



Product Backgrounder

The eG Solution for Virtualization 2.0:

The eG VM Monitor™

Many of the management challenges with virtualized environments are similar to those found in existing server-based computing infrastructures, such as Citrix and Microsoft Terminal Services. While Citrix and terminal services environments involved multiple users accessing a single operating system on a physical machine, virtual environments involve multiple operating systems sharing the resources of a physical server. In either case, a single malfunctioning application could affect the performance of all other applications sharing the common resources of the server.

The eG Enterprise Suite™ from eG Innovations supports virtualization platforms from VMware, Sun Microsystems (Solaris Containers and Logical Domains), and CitrixXen Server and has been deployed by enterprises worldwide for monitoring mission-critical IT infrastructures. The eG VM Monitor™, part of the eG Enterprise Suite™, provides capabilities essential to fulfilling the monitoring requirements of Virtualization 2.0 discussed in the eG Innovations Market Backgrounder. These product capabilities include:

- Integrated dashboard for virtual and physical infrastructure monitoring
- Tracking the performance of virtual and physical machines in a virtual infrastructure
- In-N-Out Monitoring™ of virtual infrastructures for deep diagnostics
- Monitoring every layer of every infrastructure tier
- Automatic baselining of the target infrastructure
- Problem demarcation and automatic root-cause diagnosis
- Scalability of the monitoring solution
- Virtual desktop monitoring and reporting
- Personalized role-based views for different stakeholders

Each of these capabilities of the eG Enterprise Suite is discussed in more detail below.

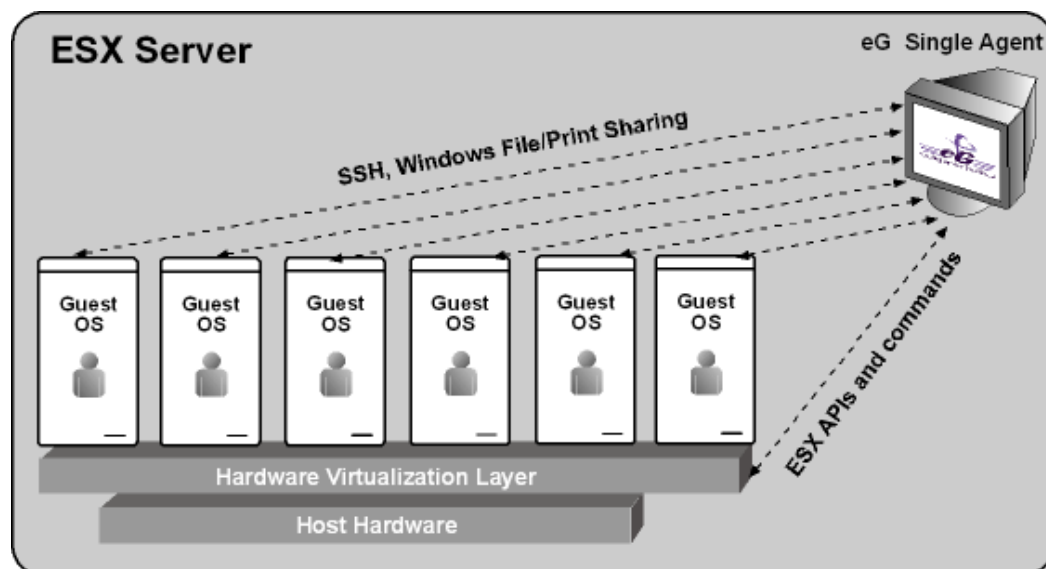
- **Integrated dashboard for virtual and physical infrastructure monitoring** – With monitoring technology that is capable of handling virtual and non-virtual servers, eG Enterprise offers a single integrated dashboard to allow the entire infrastructure to be managed end-to-end. Agent-based monitoring is supported using a single agent technology that is licensed per operating system monitored, irrespective of the applications executing on the operating system.

As the name implies, the licensing is independent of the operating system (i.e., Windows, Solaris, AIX, Linux, HPUX, etc.) and is also independent of the hardware capabilities of the server being monitored (i.e., the same license works for a one processor or a four processor system). The single agent license allows unparalleled flexibility in the way the monitoring system is set up and used – for example, an administrator could be using the agent to monitor Oracle on Solaris at one time, and could later use the same agent license to monitor Microsoft SQL on Windows.

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Agentless monitoring (using Windows Management Instrumentation – WMI, SNMP, or Secure Shell) is also supported and administrators have the flexibility to decide which servers and applications they would like to monitor with agents and which ones to monitor in an agentless manner. Metrics about the virtual and physical infrastructure, reported by the agents are analyzed by a management console and real-time alerts and historical reports made available to administrators.

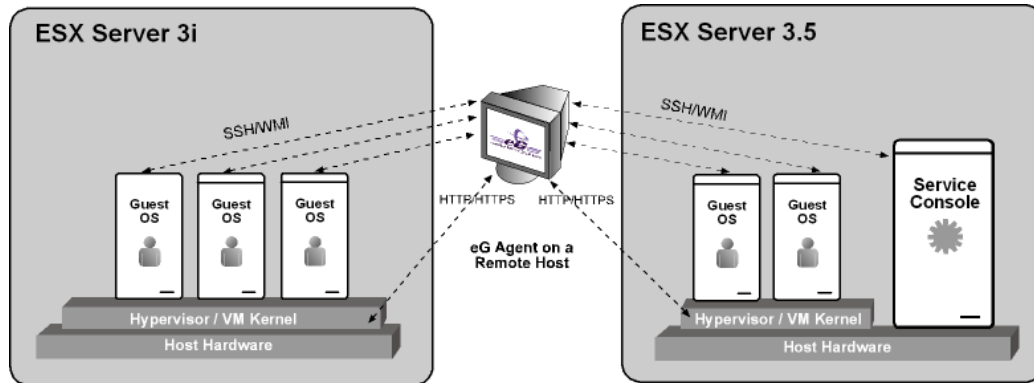
- Tracking the performance of virtual and physical machines in a virtual infrastructure** -- Agents designed for physical infrastructures cannot be directly used for virtual infrastructures. To obtain visibility into the performance of the physical machines of a virtual infrastructure and to track the behavior of VMs supported on these physical machines, the monitoring solution must communicate with and extract key metrics from the hypervisor. The eG VM Monitor enhances eG Enterprise with the ability to monitor virtual infrastructures. Using APIs and command line interfaces supported by hypervisors for VMware ESX, Citrix XenServer, Solaris Logical Domains (LDoms), Solaris Containers, etc., eG agents and agentless monitors extract metrics that indicate the usage levels of the physical server and the physical resources that each of the VMs consume. Thus, eG Enterprise offers a solution capable of handling the heterogeneous hypervisor options that have become available in Virtualization 2.0.
- In-N-Out Monitoring™ of virtual infrastructures for deep diagnostics** -- Recognizing that Virtualization 2.0 requires detailed drill downs inside the VMs, eG Enterprise incorporates a patent-pending In-N-Out Monitoring technology. A virtualization-aware eG agent deployed on a physical server (e.g., VMware ESX) can be used to monitor the VM kernel, the service console (if appropriate) and the individual VMs. Agentless monitoring is also supported as an option for heavy-weight hypervisors like VMware ESX, while it is mandatory for light-weight hypervisors that do not have the service console, like VMware® ESXi servers.



In-N-Out Monitoring technology allows a single eG agent to obtain an outside view of a VM as well as an inside view of each VM.

This “outside” view of a VM indicates relative usage of physical server resources (CPU, memory, disk, network) for each VM. As discussed earlier, while the outside view of a VM is useful in determining which VMs are resource hogs, this view does not provide in-depth insights needed for further diagnosis to determine which applications are consuming the resources. To complement the outside view, eG Enterprise provides an “inside” view of a VM, which highlights the relative resource consumption levels of the applications running inside the VM. While the outside view indicates the portion of physical resources a VM consumes, the inside view reveals the relative usage levels for the applications running inside the VM. This inside view of a VM is critical for effective root-cause diagnosis.

eG Enterprise obtains the “inside view” using the same agent that monitors the outside view, which can be obtained using agent-based monitoring or in an agentless manner, as below; both examples show ESX servers but apply also other virtualization platforms currently supported. Administrators can even choose which servers they wish to monitor with agents and which ones to be monitored without agents. In either case, agents are not required to be installed on the VMs to obtain the inside view.



Agentless monitoring of virtual environments using eG Enterprise. The same agent can be used to monitor the virtual servers, the physical environment, as well as applications (Citrix, Oracle, SQL, Web servers, etc.).

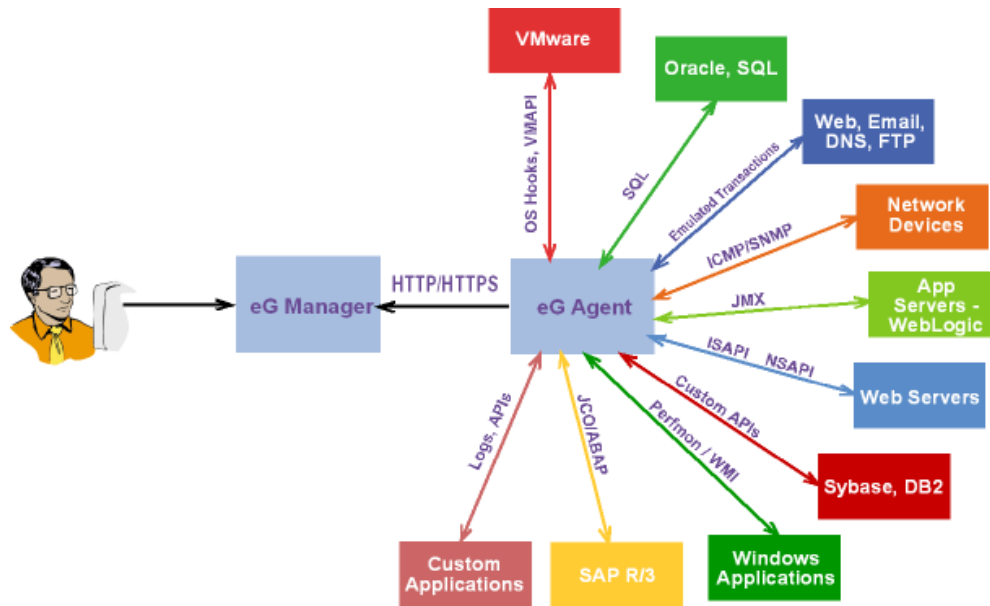
VMs are known to suffer from clock skews and hence, metrics collected from within a VM have to be analyzed with care. Rather than use metrics collected from within a VM in absolute terms, eG Enterprise uses the inside view to compare the resource usage levels across applications running in the VMs. Other key indicators of VM and application bottlenecks such as memory leaks, handle leaks, disk partitions filling up, VMs being rebooted unexpectedly, etc., can also be obtained using the inside view of a VM.

There are several advantages in using a single agent to obtain the inside and outside views of a VM. Installing additional agents inside the VMs to get the inside view can be a cumbersome process. This is especially true in a virtual desktop environment, where tens of VMs could be running on the same physical server. Installing agents inside the VMs could be wasteful in physical resource usage, and would incur substantial additional licensing costs. The deployment time is also reduced since only a single agent needs to be installed per physical server to obtain the inside and the outside view.

For monitoring virtualized environments, the eG Enterprise suite is licensed per physical server, irrespective of the number of sockets or CPUs on the server, and the number of VMs hosted on it.

- **Monitoring every layer of every infrastructure tier** -- As its name suggests, the eG single agent is capable of monitoring a variety of networking, operating system and application technologies. Out of the box, the eG agent supports 10+ operating systems and virtualization platforms and over 85 common applications, including Citrix, terminal services, database servers (Oracle, SQL and Sybase), web servers (IIS and Apache), Active Directory, messaging servers, and Java application servers (WebLogic and WebSphere). If in-depth monitoring of applications running inside the VMs is necessary, additional agents need to be installed on the VMs.
- **Automatic baselining of the target infrastructure** -- To determine the norms of the target infrastructure, eG Enterprise includes the ability for the eG manager to automatically baseline each and every metric that is collected. History is used as a guide, and trusted statistical quality control techniques are used to determine the norms of every metric collected. Any deviation of a metric from the norm is flagged as a proactive alert.
- **Problem demarcation and automatic root-cause diagnosis** -- Perhaps the most significant challenge that Virtualization 2.0 poses from a monitoring and management standpoint is effective root-cause diagnosis. When a problem happens, where is the real cause? Is it the network? Database? Application? Virtual machine? Physical server? eG Enterprise handles the root-cause diagnosis problem in a simple and elegant way.

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The eG single agent architecture:

- A single agent license for Microsoft, Linux, Sun Solaris, HP/UX, IBM, AIX, VMware, Tru64
- A single price, regardless of OS or server configuration - 2, 4, 8, 16 CPUs
- A single agent for monitoring any application
- A single price to manage multiple applications on the same server
- Auto-upgradeable
- Agentless monitoring option
- 100% web-based HTTP/HTTPS

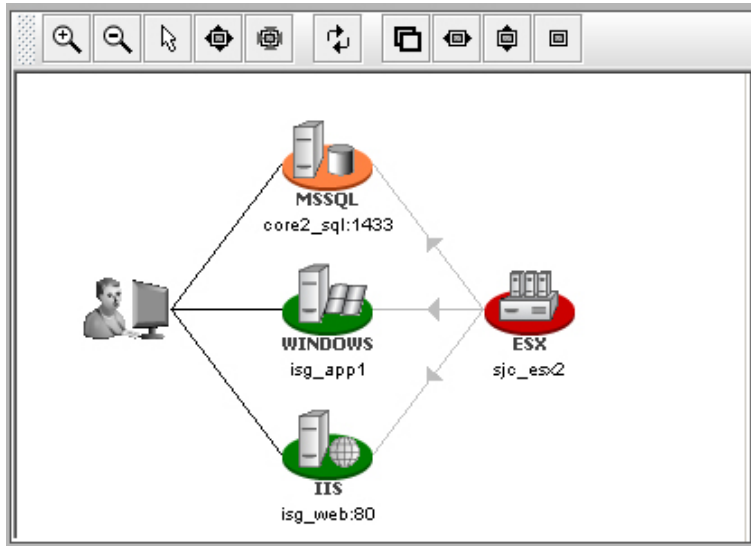
There are three main aspects to the eG solution:

1. **Layer model representation** -- eG Enterprise represents each infrastructure component (network device, application, physical server) as a collection of functional protocol layers. The layers are arranged hierarchically, and the representation itself is similar to the OSI model of the protocol stack. While the OSI model was theoretical, eG Enterprise uses practical models to represent the current state of each infrastructure component.

Each layer is mapped to a number of metrics and the state of a layer is determined based on the state of the metrics that are mapped to it. The state of a layer is correlated with that of other layers below it in the hierarchy. By representing the status of the physical server and the VMs as part of the same model, eG Enterprise automatically correlates their performance.

2. **Using business services topologies for problem demarcation and root-cause detection** -- eG Enterprise represents service topologies to depict the components involved in supporting a business service and the inter-dependencies between them. By analyzing and correlating the status of each of the components in real-time using inter-dependency information that is available in the service topologies, eG Enterprise helps IT administrators with triage; i.e., to determine which domain is the potential cause of a problem.
3. **Using VM auto-discovery for root-cause diagnosis** -- eG Enterprise auto-discovers the VMs that are running on each physical server and the applications executing on each of these VMs. This information is updated dynamically to keep track of any live migration that may be triggered in the virtual infrastructure. The application- to-VM and VM-to-physical server mappings thus discovered are used to further refine the root-cause diagnosis automatically.

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Screen shots show topology maps, root cause analytics and detailed diagnostics:

Top: Virtual machine mappings are auto-discovered and a virtual topology map of VM to physical server dependencies is automatically created. This information is used by eG Enterprise to refine its root-cause diagnosis.

Middle: The alarm window of eG Enterprise clearly highlights where the root-cause of a problem lies.

Bottom: Detailed diagnosis provided by the eG agent highlights the cause of the CPU spike on the service console. Several Samba backup jobs have been triggered in the middle of the day on the service console of the VMware server, and this is affecting the performance of business services that rely on the virtual infrastructure.

The screenshot shows the 'Alarms - eG Manager' window. The top section displays 'CURRENT ALARMS' with a table of active alarms. The middle section shows the 'Detailed Diagnosis' for the alarm 'CPU usage is high (console)' on component 'sjc_esx2'. The bottom section lists the top 10 CPU processes at two different times.

Time	PID	%CPU	ARGS
04/25/08 09:58:16	10843	36	samba -backup 192.168.10.105 isg-web core-sql 192.168.10.102 -archive /opt/samba/today
	10875	36	samba -backup 192.168.10.105 isg-web core-sql 192.168.10.102 -archive /opt/samba/today
	17702	30.7	samba -backup 192.168.10.105 isg-web core-sql 192.168.10.102 -archive /opt/samba/today
	11209	0.9	/usr/lib/vmware/hostd/vmware-hostd /etc/vmware/hostd/config.xml -u -a
	19224	0.7	/opt/egurkha.demo/jre/bin/i386/native_threads/ja -Xrs -Dsun.net.inetaddr.ttl=900 EgMainAgent -manager 65.160.98.187 -port 80 -dir /opt/egurkha ssl false -highSecurity false -proxyHost 192.168.10.105 -proxyPort 808
04/25/08 09:53:40	10843	36	samba -backup 192.168.10.105 isg-web core-sql 192.168.10.102 -archive /opt/samba/today
	10875	36	samba -backup 192.168.10.105 isg-web core-sql 192.168.10.102 -archive /opt/samba/today

The top screen shot shows the virtual topology map. From the dependencies shown, eG Enterprise is able to automatically deduce that the problem in the SQL database server is being caused by an issue on the VMware ESX server.

The exact problem in this scenario is depicted by the middle and bottom diagrams. The middle screen shot shows the alarm window that maintains a list of outstanding alarms. The top-most alarm is the most critical: this signifies the root-cause of the problem. In this case, the alarm window clearly indicates that high CPU usage on the console operating system of the VMware ESX server is causing a response time slowdown for the business service.

The lower diagram provides an additional level of diagnosis. This figure indicates that run-away back up jobs on the ESX server are causing high CPU on the service console. In turn, this is causing the SQL server's disk accesses to be slow and thereby affects the business service's response time.

In summary, customer benefits of eG Enterprise auto-discovery and root cause diagnostics are:

- Rapid diagnosis ensures lower downtime, directly translating into minimal business impact
 - Proactive alerts ensure that problems are detected and corrected before users notice, thereby ensuring better customer satisfaction and productivity
 - Quick problem identification ensures that only the right administrators are informed of a problem. This reduces finger pointing among IT staff and ensures that less time and money is wasted on fire fighting.
 - By streamlining problem diagnosis, eG Enterprise empowers lesser- skilled helpdesk personnel to handle routine troubleshooting tasks. Infrastructure experts can thus spend time on more productive tasks, including capacity planning and optimization. This leads to significant operational efficiency.
- **Scalability of the monitoring solution** -- This is an important requirement for Virtualization 2.0. eG Enterprise is used in production environments to monitor hundreds of VMware ESX servers and thousands of VMs. For monitoring virtual environments, eG Enterprise offers various options. Agents can be installed on each of the servers and, since an agent is monitoring just the server on which it is installed, this approach scales easily. When agentless monitoring is used, eG Enterprise allows multiple remote data collectors to be set up. As each data collector starts to reach its monitoring limit, additional collectors can be added easily. The monitoring can be done by connecting to each physical server (e.g., VMware ESX) or by relying on the statistics collected by existing silo monitoring solutions like VMware's Virtual Center. Administrators can specify how the monitoring system is set up. The number of monitoring choices that eG Enterprise offers makes it one of the most flexible and scalable solutions in the industry.
 - **Virtual desktop monitoring and reporting** -- The monitoring and reporting needs for VDI infrastructures are very similar to those for Citrix and Terminal Services infrastructures. The questions that administrators of these infrastructures need to answer include how many users are logged in, which user is logged into which VM, what resources each user is taking up, what applications are the users running, who the most frequent users are, and who the top resource consuming users are. Virtual infrastructure administration and monitoring tools (e.g., VMware VirtualCenter and Citrix XenCenter) do not take the user perspective and instead report resource usage for the individual VMs. On the other hand, using the inside view of the VMs, eG Enterprise is able to map VMs to users who are logged into the VMs, and all the metrics collected and reports generated by eG Enterprise report resource usage levels and login access patterns specific to the users who are using the VDI environment. Furthermore, the monitoring is done independent of the connection broker technology that is employed in the target infrastructure. The user oriented monitoring and reporting approach that eG Enterprise adopts for VDI infrastructures makes it the monitoring technology of choice for any enterprise looking for a VDI monitoring solution.
 - **Personalized role-based views for different stakeholders** -- eG Enterprise includes pre-defined roles for monitoring staff, helpdesk personnel, executive staff, and capacity planners. Custom roles can also be created to suit the needs of the organization. Each user is assigned a specific role in keeping with the tasks that the user performs, and the user's view is created to provide the user with access to monitor, administer, and report on just the parts of the infrastructure that he/she is responsible for. Users may also share views of the common infrastructure components and business services that they help manage. By providing a common dashboard across heterogeneous components and services, eG Enterprise offers a platform that facilitates collaborative management among the IT operations teams.

The table on the following page summarizes why eG Enterprise is a *Virtualization 2.0 Ready* monitoring solution.

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	Virtualization 2.0 Ready Requirement	eG Enterprise Capability
1	Ability to handle a mix of physical and virtual infrastructures	✓ Support for monitoring 10+ operating systems and 80+ applications on physical and virtual machines plus a mix of virtualization platforms (VMware ESX, Citrix Xen, Solaris LDOMs and Containers, etc.)
2	Support for heterogeneous virtual infrastructures	✓ Provides out-of-the-box monitoring support for VMware Virtual Infrastructure, Citrix XenServer, Solaris Containers and Logical Domains (LDOMs), and Microsoft Virtual server environments
3	Visibility into physical server and virtual machine configuration and performance	<ul style="list-style-type: none"> ✓ "Outside" view of performance of each VM ✓ Monitoring of the virtualization platform – the hypervisor, VM kernel, service console ✓ Monitoring of virtualization platform features such as Live Migration and High Availability
4	Inside view of VMs with problem identification	✓ Only monitoring solution that can provide an "outside" and an "inside" view of the virtualized environment using a single agent. The inside view is critical for root-cause diagnosis – to know which application inside the VM is faulty.
5	Baseline metrics automatically	<ul style="list-style-type: none"> ✓ Uses past performance and statistical quality control techniques to automatically determine the norms of performance of every metric ✓ Proactively alerts when these thresholds are violated
6	Automatic correlation for pinpointing the root-cause of a problem	<ul style="list-style-type: none"> ✓ Correlation across virtual machines and between virtual machines and physical machines ✓ Correlation across protocol layers to identify problematic layers ✓ Correlate between applications responsible for business service delivery ✓ Provide single-click diagnosis with root-cause information
7	Scalability of the monitoring solution	<ul style="list-style-type: none"> ✓ Highly scalable, 100% web-based architecture ✓ Agent-based and agentless monitoring flexibility ✓ Integration with virtualization platform monitors like VirtualCenter; can also monitor physical servers directly to avoid any single point bottlenecks
8	Support for virtualized desktop environments	<ul style="list-style-type: none"> ✓ Monitor of user activity, application mix, access patterns ✓ Reports revealing the overall effectiveness of your virtual desktop environments – most frequent users, login/logout times for audit, applications accessed by users, top resource consumers
9	Personalized role-based views for different stakeholders	<ul style="list-style-type: none"> ✓ Roles can be defined to restrict access to users based on their roles ✓ Personalized views can be created for each user limiting their view to the portions of the infrastructure that they are responsible for.

Conclusion

This document outlines the key capabilities of the eG Enterprise Suite and the eG VM Monitor that address the management challenges that must be overcome as the use of virtualization continues to increase in production enterprise environments. Virtualization 2.0 identifies fundamental changes that are needed in terms of how virtualized environments can be monitored most effectively and efficiently.

Over the last several years, eG Innovations has enhanced the eG Enterprise Suite to address the challenges that resource sharing in IT infrastructures poses. This document highlights recent changes in the eG Enterprise Suite that are intended to make it the monitoring solution of choice as enterprises continue to look for solutions to handle the second phase of virtualization deployments -- Virtualization 2.0 -- and the phases that are sure to follow.

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