



Monitoring and Managing Citrix Server Farms

White Paper



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1. Access Infrastructure Environments

Thin-client environments based on Citrix® access infrastructure software from Citrix Systems, Inc. have grown in popularity as cost-effective, efficient modes of accessing a variety of heterogeneous applications on-demand. By hosting applications on Citrix XenApp® server farms and making them accessible over a distributed network, IT administrators can allow users in different locations to effectively access and share software and hardware resources and licenses. Various modes of access to Citrix-based applications are possible – via native clients, using a Web client, etc.

Figure 1 depicts a typical Citrix access infrastructure. Typically, such an infrastructure includes a collection of diverse applications. Users access the infrastructure services using their Microsoft Windows domain username and password. Primary and secondary domain controllers are used to validate user requests. The web interface supports browser based access to the applications on the XenApp server. The web interface passes authenticated requests to the Citrix XenApp servers that host a number of applications. In turn, the applications may use backend databases, printers, etc., for different functionalities.

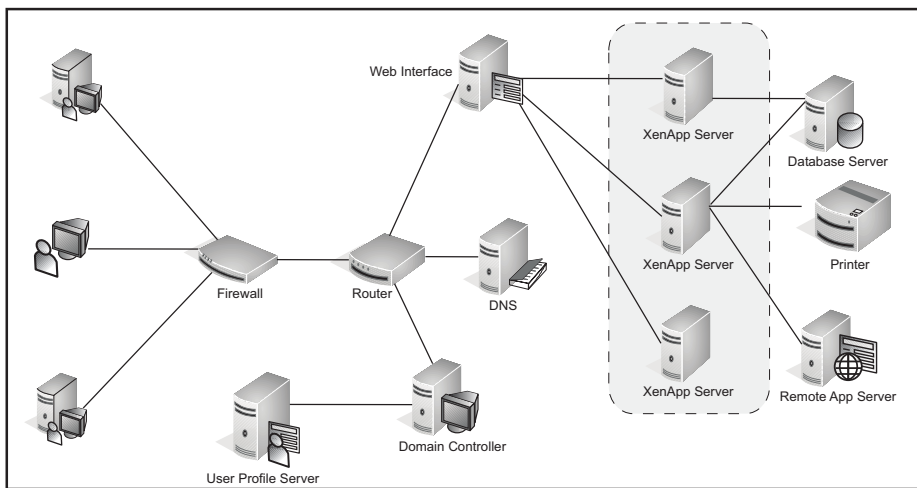


Figure 1 : A typical Citrix XenApp server infrastructure

2. Challenges in Monitoring Access Infrastructure Environments

While access infrastructure environments offer economies of scale, there are significant challenges in maintaining and operating these environments:

- Independent of scale, Citrix environments are mission-critical. In order to be an effective alternative for desktop applications, these Citrix environments must deliver the same quality of service that users have come to expect from their local applications.
- Citrix environments rely on the server farm for software processing, and hundreds of users may be accessing a Citrix farm at the same time. Even a transient problem in the server farm can impact all of the users accessing the farm. Furthermore, since different applications are hosted on the same server, a performance problem (e.g., excessive CPU consumption) of one application can adversely impact the performance of other applications hosted on the server. Likewise, since multiple users access applications running on the same server, a careless user can impact the performance of all the other users accessing the server farm.
- Typical Citrix environments are distributed. Clients can access the server farm over a variety of network links, spread across different geographies. The clients may be in different domains, with different access policies and rights. Since there are different disparate infrastructure elements – domain controllers, firewalls, network routers, databases, XenApp servers, hosted applications, etc. – involved in delivering the end-user service, a failure or malfunction of any of these elements can adversely impact the user experience. Problem diagnosis and troubleshooting are often time-consuming, even for the expert administrator. The fact that the infrastructure elements are multi-vendor and heterogeneous in their functions further compounds the difficulty in managing these infrastructures.

To effectively monitor a Citrix farm, an administrator requires a solution that:

- **Monitors the entire infrastructure** - from the network layer to the server operating systems to the individual applications;
- **Provides in-depth insights into the performance of all the applications in the Citrix infrastructure** - for example, the solution should be able to differentiate between user disconnects that are caused by insufficient licenses and login problems that occur because the domain controller is not able to handle the user traffic to it;
- **Offers proactive alerts** – to administrators before a problem becomes severe enough to be noticeable by users;
- **Automatically differentiates between the source and effect of problems**, so administrators can focus their efforts in resolving the source of problems rather than the effects;
- **Facilitates capacity planning** – by providing administrators with insights into the performance of their infrastructure (e.g., is the load being effectively balanced across the different servers in a farm), by assessing usage of the server resources and licenses, thereby enabling administrators to identify and plan for potential resource/license constraints that may arise in the future.

3. The eG Difference

Traditionally, IT infrastructure operations teams have been organized as domain experts – i.e., one expert for the network devices, another for the Citrix XenApp server, another for the database, etc. Most monitoring solutions mirror this silo-based organization and operations approach – they have separate solutions for monitoring different network elements and applications (see Figure 2).

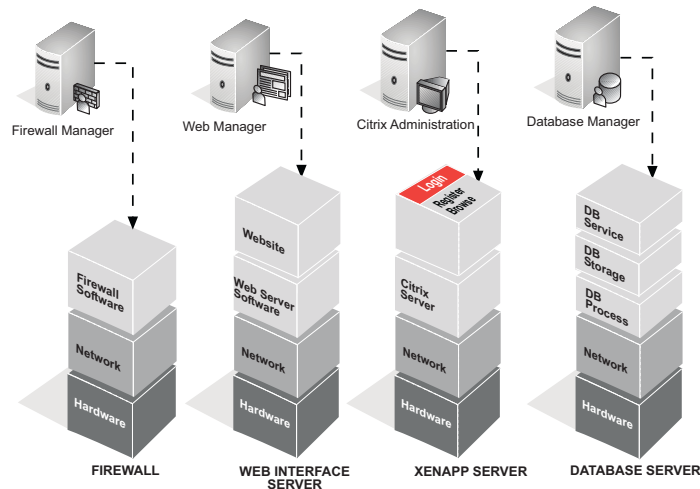


Figure 2 : The silo-based monitoring approach

The main drawbacks of this silo-based approach are:

- There is no holistic view of the end-user service. Consequently, the administrators are unable to proactively track the end-user service performance and initiate immediate remedial actions
- Since the individual applications are monitored independently, most likely using different solutions, problem troubleshooting and diagnosis are often manual processes that require a great deal of expertise. To understand why, consider a Citrix environment where a database application is being accessed via a XenApp server using an ICA[®] Web Client. Since the web interface depends on the XenApp server, which in turn uses the database server to respond to the user request, a slow-down in the database tier can ripple and affect the XenApp server and the web interface (see Figure 3). Consequently, a single problem can result in multiple alarms, and the administrator is burdened with the task of analyzing and correlating across each of the infrastructure tiers to determine the root-cause of a problem – i.e., whether the problem lies in the network, the Web server, the authentication server, the Citrix XenApp server, or the backend database.

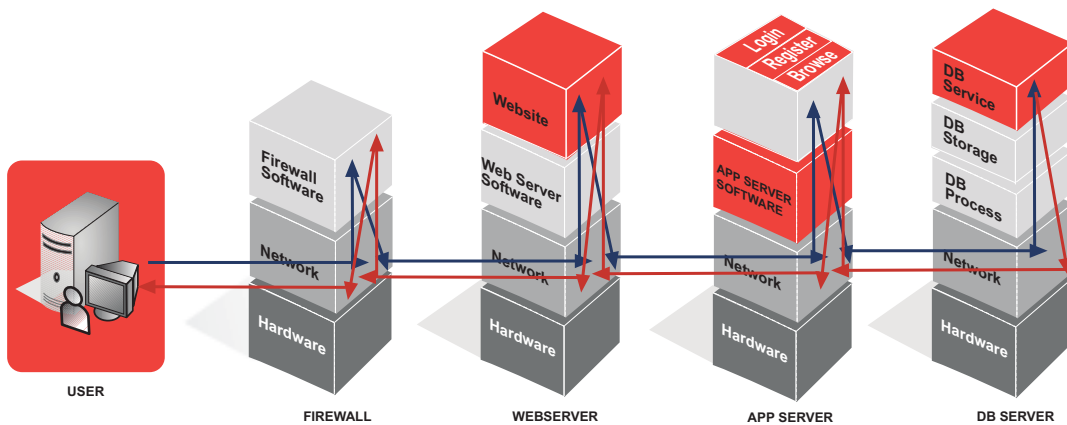


Figure 3 : Limitations of the silo-based approach to monitoring – a problem in one tier (e.g., the database) can impact all the other tiers (e.g., the web server, Citrix XenApp server)

The eG Enterprise suite is designed to overcome these drawbacks. Taking an end-to-end, integrated view of the target infrastructure, eG Enterprise monitors across all the network, server, and application components in real-time. Considering the inter-dependencies in the Citrix infrastructure between the network elements and application components across all the tiers of the infrastructure, eG Enterprise analyzes the performance and usage of the infrastructure and is capable of automatically identifying and isolating the root-cause of problems. By doing so, eG Enterprise eliminates finger-pointing during problem resolution.

4. Deploying the eG Enterprise Suite

Figure 4 depicts the deployment of the eG Enterprise suite to monitor a Citrix farm. eG's Single Agent is a software component that is installed on all the critical servers of the infrastructure. The eG manager is a central repository to which the agents periodically send health reports. All the collected statistics are stored in a relational database (Oracle or Microsoft SQL) for post-facto analysis and trending.

The eG Enterprise suite is 100 percent web-based. Users can access the manager using a browser via HTTP/HTTPS protocols. This enables users to monitor their Citrix infrastructure in real-time, from anywhere, at any time. The agents too report to the

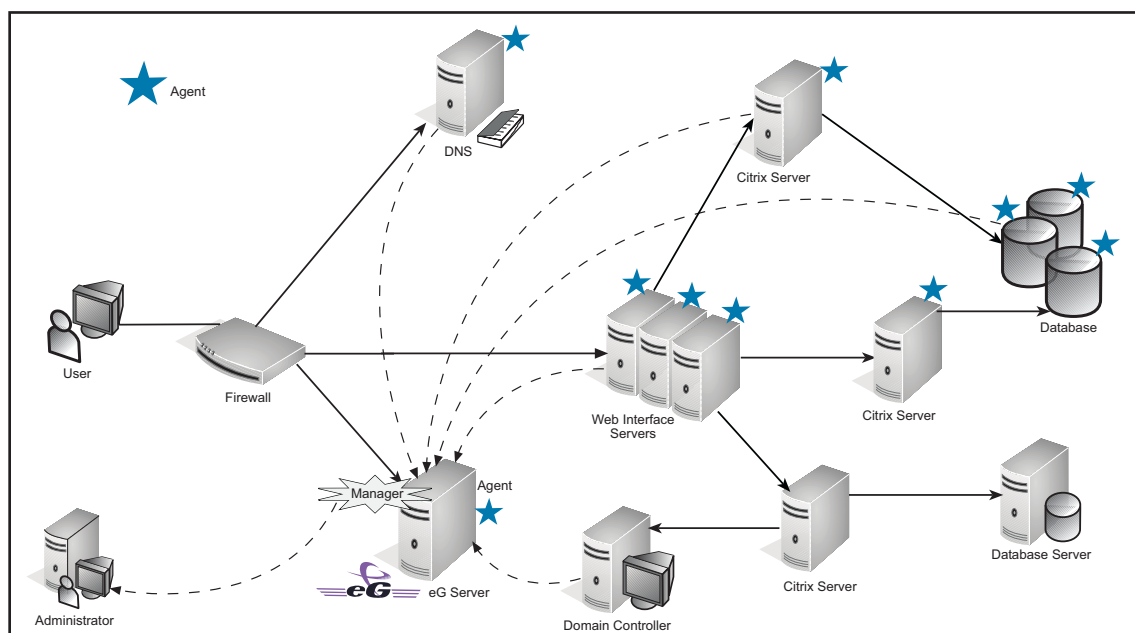


Figure 4 : Deployment of eG agents to monitor a Citrix infrastructure

manager using HTTP/HTTPS only. The use of open standard web protocols for communication ensures that elaborate firewall rules or explicit virtual private networks (VPNs) do not need to be setup just for the purpose of monitoring the target infrastructure.

5. Monitoring Citrix Infrastructures – An Example

5.1. Problem Diagnosis Using eG Enterprise

Using an illustrative example, this section describes how the eG monitoring suite makes monitoring and management of a Citrix infrastructure easier, more effective, and more efficient. In the eG architecture, a Citrix farm is represented as a service, which is a collection of network devices and applications with logical interdependencies between them. Figure 5 represents the service offered by a Citrix infrastructure in an organization named infoway. The color coding reflects the current state of the service. In this case, a dark red color indicates that there is a critical problem with the service.


Services in Critical State	
Service Name	Associated Components with Abnormal Measures
 infoway (Site)	✘ operadb:1521:opera ✘ infoway_ctx2:1494 ✘ infoway_nfuse2:80

Figure 5 : The state of the infoway service, as displayed via the eG web console

Figure 6 provides more details on the nature of problems associated with this service. This figure depicts the key user transactions to the web interface that is the web frontend to the Citrix XenApp server farm. The transactions to be monitored are configured via the eG administrative interface. Using the eG web adapter, which plugs in to the web interface and provides real-time statistics regarding the different requests and responses from the web interface, operators can track the status of the key transactions for the service hosted via the Citrix XenApp server farm. It is clear from Figure 6 that user logins are failing, and users are probably complaining about this. A key challenge is how to translate such a user complaint into an activity that can be performed by the operations staff to fix the problem. The shorter the time period for deducing what action is to be taken, the shorter is the service downtime and consequently, better is the user satisfaction.






SERVICE: INFOWAY ◀ Back						
Last Measurement Time 04/25/08 07:33:33						Configure Transactions
Transactions (infoway_nfuse2:80)	Requests (Req/Sec)	Errors (%)	Aborts (%)	Data transmitted (KB/Sec)	Avg response time (Secs)	Current requests (Number)
■ ApplicationAccess 	✓ 0.1045	✘ 100	✓ 0	✓ 0.429	✓ 0	✓ 0
■ DownloadCatalog 	✓ 0	✓ 0	✓ 0	✓ 0	✓ 0	✓ 0
■ Registration 	✓ 0	✓ 0	✓ 0	✓ 0	✓ 0	✓ 0
■ SubmitContacts 	✓ 0	✓ 0	✓ 0	✓ 0	✓ 0	✓ 0
■ UserLogin 	✓ 0.101	✘ 100	✓ 0	✓ 0.4147	✓ 0	✓ 0

Figure 6 : User logins to the infoway service are failing

Clicking on the user login transaction in Figure 6 reveals the detailed data flow diagram (i.e., topology) of the infoway service. In this case, the infoway site employs a multi-tier architecture – the Web Interface component (infoway_nfuse2:80) handles all incoming requests from web clients and forwards them on to a Citrix ZDC (infowayctx_farm2:1494), which in turns forwards the request to a Citrix XenApp server (infoway_ctx2:1494). Backend Oracle and Microsoft SQL databases, and a file server are also used in the service delivery.

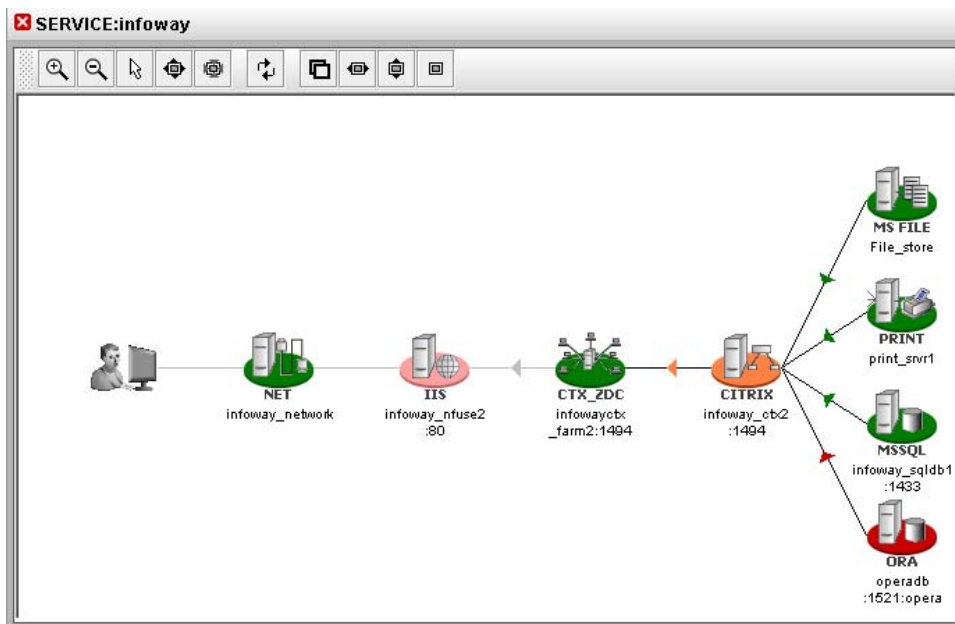


Figure 7 : Topology of the infoway service

The color coding in the eG user interface represents the real-time state of each service, network device, or application. The state of a network device or application is determined based on real-time metrics collected and reported by the eG agents. In the eG architecture, customized models are provided for each network device and application being monitored. Each of these models determines what metrics to collect for each application or network device, how to collect these metrics, how to analyze the collected metrics, and what to deduce from the analysis. Since each infrastructure component performs different functions, the layer model for the different applications and network devices are different. Customized models for domain controllers, databases (Oracle, Microsoft SQL, etc.), network printers, firewalls, DNS and DHCP servers, etc., are included as part of the eG Enterprise suite.

From Figure 7, it is clear that there are several problems with the applications involved in supporting the infoway service. The color coding indicates that the most severe problem is with the backend Oracle database server. By clicking on the Oracle database in Figure 7, an operator can zoom into the Oracle database server. Figure 8 reveals the details of the Oracle database server. In the eG architecture, every application or network component is represented by a hierarchical layer model. In this model, each layer performs a unique set of functions and depends on the layers below it in the model for its proper functioning. From Figure 8, it is clear that the Tablespaces layer of the Oracle database has a problem, and that one of the tablespaces – i.e., ORDERS has no free space remaining for additional entries.

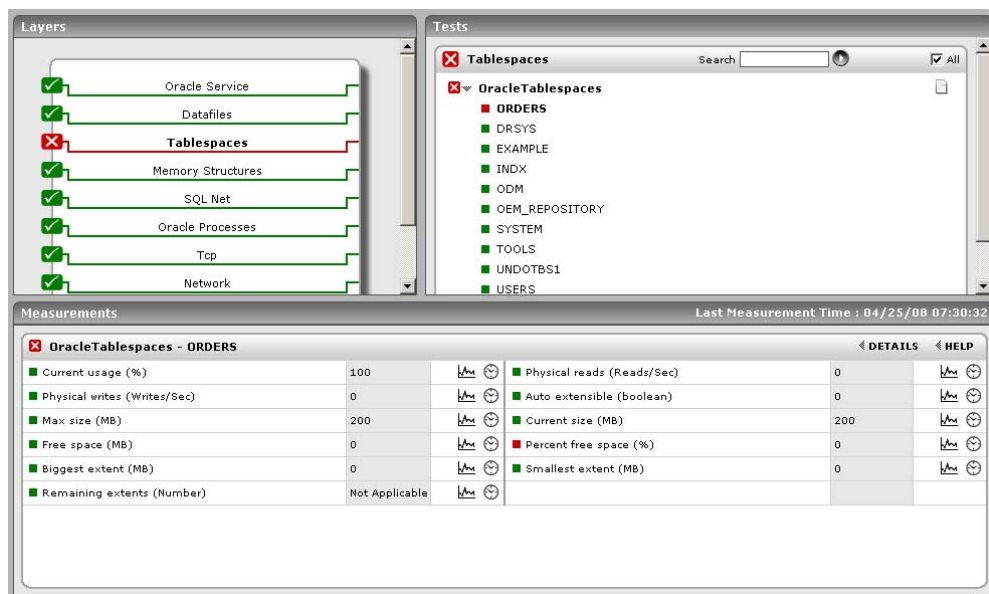


Figure 8 : The layer model of an Oracle database showing that one of the tablespaces has no free space

Figures 5-8 have revealed how an operator can quickly translate a user problem into an actionable operational activity and with the help of the Oracle database administrator quickly fix the cause of the problem. With eG's patented problem diagnosis and correlation engine, root-cause diagnosis can even be achieved in an automated manner. Figure 9 indicates eG's alarm window where current alerts are automatically prioritized by the eG manager, with the most critical alarms being indicated at the top. Notice that the most critical alert is relating to Oracle tablespaces and that the description provides a clear indicator as to where the problem is. This auto-correlation and diagnosis capability of the eG Enterprise suite can significantly benefit Citrix administrators – they can quickly focus on the root-cause of problems, rather than being distracted by the side-effects. Not only does this save time and effort, but it also results in better utilization of the expertise of the operations staff for more productive tasks.

CURRENT ALARMS						Sort by :	Priority & Time	Show :	All
	TYPE	COMPONENT NAME	DESCRIPTION	LAYER	START TIME				
	Oracle Database	operadb:1521:opera	High tablespace usage {ORDERS}	Tablespaces	04/25/08 04:31				
	Citrix	infoway_ctx2:1494	High CPU usage {java.exe}	Citrix Applications	04/25/08 04:20				
	Citrix	infoway_ctx2:1494	High CPU usage {kevin}	Citrix Users	04/25/08 04:20				
	IIS Web	infoway_nfuse2:80	Many errors {UserLogin}	Web Transactions	04/25/08 04:19				
	IIS Web	infoway_nfuse2:80	Many errors	Web Site	04/25/08 04:19				

Figure 9 : The eG Alarm window that show alarms prioritized based on their criticality

5.2. Monitoring of a Citrix XenApp server

The previous section explained how the eG Enterprise suite helps with problem detection and correction. This section delves into how eG Enterprise monitors a Citrix XenApp server. To explain the layer model of a Citrix XenApp server, consider the service topology of Figure 7. Notice that the infoway_ctx2:1494 application is having a problem. Figure 10 reveals the customized model of the Citrix XenApp server.

Notice in Figure 10 that the Citrix Users layer has a problem. The right hand side of Figure 10 reveals that a specific user – Kevin – is using too much CPU (over 30%). Clicking on the magnifying glass next to the cpu usage for user's processes measure reveals more details of the processes being executed by Kevin on the XenApp server. Figure 11 provides the details of Kevin's resource utilization on the XenApp server. It is clear from the figure that a java application executed by Kevin with process ID 3924 is consuming over 30% CPU. This example indicates how a user can drill through the layer model of a Citrix XenApp Server to detect how users are accessing and utilizing the server, what applications are being accessed, etc.

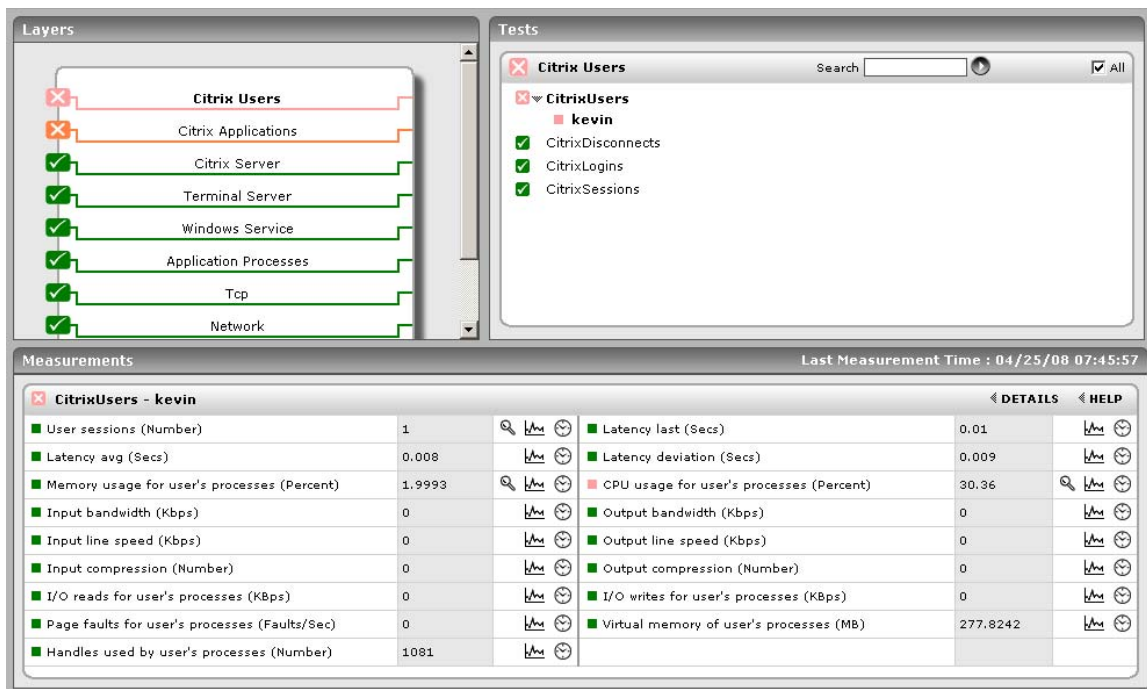


Figure 10: Customized model of a Citrix XenApp server

The table below summarizes the functionality of each of the layers of the Citrix model in Figure 10.

Layer	Purpose	Monitored Metrics
Operating System	Monitors the state of the host on which the Citrix server is being executed	CPU usage per processor, concurrent running processes, free memory, swap memory, blocked processes, disk space usage, I/O rates, etc.
Network	Checks to see if the Citrix server is accessible on the network; tracks the network traffic to and from the server	Network availability, packet loss, average and minimum latency, packet rate into and out of the server
Tcp	Captures the TCP connection statistics to the Citrix server	Incoming and outgoing TCP connection rates, currently established connections, connection failure rates
Application Processes	Monitors the processes corresponding to the Citrix server	Number of processes running, their CPU and memory usage
Windows Service	Monitors the Windows services corresponding to the Citrix server	Availability of the critical XenApp services
Terminal Server	Monitors the Terminal server component of the windows OS	Availability and resource usage of terminal server sessions
Citrix Server	Monitors the Citrix server and its internal components	Availability and response time of the Citrix server; Status of the data store, access rates to the server internal components like the data store, dynamic store, and the local host cache; Availability and responsiveness of the Windows authentication service that the Citrix server uses; Product and connection licenses in use
Citrix Applications	Monitors the status of each of the published applications	The number of simultaneous accesses to a published application, and the cumulative CPU and memory usage for these accesses
Citrix Users	Monitors user sessions to the Citrix server	Current active and inactive sessions, average duration of current sessions; for each logged in user, measure the CPU and memory used and provide details of applications being accessed

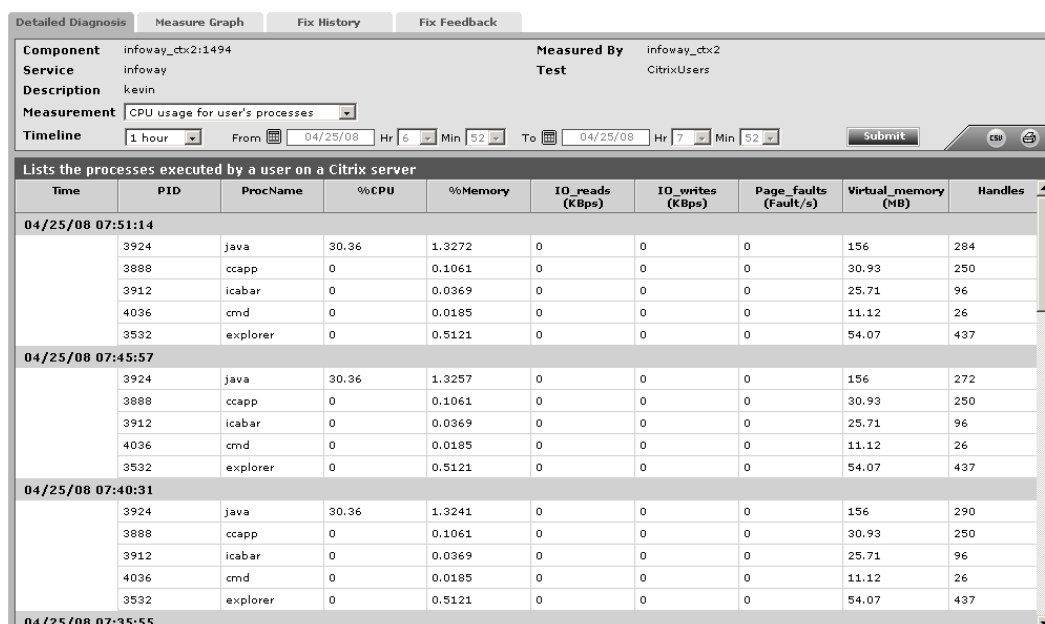


Figure 11: Details of user kevin's resource usage

The table below summarizes the Citrix monitoring capabilities of the eG Enterprise suite.

<p>XenApp Server Monitoring</p>	<p>Are the Citrix servers available to service user requests? Are there sporadic disconnects from the Citrix server? At what times do peak usage of the servers happen and is the server capacity adequate? Is the user load being balanced across all the servers? Is the data store available? What are the access rates to the data store, the dynamic store, and the local host cache? How much IMA traffic is happening between servers?</p>
<p>User Monitoring</p>	<p>What is the average response time that critical users are seeing when connecting to a XenApp server? How many users are logged in to each server in the Citrix farm? What is the resource usage (CPU and memory) for each user?</p>
<p>Operating System Monitoring</p>	<p>What is the average CPU and memory usage on all the servers in the farm? Is any unusual memory scanning/paging activity happening on the systems? Are the critical XenApp and IMA processes up? What is their resource consumption?</p>
<p>Published Applications Monitoring</p>	<p>What are the published applications on a XenApp server? Who is using each application? What is the resource usage for each published application?</p>
<p>License Monitoring</p>	<p>How many product and connection licenses are available in the farm and what is their usage? Are there enough licenses available for each of the published applications?</p>
<p>Infrastructure Services Monitoring</p>	<p>Is the web interface server forwarding requests to the XenApp server? Are the backend databases working? What is the resource usage of the databases? Are users able to login to the server farm? How long is the login process taking? What is the usage of the Microsoft Windows Domain Controller?</p>

5.3. Performance Reporting

The eG Enterprise suite also includes extensive pre-canned and customizable reports of the availability, performance, and usage of a Citrix infrastructure. Figure 12 depicts an executive report of a Citrix XenApp server's performance over a two week period. The pie-chart on the left hand side reveals the overall percentage of time that the server has been in Critical/Major/Minor/Unknown/Normal state. The right hand side provides a day-wise breakdown of the health of the application, so as to help the administrator identify specific day(s) when the application could have had problems.

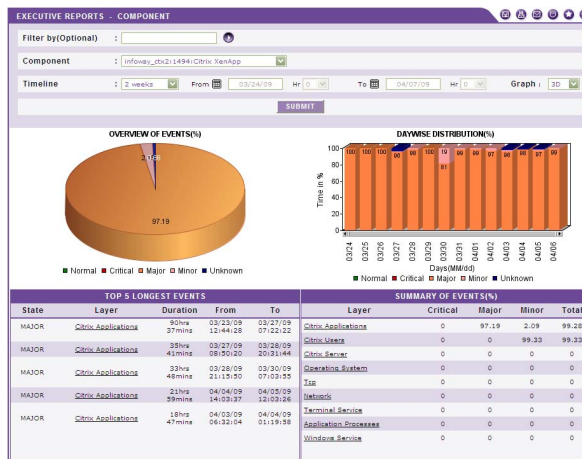


Figure 12: Executive report summarizing the performance of a XenApp server

eG's operations reports provide detailed insights into the performance of the individual infrastructure components. For example, a part of the operations report for a Citrix XenApp server is the comparison of the resource usage of the different applications hosted in the Citrix farm (see Figure 13).

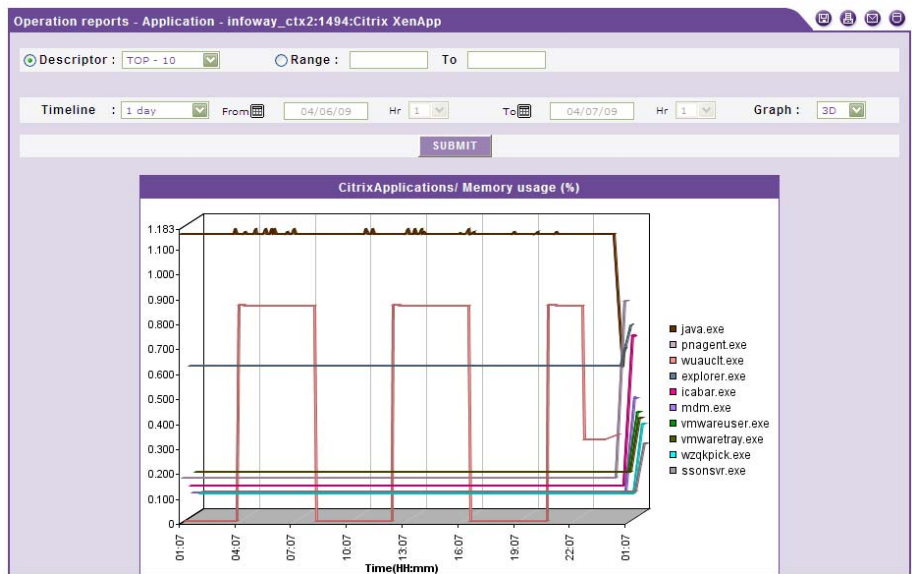


Figure 13: Comparison of the memory usage of applications deployed on a Citrix XenApp server

6. Benefits

The table below summarizes how the eG Enterprise suite simplifies the day-to-day activities of a Citrix administrator.

eG Feature	Benefit to the Citrix Administrator
Integrated monitoring of Citrix and other IT infrastructure components (e.g., SQL/Oracle databases, network printers, domain controllers, authentication servers, network routers, etc.)	Single integrated interface from where the entire IT infrastructure can be managed
100% web-based architecture with personalized user views	Monitor from any where, at any time; Easy to provision and get up and running; Monitor even across firewalls without needing VPNs; create personalized views for each operator, so each operator tracks the state of just the servers that he/she is responsible for
Real-time external monitoring of Citrix server availability and response time	No longer need to wait for users to complain – receive and react to real-time alerts (email, SMS, web, etc.) on infrastructure problems
Automatic correlation with internal metrics of server usage and process availability	View a Citrix farm as a business service with inter-network and inter-application dependencies; Use these dependencies to automatically differentiate between network and server problems, thereby focusing efforts on resolving the key problems
Integrated monitoring of all aspects of a Citrix farm including license usage, authentication, database availability, network performance, etc.	Eliminates guesswork from the troubleshooting process; Use hard evidence provided by the eG agents to identify problems and initiate remedial action
Automatic baselining of usage metrics to learn the norms of the infrastructure	Be informed as soon as the service usage deviates from the norms, without needing elaborate manual configuration; Use this information for proactive capacity planning
Extensive performance reporting and service level analysis	Clearly document the service levels being offered across the infrastructure; identify and correct performance bottlenecks to improve service quality
Remote control over the web	Securely login to the remote server from any where and initiate corrective actions when problems are detected; Reduces problem fixing time and improves service quality



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