PERFORMANCE ASSURANCE FOR VIRTUALIZED CITRIX XENAPP INFRASTRUCTURES

An eG Innovations Technical White Paper

www.eginnovations.com

Total Performance Visibility

CITRIX XENAPP – A TRIED AND TRUSTED REMOTE ACCESS TECHNOLOGY

In recent years, there has been a lot of focus and discussion on virtual desktop technology. Virtual desktop technology promises several benefits including better resource sharing, efficient license management, centralized administration and higher security. However, there are still concerns about its cost efficiency, especially for most enterprise applications.

While some applications require the higher security levels that virtual desktop technology offers, there are many other scenarios where it is not essential to provide separate desktop operating system instances for each user. For such use cases, Citrix XenApp and Microsoft Terminal/Remote Desktop Services provide a more cost-effective means of delivering applications and remote desktops securely to users. The visibility of Citrix XenApp and Microsoft Terminal/Remote Desktop Services as remote access mechanism is proven with more than hundreds of millions of users. While Microsoft Terminal Services is primarily used within local networks, Citrix XenApp is popular for both remote and local network access as a result of the efficiency and capabilities of Citrix's proprietary HDX protocol.

Organizations of all sizes – in multiple industries including banking and finance, legal, government, healthcare, education and insurance are using Citrix XenApp technology today for providing secure access to users. In almost all of these scenarios, a Citrix XenApp infrastructure is mission-critical, and if a server goes down, it will impact several tens to hundreds of users who are accessing business applications hosted on the server.

VIRTUALIZING CITRIX XENAPP

There is a growing trend to virtualize XenApp. There are many advantages of virtualizing XenApp services:

- Higher deployment flexibility and rapid responsiveness – depending on load given a VM can be spun up very quickly.
- High-availability benefits because clustering physical servers makes it possible to set up an HA cluster. If one of the physical servers goes down, the VMs on that server can be moved to one of the other servers in the cluster, thereby minimizing any disruption to the business service tools. A new more holistic model is needed to ensure uninterrupted visibility across every tier and layer of the cloud ecosystem.
- Load balancing capabilities allow VMs on a heavily loaded server to be dynamically moved from that machine to another one in the cluster (VMotion and XenMotion provide this capability for VMware vSphere and Citrix XenServer, respectively).
- Ease of maintenance to enable patches, hot fixes, etc. to be applied to a gold image that can be streamed to the VMs.

While virtualization of Citrix XenApp offers several benefits, this move also introduces a number of new challenges when it comes to assuring the performance of business services that use this technology. In this paper, we discuss the new challenges that Citrix administrators have to address as they virtualize Citrix XenApp and describe how eG Enterprise from eG Innovations helps address these challenges.

> "95% of Citrix deployments are already virtualized"
>
> **- 2016 Citrix Performance Survey,**
> *By eG Innovations & DABCC*

VIRTUALIZED CITRIX XENAPP PERFORMANCE CHALLENGES

Even when it was installed on physical servers, Citrix XenApp was one of the most performance-critical applications in the enterprise. This is primarily because XenApp is used to access highly interactive applications, and as soon as a performance issue occurs, users notice and complain. For example, performance slowdowns can mean that users see their keystrokes appear after several seconds, making it very difficult for them to productively use the remote access service based on XenApp.

The business implications of performance slowdowns in a XenApp infrastructure can be significant. When a user, who has been provided a dedicated desktop, experiences a slow-down, the problem impacts that user only. On the other hand, a problem in the Citrix XenApp environment can impact all the users in the server farm. If users experience frequent issues, they will want their physical desktops back. This can significantly change the cost dynamics for the organization and project. Hence, it is critical for enterprises to assure the performance of their XenApp infrastructure.

INCREASED COMPLEXITIES

From the user point of view, the usage model of XenApp is very simple: a user logs in through a web page, sees applications published and accesses any of these applications from their thin client device. Although the usage model is simple, internally, many different applications and infrastructure components have to work in concert to support this service. For example, users login to a web StoreFront that relies on Active Directory for user authentication. The StoreFront forwards the request to the least loaded XenApp server in the farm and for doing so, it communicates with a Delivery Controller (see Figure 1). The user's profile has to be loaded by the XenApp server from a file server, and the application GUI hosted on the XenApp server may access backend applications.

Because of the inter-dependencies between tiers, a slow-down in any one tier can impact all the other tiers and ultimately affect the user experience. From the administrator's perspective, the challenge then is when a problem occurs, where is the cause of the problem: is it the network, the XenApp server, the StoreFront, in the Active Directory, or is it one of the back-end applications?

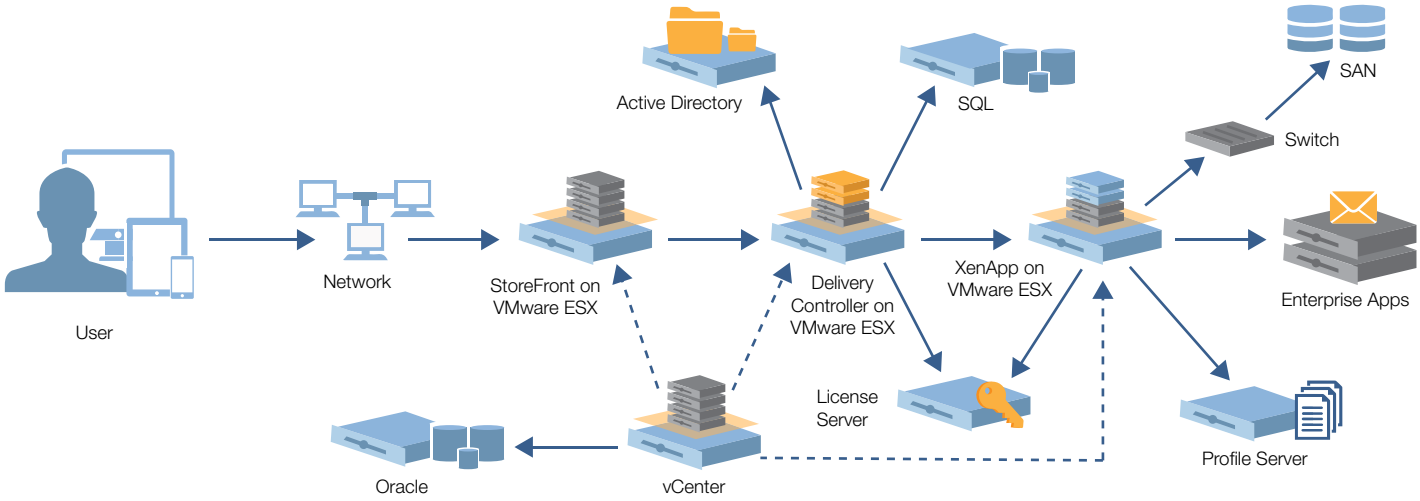


Figure 1: A virtualized XenApp deployment: Each of the application tiers could be run inside a virtual machine

Virtualization of XenApp adds to these challenges because:

- There are many new components that need to be managed. These include the virtualized servers (VMware vSphere, Citrix XenServer, Microsoft Hyper-V), the centralized administration application like VMware vCenter, the storage devices, SAN switches, etc.
- Secondly, all of the applications supporting the Citrix service may be run on virtual machines – that is, the XenApp server, the web StoreFront, the license server, provisioning server, Active Directory, etc. can all be hosted on VMs. A slowdown in the virtualization tier can cause affect all of these applications. In such a case, if a Citrix administrator only had visibility into the Citrix stack, he/she could end up spending hours looking at the Citrix servers, when the real issue is in the virtualization tier.

Therefore, to be able to troubleshoot problems effectively, Citrix administrators need to have an additional degree of visibility. They now need to know when a problem happens, could it be the virtualization platform that could be causing the slowdown?

ADDITIONAL DEPENDENCIES

Another complication with virtualization is that it introduces new types of dependencies because VMs share the resources of the physical machine they are hosted on. For example, consider a scenario where the Citrix XenApp server is hosted in a VM that is running on the same physical server as another VM that is hosting an Oracle database server. Now, if all of a sudden, there are a lot of requests to the Oracle database, this can cause a lot of IO operations to the physical server's disk, thereby slowing down disk accesses for all the VMs on that physical server, including the Citrix XenApp server (see Figure 2). A performance assurance solution for virtual XenApp infrastructures needs to consider these new dependencies that virtualization introduces.

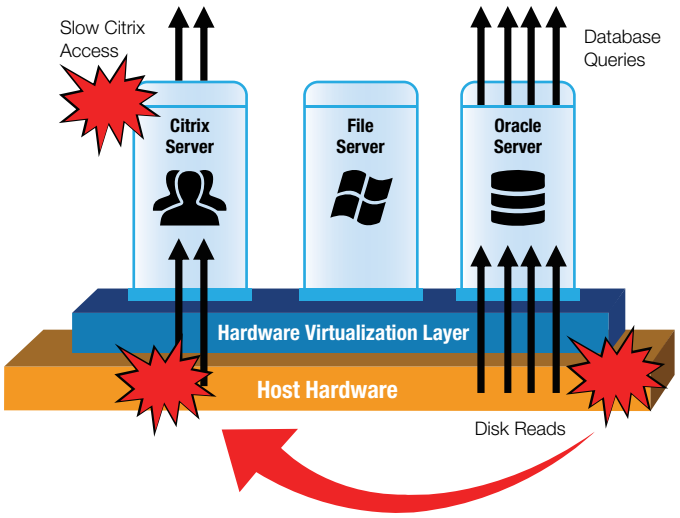


Figure 2: Virtualization introduces new interapplication dependencies that management systems have to take into account. In this figure, excessive load to the Oracle database is choking the physical hardware and in turn the VM hosting the Citrix XenApp server.

DYNAMIC ENVIRONMENT

Virtualization also introduces dynamicity to the IT infrastructure. In many enterprise infrastructures, VMs are clustered on multiple physical servers and the virtualization platform is capable of migrating VMs from one physical machine to another. The migration may be triggered by physical server failures or by increased load on one of the physical machines. Since VMs, (and the applications that run on these VMs), can be running on different physical machines at different times, the existential dependencies we discussed earlier (with one VM on a physical machine impacting another) need to be discovered in real-time. Manually tracking these movements and correlating across VMs and applications is near impossible. Citrix administrators therefore need real-time visibility, not only into the application, storage, and network tiers that support the XenApp service, but they also need visibility into the virtualization tier.

HARDWARE SIZING

Another challenge that Citrix administrators need to address is how to size the virtual XenApp infrastructure.

XenApp instances supporting even upto hundred concurrent users are common when hosted on physical servers. When virtualizing these instances, Citrix administrators have to determine whether they configure a few large (more memory, more CPU) VMs to host the XenApp servers, or should they set up many smaller VMs? While bigger VMs can support more users, these VMs are often more difficult to migrate across physical servers since they require more resources than smaller VMs. If the physical servers are not clustered, then smaller VMs may be preferred to reduce the impact of a VM failure. Another consideration is whether a 32 bit or a 64 bit operating system is to be used.

FRAGMENTED TOOLSETS RESULT IN SLOW RESPONSES TO PERFORMANCE ISSUES

To manage XenApp running on virtual infrastructures, administrators today have to rely on a hodgepodge of monitoring and management tools. Citrix Director/ EdgeSight provides deep visibility into the XenApp stack, but it has no visibility into the virtualization platform or the storage and network tiers. There are specialized tools available for monitoring networks, for databases, for the applications being accessed through Citrix XenApp (SAP R/3, Exchange), etc. Virtualization platforms include their own administration and monitoring tools. For example, Citrix XenCenter provides visibility into Citrix XenServer, where as VMware vCenter and vCenter Operations can be used for VMware vSphere.

The challenge though is while there are several different tools for the infrastructure, there is little integration or correlation between these tools. Administrators have to manually analyze the different tools and determine the cause of a performance slowdown. What makes the problem worse is that each of the infrastructure tiers is managed by a different group/individual within the enterprise. Coordination across different groups coupled with manual analysis of different toolsets makes performance assurance for virtual XenApp infrastructures very slow and reactive.

Since virtual XenApp infrastructures are dynamic, manual diagnosis is not sufficient. Also, to correlate across the different tools, deep domain expertise is required. Hence, the domain experts often find themselves being pulled in to do routine fire-fighting.

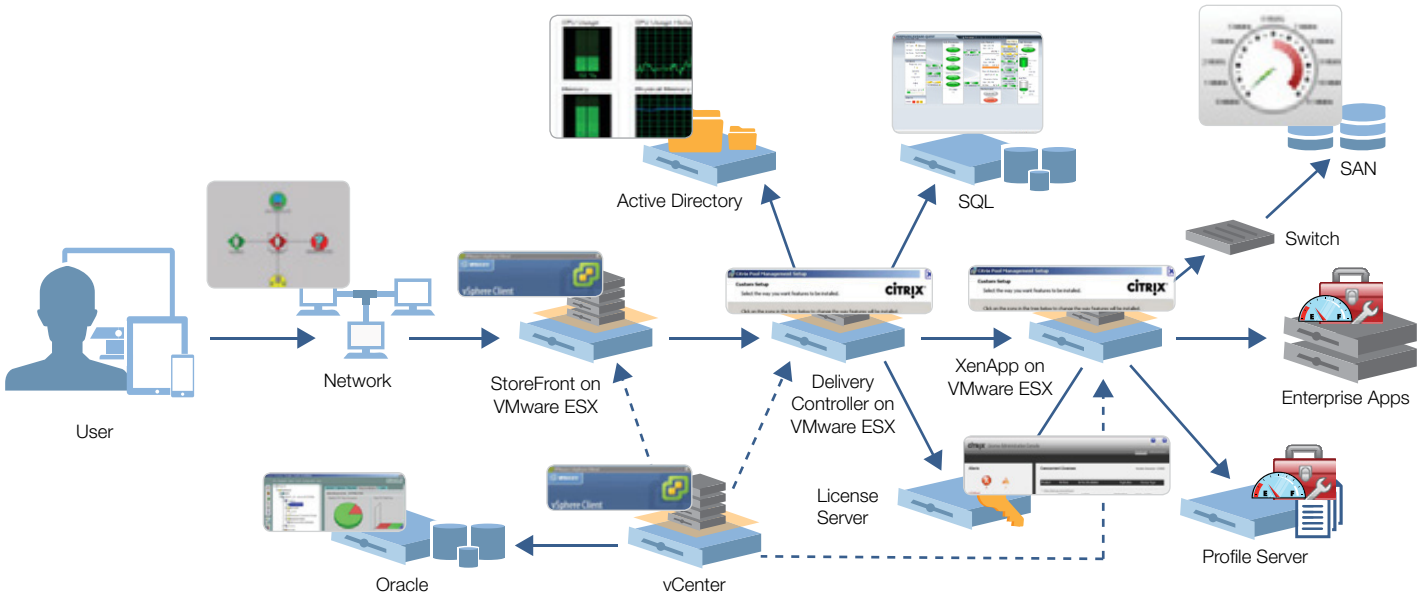


Figure 3: Citrix service managers have to deal with fragmented toolsets. There are specialized tools for monitoring and administering every tier of the infrastructure, but what the service managers need is a single pane of glass from where they can monitor, diagnose and report on the performance of the infrastructure.

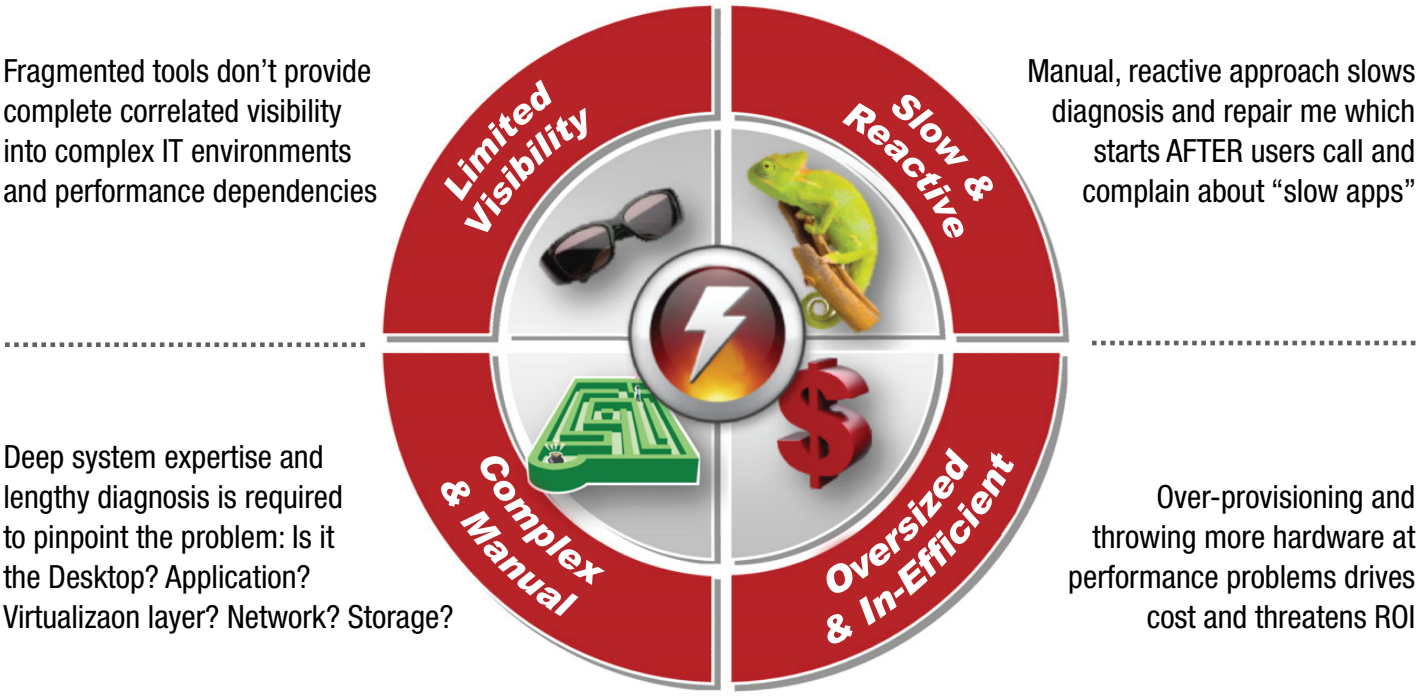


Figure 4: The key performance assurance challenges administrators of virtualized XenApp infrastructures face

Finally, because they do not have complete visibility into the entire service infrastructure, when faced with performance issues, administrators often throw hardware at the problem. This results in over-engineered infrastructures that are difficult to scale to support additional user workloads. Figure 4 summarizes the challenges in ensuring performance assurance for virtualized XenApp infrastructures.

THE SOLUTION FOR VIRTUAL CITRIX XENAPP PERFORMANCE ASSURANCE: eG ENTERPRISE

To effectively troubleshoot a scenario where a user complains that "Citrix is slow" or "Citrix is not working", administrators need visibility into the end-to-end service infrastructure including the network, application, Citrix XenApp, applications, virtualization platform and storage.. This is what eG Enterprise provides – complete visibility into every layer and every tier of the Citrix service infrastructure. It monitors the Citrix service, not just the Citrix server. So it provides automated diagnosis and correlation, the metrics and the analysis that helps operations teams understand very quickly how the Citrix service is working and which parts of the infrastructure are working and which ones are not using color coded displays.

With eG Enterprise in place, Citrix admins have visibility into parts of the infrastructure they never did before. The net effect is, when a problem happens, they can clearly identify what caused the problem, so they can accelerate problem resolution to restore service quickly - and prove that, most of the time, it's not Citrix that is the cause of the issue. In that sense, eG Enterprise is like a general practitioner for a Citrix XenApp infrastructure. When a person is not well, he/she consults a general practitioner. 80% of the time, the general practitioner solves the problem. In other cases, the general practitioner may involve a specialist to solve the problem. In the same way, the eG Enterprise Citrix service management solution is the first point of contact for understanding how a Citrix service infrastructure – whether physical or virtual – is performing. A majority of the time, the eG Enterprise

manager itself is able to provide sufficient diagnosis of problems. In cases where it does not have sufficient visibility, eG Enterprise can point the administrator to the domain where the problem lies and the administrator can then use specialized tools (e.g., network sniffer, database query plan analyzer, etc.) to diagnose further.

KEY CAPABILITIES OF eG ENTERPRISE

Total Performance Visibility:

eG Enterprise's unique universal monitoring technology provides total performance visibility about the infrastructure. Out of the box monitoring support for over 150+ enterprise applications, 10+ operating systems and 10+ virtualization platforms ensures that eG Enterprise can monitor the health of every tier of every layer of a virtual XenApp infrastructure. By doing so, eG Enterprise provides a single pane of glass view across the network, server, storage, application and virtualization tiers.

Fast, Pre-Emptive Problem Detection and Alerting:

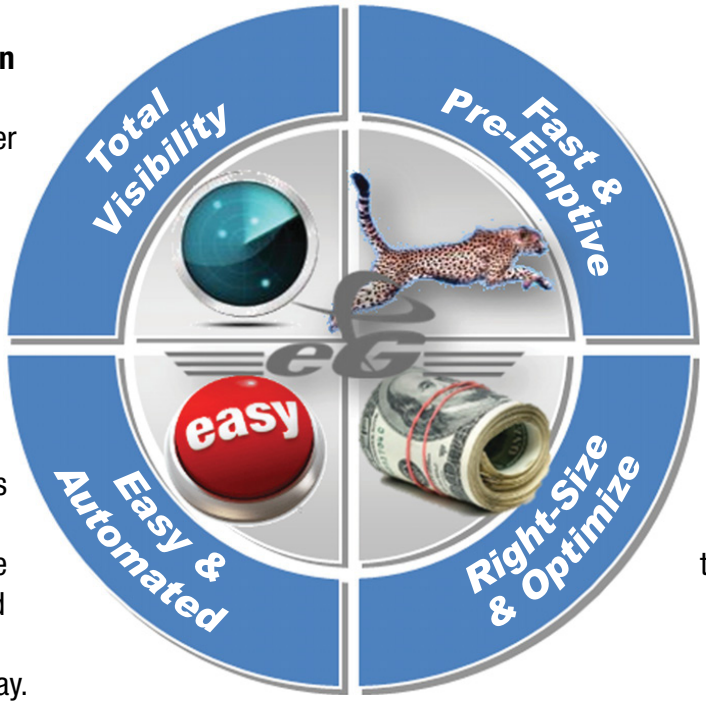
By analyzing the past history of metrics, eG Enterprise determines time of day norms for all the metrics that it collects. When any metric deviates from its norm, eG Enterprise triggers a preemptive alert. Since the norms are determined automatically, with very little human intervention, eG Enterprise is very easy to set up and operate. Furthermore, since its alerts are based on violation of historical norms, most often, eG Enterprise alerts administrators well before users have noticed a problem. The key benefit of this capability is that it helps prevent catastrophic failures, avoids downtime and ensures user satisfaction.

Automated Root-Cause Diagnosis:

eG Enterprise embeds the industry's first virtualization-aware automatic root-cause diagnosis technology. Considering inter-application dependencies, application

Unmatched performance visibility and autocorrelation of all components and dependencies that impact user experience – across desktop, application, network, storage and virtualization tiers.

Automatic root-cause diagnosis pinpoints problems and accelerates diagnosis and resolution of performance issues – so your highly skilled staff can be more productive rather than fighting fires all day.



Fast, pre-emptive problem detection & alerting so you can fix performance problems BEFORE users complain. Prevent downtime ensure great performance and enhance on user satisfaction.

Right-size and optimize your environment and reduce hardware cost by 20% through better utilization rates.

Figure 5: Key capabilities of eG Enterprise

to VM mappings and VM to physical machine dependencies, eG Enterprise correlates alerts that it receives from every tier of the infrastructure. The result is that when a problem happens, eG Enterprise can accurately prioritize alerts and pinpoint the root-cause of a problem – whether it is in the network, database, XenApp server, Active Directory, or in the virtualization platform or storage tiers. Not only does this accelerate diagnosis and resolution of performance issues, but it also makes diagnosis much simpler so even lower skilled service desk personnel can play an active role in problem resolution. This ensures that the organizations highly skilled domain experts can be used for more productive tasks rather than fighting fires all day.

Right-Size and Optimize your Deployment:

Extensive trending, prediction and analysis reports included in eG Enterprise help administrators understand how well their infrastructure is being used, where their capacity bottlenecks are, and what can be done to scale the infrastructure to support additional users. Based on these reports, administrators can invest wisely to enhance the utilization of their infrastructure.

TROUBLESHOOTING A VIRTUALIZED CITRIX XENAPP INFRASTRUCTURE WITH eG ENTERPRISE - A REAL -WORLD SCENARIO

To illustrate how eG Enterprise helps, let us consider a real-world example. This example considers a small Citrix XenApp server farm that is virtualized. eG Enterprise is being used to monitor this infrastructure. In the eG Enterprise console, color codes are used to represent the state of the infrastructure and the different servers, networks, storage devices and services it supports. While green indicates normalcy, different shades of red indicate different levels of problems. Pink color is used to denote a proactive alert – i.e., there is an abnormality but it is not business impacting, hence, the administrator can look at this problem when he/she has time. Orange signifies a major alert – i.e., the problem is severe but this is probably an effect rather than the cause of a problem. Red color indicates a critical alert – i.e., the problem is business impacting and the alert indicates a root-cause of the problem.

Service views can be created in eG Enterprise to represent the key business services being delivered by the infrastructure. Associated with each service are key transactions to be monitored to assess the health of the service, and a topology graph showing what applications and network devices are involved in service delivery and the inter-dependencies between them. Figure 6 below shows that eG Enterprise is currently reporting a major problem (represented by the orange color code) with the *Infomart* service which is being delivered through the Citrix XenApp infrastructure.

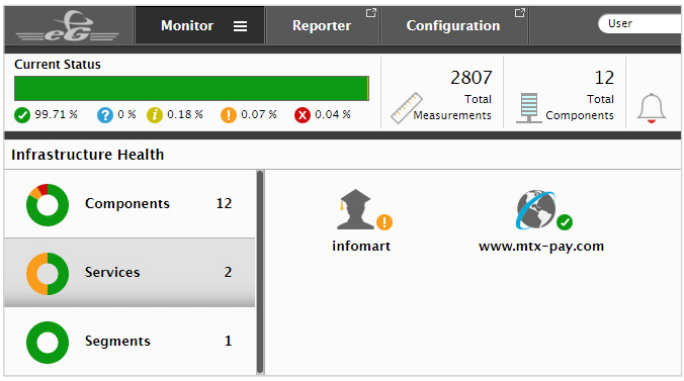


Figure 6: Key business services being monitored by eG Enterprise

A drilldown from the problematic service (*Infomart*) provides the administrator with a view of the key transactions to the business service being performed by users. An eG agent installed on the web interface front-end provides a view into the transactions being processed by users of the service. From Figure 7, it is apparent that users are seeing errors with two of the transactions – *ApplicationAccess* and *UserLogins*. At this point, the administrator knows that there is a problem with the business service. What he/she does not know is what is causing the issue – i.e., is it the network? Database? Application? Virtualization platform? XenApp? Storage?

To investigate further, an administrator can click on any of the problematic transactions in Figure 7. eG

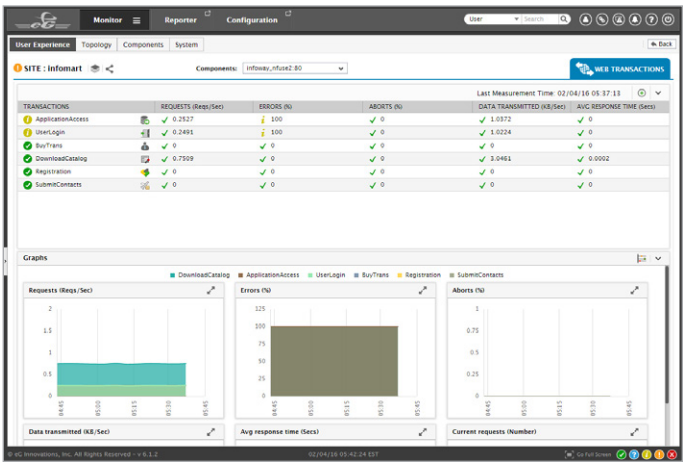


Figure 7: An overview of the user experience. This figure shows the performance of key business transactions to the web front-end

Enterprise now provides the administrator with a view of the service topology for the *Infomart* service (see Figure 8). The service topology shows the different applications involved in service delivery and the dependencies between them. Walking the service topology left to right in Figure 8, when a user accesses the service, the request goes through a router to an IIS web front-end, which then forwards the request to a Citrix Delivery Controller/Zone Data Collector (ZDC) depending in the version of XenApp.

The ZDC then forwards the request to a XenApp server. Users then access applications hosted on the XenApp server. These applications can use backend file stores, SQL and Oracle databases, or print services. In this example, eG agents are being used to track the health of each of the infrastructure tiers. Based on the status reports from the agents, the eG Enterprise manager has determined that two of the tiers – the web front-end and the XenApp server have issues. Using eG's automated root-cause diagnosis technology, the eG manager has determined that the higher priority problem is in the XenApp server. As you can see from Figure 8, just following the color cues, a service desk person can easily determine where they need to focus their attention to troubleshoot a problem – in this case, the focus is on the XenApp server (*infoway_ctx2*).

The next level of diagnosis can be obtained by clicking on the *infoway_ctx2* XenApp server in Figure 8. If this XenApp server were hosted on a physical server, the drill down would have zoomed into the status of this application and its functional layers. In this example, the *infoway_ctx2* XenApp server is hosted in a VM. The eG Enterprise system auto-discovers this, and so the next drilldown shows this VM and its dependency on the physical machine it is hosted on. Figure 9 shows this virtual topology.

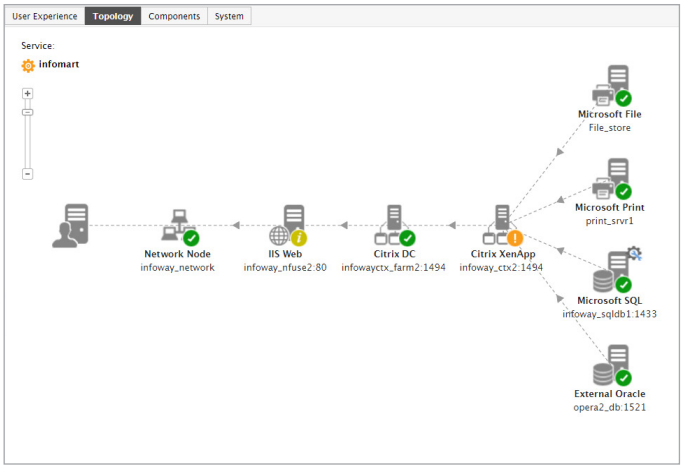


Figure 8: Service topology of the Infomart service showing the data flow between the applications and devices supporting the business service.

From this figure, it is apparent that the Citrix ZDC and the web front-end applications are also hosted on VMs running on the same physical server – namely, the VMware ESX server, *nyc_vm_02*. eG Enterprise discovers this mapping of applications to VMs and VM to physical machines in real-time. It also correlates the status of the applications with that of the physical server that the applications and their VMs are hosted on. As is apparent from Figure 9, while the *infoway_ctx2* XenApp server has a major issue, the ESX server *nyc_vm_02* on which it is hosted has a critical issue that is probably impacting the XenApp server as well. Hence, by looking at Figure 9, an administrator can determine that the focus has to be on the ESX server *nyc_vm_02* and not on the XenApp server *infoway_ctx*.

Figure 10 shows the drilldown into the *ESX server nyc_vm_02*. eG Enterprise uses a layer model representation to depict the functioning of all of the components it supports. The metrics it collects are mapped to different

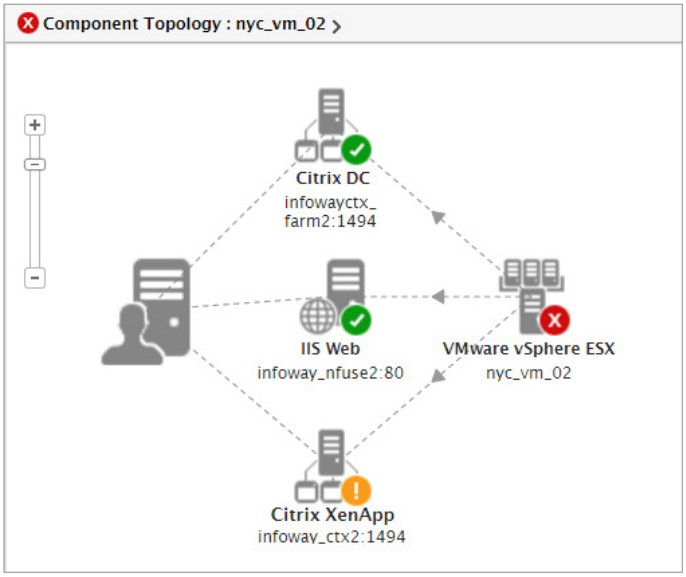


Figure 9: Virtual topology showing the ESX server that the Citrix XenApp server infoway_ctx2 is running on

functional layers and the layers are hierarchically organized to represent the dependencies between them. The layer model for the ESX server is shown on the left hand side of Figure 10. Walking the ESX server's layer model bottom up in Figure 10, we can see that the hardware layer of the ESX server is fine. The operating system layer, which represents the hypervisor and service console, has a critical issue. The network connectivity to the server looks fine, the virtual networks and VM processes appear to be fine. The outside view of the VMs shows a major issue – probably a result of the critical issue at the operating system layer.

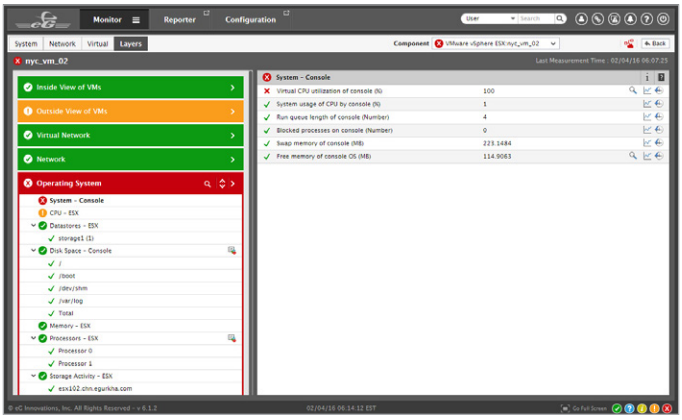


Figure 10: The layer model of the ESX server nyc_vm_02

The right hand side of Figure 10 provides more details about the critical issue at the operating system layer.

The system performance of the ESX server's service console is showing a critical issue. The *Measurements* panel at the bottom of Figure 10 shows why this is the case. The virtual CPU usage of the service console is at 100%. The service console is a boot-strap operating system for the ESX server. This thin operating system is used to get the ESX server up but is not expected to perform many other tasks. In this case, it looks like some application running on the ESX service console is taking up a lot of CPU cycles.

eG Enterprise's detailed diagnosis capability provides additional details. Notice the magnifying glass icon next to the "*Virtual CPU utilization of console*" measurement in Figure 10. Clicking on this icon brings up detailed diagnosis for this measurement.

Figure 11 shows the detailed diagnosis for the virtual CPU usage measurement. The detailed diagnosis information is collected by the eG agents periodically. The diagnosis differs from one measurement to another – for example, for CPU utilization, the diagnosis shows the top processes running sorted by their CPU usage, whereas for slow response times from a database server, the diagnosis would show the top queries running on the server, sorted by their execution time. Figure 11 shows the top processes running in the ESX server's service console, sorted by CPU utilization.

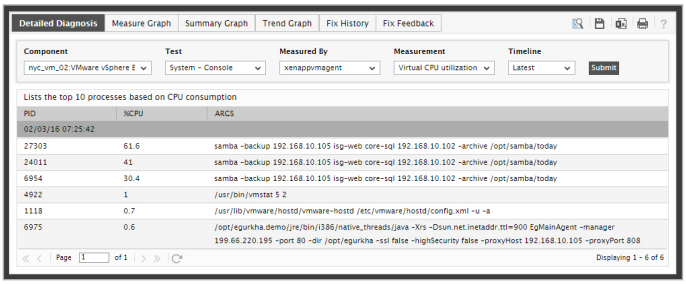


Figure 11: Detailed diagnosis showing the top CPU consuming processes running in the service console of the ESX server, nyc_vm_02

From Figure 11, it is clear that the top CPU consuming process is a samba backup job running inside the ESX service console. What has happened here is that the VM administrator had just returned from vacation and he had started a backup job on the ESX server.

What the administrator did not realize is the impact the backup job had on the VMs and the business service that was being supported by the virtual infrastructure. From the user perspective, the complaint was that Citrix access was slow. Without end-to-end visibility, the service desk which received the user complaint would have been focused on the Citrix XenApp server, which would have been the wrong place to start. Even if the service desk had asked the VM administrator if there was anything abnormal with the ESX server, they would have been told that everything was as expected. This is because the VM administrator started the backup job and he was aware of the additional load on the ESX server.

What this example has shown is the value of a correlated performance view into the virtualized XenApp infrastructure. By correlating the performance of the web front-end, the XenApp application and the virtual platform, eG Enterprise has zoomed in on the root-cause of the problem – i.e., a backup job running inside the ESX server's service console.

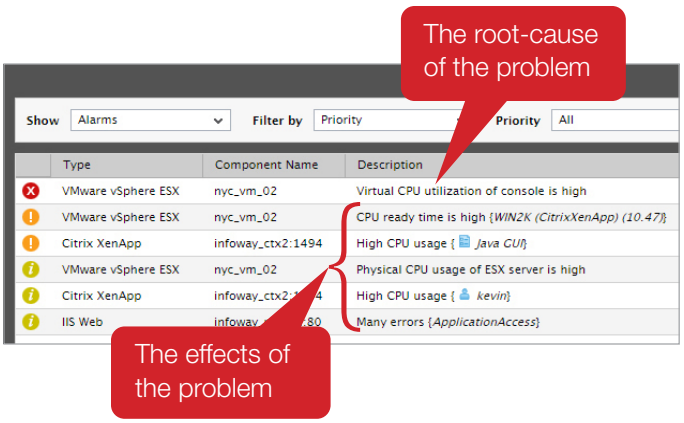


Figure 12: eG's current alarms window highlights the root-cause of the problem in the virtual XenApp infrastructure

We went through the different drilldowns to illustrate how eG Enterprise worked. In reality, the administrator or service desk person does not have to click many times to get to the root-cause of a problem. In fact, when a user logs in, they get to see a current alarms window. Figure 12 shows the current alarms window, which has a list of all open alarms and their priorities. Notice that the top most alarm in Figure 12 is the highest priority alarm and it clearly indicates that the CPU usage of the ESX service console is high. The detailed diagnosis can be accessed from this alarm window itself, thereby with just one click, the administrator/service desk person can immediately determine where the root-cause of the problem lies. Notice that the XenApp performance issues and the errors seen on the web front-end are marked as lower priority problems because they represent effects of the problem (and not the cause). All the alerts shown in the alarm window can be sent to operations personnel as SMS alerts, pager messages, SNMP traps, etc.

RIGHT-SIZING A VIRTUAL INFRASTRUCTURE – A CASE STUDY

A specific example of how eG Enterprise was used to optimize a virtualized XenApp environment is summarized by the experience of a recent healthcare institution that deployed eG Enterprise. This client was moving Citrix XenApp from physical to virtual servers. They were migrating to virtual infrastructures partly because the XenApp version they had deployed, was reaching end-of-life and partly because they expected to gain from resource consolidation, space savings and the agility and reliability benefits that virtualization offered. VMware vSphere was the virtualization platform chosen for the migration.

The client decided to use eG Enterprise to ensure that they could benchmark the performance of their physical infrastructure prior to the migration and after the migration. Prior to the migration, the client's physical XenApp servers had supported around 60 concurrent users on each server.

During the migration, the client decided to use physical servers configured with eight (8) cores/ sixteen (16) processors. During the assessment phase of the project, the client had estimated that they could support forty (40) users on each virtual XenApp VM and that they could have four (4) VMs each configured with four (4) virtual processors on each physical host. This amounted to one hundred and sixty (160) users

on each physical host. The business case for this migration was based on this user to physical host density.

However, despite all the pre-planning, the client found that the migration was not smooth. Citrix XenApp users experienced performance slowdowns and the client was not able to even support half the number of users they expected on each physical host. Since eG Enterprise provided the client with visibility into the XenApp tier as well as the virtualization tier, they were able to correlate performance slow-downs seen in the XenApp tier with metrics from the virtualization tier. Based on the load patterns at the virtualization tier, eG Enterprise identified that the VMs were seeing excessive wait times. What was happening was that since the VMs each had been configured with four virtual processors, even if one of the physical processors was available on the physical host, the hypervisor would NOT allocate that processor to a VM but would wait for four processors to become available before it would schedule CPU time for the VM. This resulted in unacceptable latencies for Citrix XenApp users.

Based on the high wait times seen at the virtualization tier, the client reconfigured the XenApp VMs to have fewer processors (one core/two processors) and assigned fewer users to each of the VMs. Performance tests of the reconfigured infrastructure indicated that sixteen (16) smaller VMs, each supporting twenty plus (20+) users had much better performance than when there were quad processor VMs.

Further tests with eG then showed that the VM density could be increased further to ten (10) VMs per physical host with each XenApp still supporting twenty (20) users. In effect, now the client was able to support a total of 200 users per host, while maintaining acceptable user performance.

In summary, eG Enterprise ensured:

- **A successful migration of the client's XenApp infrastructure – from physical to virtual;**
- **A 25% improvement in user density over the budgeted number, with better performance;**
- **A reduction of 25% in the number of virtual hosts required to support the XenApp farm.**

This real-world case study illustrates how with the right metrics and analysis, significant optimizations can be done in a virtual XenApp infrastructure, to ensure user satisfaction and great ROI.

CONCLUSIONS

Virtualized Citrix XenApp server farms are often harder to manage than physical XenApp farms. In this paper, we have outlined how a holistic approach – correlating the performance of each of the infrastructure tiers with that of the virtualization tier - can help ensure that XenApp functions as well in a virtualized infrastructure as it does in a physical infrastructure. For more information on the eG Enterprise solution for managing virtualized Citrix XenApp, please visit http://www.eginnovations.com.

About eG Innovations

eG Innovations is dedicated to helping businesses across the globe transform IT service delivery into a competitive advantage and a center for productivity, growth and profit. Many of the world's largest businesses use eG Enterprise Universal Insight and Correlative Intelligence technologies to enhance IT service performance, increase operational efficiency, ensure IT effectiveness and deliver on the ROI promise of transformational IT investments across physical, virtual and cloud environments.