Blue Vector Monitoring and Management Engine for Cloud Computing

As IT departments move their server banks into public and private cloud computing formations, it is imperative that they maintain levels of service that match or exceed existing capabilities. Cloud users love the premise that unlimited resources are available to them on demand, but the price to pay for this is much more complex management of applications and infrastructure.

Cloud deployments have different requirements for service delivery

Directly at the intersection of technical maturity, deployment efficiency, and financial good sense, cloud computing has grown in popularity and become the model of choice for many application and infrastructure services. Now that applications and services are un-tethered from their hardware resources and usable in an on-demand way, service paradigms that worked in more static IT environments need to be redefined. There should be a way to provide the same – if not better – service levels to users in cloud environments as in traditional ones.

The common thread defining requirements in this new environment is **adaptability**. Below are four examples:

- ***Adaptive application discovery.*** Because applications can now be spread across multiple virtual machines running on different hardware resources, keeping track of where those applications are residing as well as how to monitor them becomes far more intricate in a cloud scenario. This, coupled with the fact that IT departments will have to monitor multiple types of applications, including legacy, third-party, and home-grown, as well as new, cloud-aware ones, requires a more adaptive monitoring approach.

- ***Application SLA monitoring.*** In an environment in which applications are constantly moving, measuring service levels becomes more complicated. For example, in order to guarantee that an order management system is currently transacting 10,000 orders per minute in a cloud environment would require adaptive instrumentation within each virtual machine instance in which it resides.

- ***Application change management.*** For the same reasons that software is difficult to monitor in cloud environments, it is also hard to reconfigure and change. For example, in deploying a new SSL certificate to Web servers, IT professionals need not only to determine which Web servers need the new certificate, but they must also take the time to gain access to and perform the update. Because the process is slightly different for each type of Web server, it is manual, time consuming, and error-prone.

- ***Reaction to system events.*** One of the opportunities that cloud computing presents is the opportunity to monitor more proactively and react to system events. For example, if a fan in a server fails and the process or virtual machine needs to be moved to an alternate server, the cloud infrastructure needs to be made aware of this. It needs to be able to sense the rise in temperature and apply policies that kick off of the migration process before any damage has been done.

How these requirements are addressed today

In today's cloud-based environments, customers must build their own application monitoring and management frameworks on an individual basis because most existing solutions are focused on infrastructure monitoring. This is a limited and complex process because any statically-written monitoring agent must either be all encompassing (and hence constantly evolving) or focus only on the smallest common subset of monitoring requirements (and hence only be marginally useful).

In the order processing system example, the IT department would have to write a custom agent that monitors individual application instances while ensuring the appropriate policies regarding performance, SLAs, and so on, are enforced. As the application and the policies change and evolve, the agent must constantly be updated. This consumes expensive IT resources and creates an error-prone business process.

Blue Vector's monitoring and management engine for cloud computing

The dynamic nature of cloud computing, with its constantly shifting processes and new instantiations, makes it difficult, if not impossible, to put in a static monitoring structure that will monitor applications, configurations, and service levels dynamically. We believe the way to address this is to match the capabilities of the monitoring system with the dynamic nature of the cloud environment.

Blue Vector has designed a monitoring and management engine that **dynamically synthesizes monitoring agents** based on the current configuration of any server in the cloud or new or changed policies as defined by the IT administrator. By constantly building an accurate picture of the exact state of the cloud at any given time, the system can very quickly adapt to changes in the cloud configuration and provide the necessary modifications to the monitoring agents on any server that requires it.

The monitoring agents form a hierarchy (with agents that sit at the data center level, ones at the server level, and ones at the virtual machine level). These agents coordinate amongst themselves to provide the appropriate combination of capabilities to address monitoring and management requirements of digital assets. The engine integrates into existing monitoring frameworks and dashboards so that a **uniform monitoring dashboard** can be set up with standard processes for exception management.

Looking back at the prior requirements examples, Blue Vector plays the following roles:

- ***Adaptive application discovery.*** Blue Vector's software enables application monitoring policies to "travel" with the applications no matter where those applications migrate. Users specify the monitoring rules for each application, and Blue Vector keeps track of each application in the system, where it is located, and the rules and policies that apply to it. This takes application discovery and policy mapping out of the hands of IT personnel and automates the process, saving time and expense, as well as reducing risk.

- ***Application SLA monitoring.*** Just as Blue Vector can enable policies to "travel" with applications, it can also keep track of SLAs to measure them even as applications migrate or scale up or down. After IT specifies the SLAs for customers on certain applications or resources, Blue Vector keeps track of mapping relationships no matter where the applications reside. With Blue Vector, the IT administrator can either make changes to the SLA or to the resources being guaranteed and Blue Vector software will re-configure the monitoring agents only for the affected resources.

- ***Application change management.*** Blue Vector's software not only handles monitoring in dynamic cloud environments, but is also an agent of execution for policy and application updates. In the SSL certificate example, when IT updates the certificate for a Web server, the IT administrator notifies Blue Vector's software that Web servers in a certain logical group need a new certificate and provides the system with the new certificate. Blue Vector's software knows which servers belong to the logical group and on what machine instances they are running; it automatically updates the certificate and restarts **only the affected Web servers**.

- ***Reaction to system events.*** Blue Vector's software can react rapidly to emerging conditions and take action before a system event creates irreparable damage. In the failed fan example above, Blue Vector can sense

the temperature in the server, talk to an airflow sensor, or ascertain fan speed from the system to infer that the fan has failed and take corrective action as specified by the administrator. This can include initiating the application migration process.

Case study: Intranet monitoring and management

The case study below illustrates Blue Vector's capabilities.

A large company has employees around the world. The company's intranet gives the employees over-the-Web secure access to documents, HR information, and company communications. The IT department runs the intranet in a private cloud; the intranet consists of applications such as Web servers that provide secure intranet access; HR applications that give employees access to their HR and benefits information; and a suite of audio-visual corporate communications applications that allow users to participate in conference calls, video conferences, and make VoIP calls.

The cloud infrastructure uses Blue Vector's engine for its unified monitoring and management system that allows IT personnel to specify policies for various aspects of the intranet such as Web servers, proprietary and third-party applications, and service level agreements. IT personnel specify what resources to monitor, how to monitor those resources, and what to do when exceptions occur, along with how and where applications run and how and when they should scale.

The default policy on one of the communications applications is to restart upon failure. An event comes up and there is a need to extend the policy to say that, prior to restarting, the system must deposit the failure information into a queue for further analysis. This modification to the policy needs to be enforced everywhere the application is running. Blue Vector's software will automatically compute the set of agents that requires this change, remember where those agents are running, and distribute the modifications *only* to the agents that need revision.

During a company-wide all-hands meeting delivered via desktop video, the load on the Web servers and the video application suddenly spikes as all employees log onto the intranet at the same time. However, the company's order transaction system has an SLA that specifies orders per minute. As the load for the video application increases, the cloud pulls from the order transaction system to meet the increased demand. Blue Vector's software measures performance against the SLA for the order transaction system and notifies the appropriate IT personnel that service levels are falling short of the guarantee. It can also notify the cloud infrastructure itself so it can migrate new video server instances to other, less heavily-loaded machine instances.

Blue Vector's technology

Aspect oriented system

In a cloud environment, the sources that must be monitored are many, diverse, sometimes distributed, and often must be pulled together from disparate architectures. Moreover, the change that occurs in dynamic cloud environments makes continually tweaking monitoring and management systems a burdensome task for IT personnel. What is needed is a system in which the cost and difficulty of managing it is independent of the scale or complexity of the system. Aspect-oriented systems such as Blue Vector's differ from other software approaches in two fundamental ways:

1. The behavior of each "aspect" of the system—policies and rules, hardware interfaces, integration, etc.— is specified separately from the others
2. The system is in charge of weaving the aspects together and generating final programs for each individual location

Addressing true separation of concerns, Blue Vector's software enables the individual specification of each aspect of a system, then weaves those aspects together to automatically generate and distribute code images (in this case, synthesized agents) that run anywhere in a system – a node or a virtual machine instance. This enables Blue Vector to take very complex scenarios, break them down into their component parts, and create simple, targeted configurations.

Automatic code generation

A second attribute of our system – and one that works in concert with aspect oriented programming – is the automatic weaving of agent code. Once the targeted configurations are computed by Blue Vector's software, agent code is automatically generated and efficiently delivered to all virtual machine instances. Once this is done, system changes are only incremental. Because aspect oriented systems take care of "remembering" which code image is where and what it contains, the system knows which agents to reconfigure upon a change. It will only change those agents that are affected by the change as opposed to changing the entire system. Because our system enables dynamic automatic code generation, it lends itself particularly well to monitoring and management scenarios, which inherently change and evolve.

Event-based sense and response

A third attribute is our event-based sense and response capability. Because our system handles event processing – from global events to events at the extreme edges of a network such as those generated by sensors – it naturally lends itself to an event-intensive environment such as a cloud running a large number of applications. Our system was purpose-built not just to sense but also to respond to stimuli, so it can carry out complex, self-regulating processes locally where our adaptive agents reside. In a monitoring and management situation, this enables the system to self-manage, essentially carrying out policies all across the network for application discovery, SLA monitoring, application change management, and reaction to system events.

Integration framework

Finally, besides creating adaptive agents and enabling them to carry out event-based processes, our system can be tightly integrated with existing systems' monitoring agents. Moreover, it integrates easily with IT management systems, providing them with a continuously updated system status as well as a drill-down of policy-based actions taken at any location in the system.

Bringing it all together: An extensible, flexible engine for monitoring and management

These attributes come together to make Blue Vector's software an extensible, flexible engine for monitoring and management in cloud environments. With Blue Vector, organizations can extend their traditional monitoring and management systems to cloud environments. They can seamlessly monitor and manage the status of hardware, virtual machines, and applications, as well as physical assets, sensors, and access control systems. They can attain rich, timely data for analytics, reporting, and compliance. And they can deploy policies throughout their system to take action on conditions and events, enabling truly on-demand services.