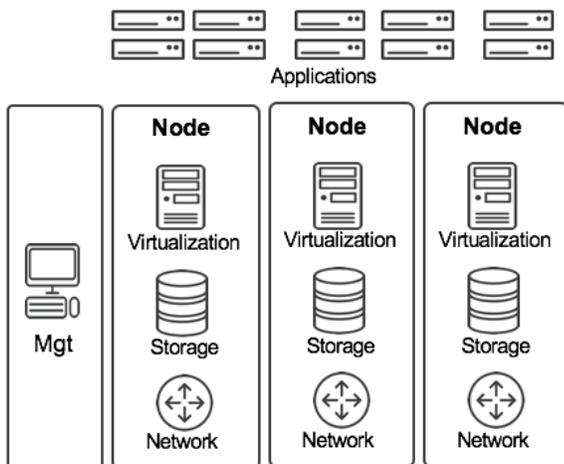
Figure 2 HCI running VDI Infrastructure newly added VDI traffic
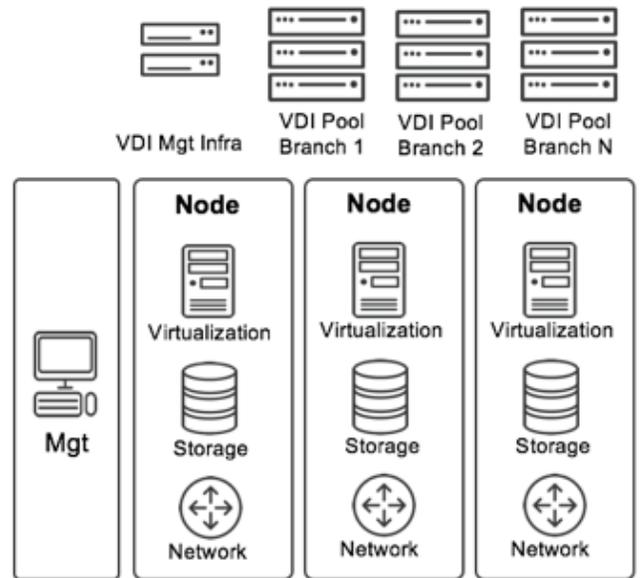
Since the user now sits farther away from his compute head, he must deal with the latency and WAN bottleneck challenges of multiple VDI sessions. Everyone suffers equally. A way to address this would be to place VDI storage on HCI in the branch, however since HCI is stateful in nature (containing real data), it would negate the IT benefits of consolidation.

Figure 3 VDI Challenges
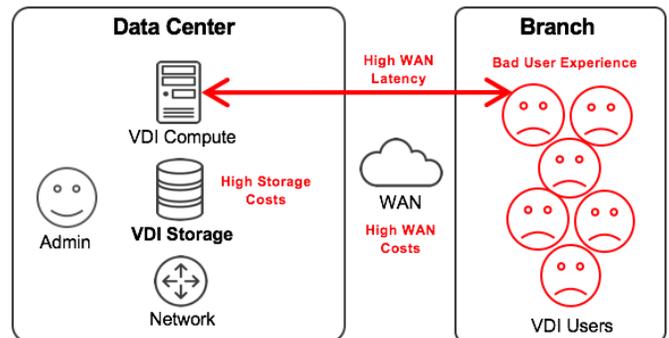
Hyper-converged Edge for VDI

It's late afternoon now. Dejected and frustrated I Google 'hyper-converged infrastructure for the edge', and I run into the Riverbed Hyper-converged Edge SteelFusion™ solution, built specifically for branch and remote offices. This seems to fit the bill—in fact, the one I laid out in my holiday wishlist for VDI.

It gives me 100% consolidation of my entire VDI infrastructure, provides consistent LAN speed user experience, is completely WAN and network independent, and I am not required to spend an arm and a leg for my back-end storage infrastructure. It addresses a fundamental architectural nuance posed by typical HCI infrastructures and that is the answer to the question—can HCI be stateless?

Architecture

Traditional HCI solutions are great infrastructures for data center services. However, they are stateful beings. They contain real data. They need to be individually managed—causing pain to admins when attempting to manage many locations. I would argue that the purpose and value of true consolidation is not to render the branch completely infrastructure-less, rather simply stateless. A user's interaction with any service, including VDI, is with the compute piece, where the service is executed. If you bring the compute closer to the user, you make the user happy by giving them better performance. The way the Riverbed Hyper-converged Edge solution is architected accomplishes precisely that. It keeps all VDI stateful storage in the data center, but moves the compute to the edge. From a cost perspective, this is a wash since we are taking compute out of the data center and redistributing it amongst various remote offices. Laws of physics dictate that we would still need some cache beneath the compute to function properly, it also places a copy of the subset of the working set data at the remote location next to the compute. It is important to note here that this is not the real data but simply a cached copy of the data that exists temporarily at the branch while the user is working on it. This creates a stateful data center with all VDI storage

infrastructure, with a stateless branch containing only the compute closer to the user—and thus, giving me the user experience I am looking for, while at the same time, consolidating data and operations to my data center.

Figure 4 Riverbed Hyper-converged Edge Solution Architecture
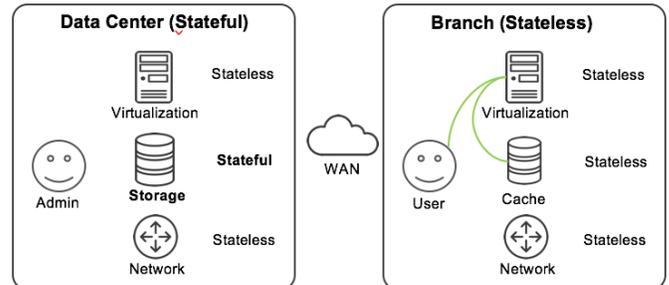
As an administrator, I can manage, control and protect everything at the data center. And the user gets LAN speed performance for his or her desktop. Since LAN networks are typically of the order of Gbps, multiple VDI streams on the LAN provide zero latency and excellent performance. It also alleviates additional traffic over the WAN by isolating the VDI streams on the LAN segment of each remote branch office.

Solution

Riverbed SteelFusion™ is the world's only Hyper-converged Edge solution designed specifically for the remote office. It facilitates 100% consolidation with LAN speed user performance. It enables data center manageability of all VDI infrastructure components, while giving local performance and WAN disconnected operations to the remote office users. It empowers organizations to extend the capability—the services, the resilience and the security—of their fully consolidated and stateful data center to a stateless branch without compromising performance, experience and productivity of the end user.

The overall solution consists of three components.

Figure 5 Riverbed SteelFusion Solution

Data Center

At the data center, the two components are the Riverbed SteelFusion Core and Riverbed SteelHead.

Riverbed SteelFusion Core

The SteelFusion Core acts as a broker and a single management portal to all remote offices. It is responsible for managing projecting VDI pools to the SteelFusion Edge cache.

Data Center SteelHead

A SteelHead also exists at the data center to accelerate the projected data in flight. In a VDI environment, since multiple VDI sessions produce same data, SteelHead ensures it is highly de-duplicated while traversing the WAN.

Both the SteelFusion Core and SteelHead can be in a highly available active-active configuration for increased performance and fault tolerance.

Remote Office

At the remote office, the Riverbed SteelFusion Edge appliance converges all three components (compute, storage cache and network) into a single, hyper-converged appliance. SteelFusion Edge consists of the following components.

Riverbed Virtual Services Platform

A compute layer called Virtual Services Platform (VSP) runs VMWare ESX 6.0 hypervisor. This is where the VDI compute for the particular branch location is executed.

Riverbed BlockStream™

VSP gets its storage from the BlockStream cache. All SteelFusion Edges communicates with the SteelFusion Core and are pushed the configs, and pertinent working set data that reside within this cache. Utilizing patented prefetch algorithms, only the working set data traverses the WAN, and is cached in this layer. This ensures that the users are getting local LAN speed performance no matter the state of the WAN, even in the case of a total outage. As users work within their virtualized desktops, the new data created at the branch is immediately and continuously streamed back over the WAN through the SteelFusion Core to its final stateful resting place in the data center.

SteelHead

At the network layer is the SteelHead. It serves a dual purpose. Firstly, it is responsible for accelerating all the prefetched and delta change traffic between the SteelFusion Edge and SteelFusion Core for a near real time RPO (Recovery Point Objective). Secondly, it is responsible for all data center application to user traffic to give the user a LAN like experience even for the apps that are not locally run on the VSP.

Comparison

In a typical VDI design, end user experience can vary greatly depending upon many factors such as time of day, state of the network and proximity to the data center. Comparing certain commonly used everyday applications over a T1 link (typical remote office WAN bandwidth) with about 80ms of latency (coast-to-coast in the US), we notice that there is almost no difference in performance between VDI with SteelFusion and VDI on a LAN network with zero latency. There is a noticeable difference in experience while comparing these to that over the WAN.

Chart 2 VDI Comparison between LAN, WAN and SteelFusion
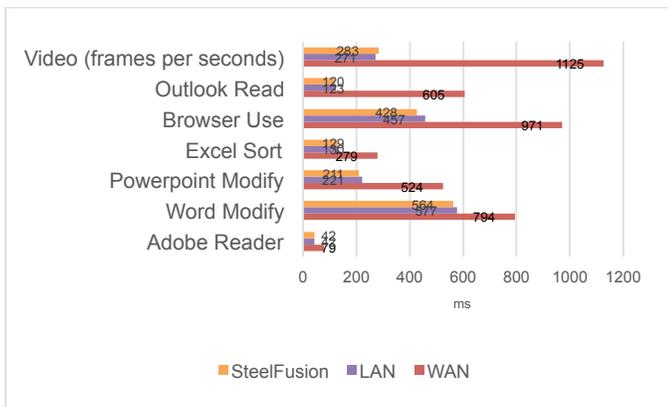
On the other end, the storage IO characteristics are also dramatically different when comparing VDI with and without Riverbed SteelFusion. The key thing to note here is that either during high IO operations (i.e. a bootstorm or steady state operations), READs are non existent on the backend storage since all READ requests are served through the SteelFusion Edge cache. The WRITEs, which are more prominent during bootstorms are also alleviated since they will primarily be served out of the SteelFusion Edge cache. This can help us save on backend storage costs.

Chart 3 Bootstorms and Steady State VDI Comparison

Summary

In conclusion, we made the correct choice by going with the Riverbed Hyper-converged Edge SteelFusion solution for our VDI deployment, versus typical HCI. The solution provides the simplicity and cost benefits of consolidation in the data center without compromising user experience and productivity in the remote branch office. It gives me full control, manageability and protection in the data center without overprovisioning storage and WAN connectivity, and my users continue to work at LAN speed even in the event of a WAN outage. Riverbed Hyper-converged Edge is true VDI Nirvana.