IBM Tivoli zEnterprise Monitoring

Abstract
The IBM® zEnterprise® System is a hybrid system that provides the infrastructure for multiple different virtualized platforms that are all managed centrally in a unified way rather than individually. Like with any other server, it is crucial to understand how the physical resources are used by whom and to what extend in order to perform tasks like performance management and problem determination. The following article gives a brief introduction of the zEnterprise and introduces the new Tivoli zEnterprise monitoring solution to gain visibility into the various workloads that run in a zEnterprise environment and that shows whether these workloads meet the expected service levels set for them in a policy.

Introduction
With the latest generation of IBM System z® mainframes, IBM provides two machines in the zEnterprise family, the IBM zEnterprise 196 (z196) and IBM zEnterprise 114 (z114) that implement the novel concept of a system of systems.

While IT-services are delivered De-facto today on different individually managed platforms, each made to fit a particular purpose, interconnected with each other through separately managed network fabric, secured by firewalls, and shared by many different users and services, the zEnterprise provides all this within a single system. Moreover, the entire system is managed in a uniform way by the IBM zEnterprise Unified Resource Manager, a software that comes with the zEnterprise firmware.

A zEnterprise consists of a Central Processing Complex (CPC) that is divided into logical partitions running large scale transaction and database workloads on the traditional mainframe operating systems z/OS®, z/VM® and Linux on System z. In addition, the new IBM zEnterprise BladeCenter® Extension (zBX) is connected with the CPC by means of a high-speed private data network that eliminates the need of externally managed switches, routers and firewalls. A zBX with its up to 4 racks can contain a mix of POWER7® and IBM System x® blades to run virtualized instances of AIX, Linux or Windows™. In addition, DataPower® XI50z blades can be installed in a zBX to offload some of the expensive work that comes with web services to a specialized hardware appliance that increases performance while reducing the cost of computing at the same time.
Does this novel concept fundamentally change the way of managing and monitoring the operating system, the middleware and the applications? Not really. In fact, most of the tools that you have today can still be used on zEnterprise as-is. The only difference, however, lies in the management of the infrastructure itself. The encapsulation that Unified Resource Manager provides on one side for ease of use across the different platforms, requires on the other side that all management activities are handled through the same component as well. To understand how the physical hardware is utilized, what the virtual servers characteristics are and how they depend on the physical resources, a monitor is needed that gives you the necessary insight to effectively manage such an environment.

The new IBM Tivoli monitoring solution for zEnterprise is a tool that has been made to exploit Unified Resource Manager services in order to provide visibility to the physical and virtual resources in a zEnterprise, i.e. the characteristics and utilization of the CPC, individual blades, the virtual infrastructure with the virtualization hosts and its virtual servers, network and storage resources and that shows how these resource are related to each other.

Before the monitoring solution is introduced in more detail, however, the next section first explains some of the basic concepts introduced with zEnterprise.

zEnterprise concepts

Up to eight zEnterprise systems can be pooled together into what is referred to as an Ensemble. The whole Ensemble is managed by a pair of Hardware Management Consoles (HMC), a primary HMC for the actual management activities and an alternate HMC that serves as a hot stand-by console in case the primary HMC fails or is unavailable for other reasons.
Virtual servers created at the HMC user interface or remotely using the HMC Web Services API can be grouped together into a *Workload Resource Group*, or in short called workload. The idea of a workload is to report and manage those virtual servers that perform a set of related activities on behalf of an IT business service as a single entity. Unified Resource Manager provides platform performance management capabilities that manage the workloads and its IT-resources towards business objectives expressed by a *Performance Policy*, much like the Workload Manager component on z/OS since more than a decade. For that, virtual servers are classified into *Service Classes* with goals and importances and if goals are not met, Unified Resource Manager dynamically re-adjusts resource assignments, helping most important workloads first, in an attempt to fulfill the goals set by the Service Classes. Unified Resource Manager can do this because it understands the relative importance of all the virtual servers in the workload but also across workloads and knows who is using how much of the resources and who is in need of them.

To provide a certain level of security among all virtual servers in the Ensemble's private data network, Unified Resource Manager allows an administrator to define virtual networks and to associate those to individual virtual servers as need may be. Thus, virtual servers that are in different virtual networks cannot communicate with each other, they are isolated as far as network traffic is concerned. Of course, this does not preclude virtual servers, that act as a central server for multiple IT-services, for example a z/OS LPAR hosting a DB2® database, to be part of multiple virtual networks.

Finally, Storage Area Network or z/VM storage resources are defined to the Ensemble and associated with individual virtualization hosts. When virtual servers are created, such storage resources can be added to a virtual server as virtual disks that may contain a bootable image of an operating system with middleware (Platform as a Service) or even a complete software service appliance (Software as a Service). The management of such services, however, is not in the scope of zEnterprise but rather in the realm of higher level enterprise service management providers such as Tivoli®, IBM Systems Director and others.

**IBM Tivoli Monitoring and zEnterprise**

IBM Tivoli Monitoring (ITM) has been enhanced by a new monitoring solution that provides visibility into the properties, the performance and the availability of physical, virtual and logical resources in the Ensemble environment. The new capability is shipped on top of ITM 6.2.3 Fix Pack 1 and is available free of charge with all ITM, ITCAM and OMEGAMON® products entitled to use this version of ITM.

Only one instance of the new solution is needed to monitor all zEnterprise systems across all Ensembles that a customer might have in his enterprise. This is a major difference in structure simplifying the deployment of the monitor and thus helping to utilize the benefits of it much faster, compared to many other monitors.

To achieve this, the complete monitoring solution is actually provided in form of two components:

1. A Tivoli Enterprise Monitoring Agent (TEMA) that interfaces with the remainder of the ITM infrastructure and being responsible for fulfillment of monitoring requests submitted by users;
2. a common collector component referred to as Enterprise Common Collector, that, on behalf of the TEMA, periodically collects inventory and monitoring data from the various Ensemble management HMCs configured to it.
Both components can be installed on any major platform (Linux, AIX, Windows), on the same server or on distinct servers, either inside the zEnterprise itself or outside on another box that qualifies for any of the supported operating system platforms.

The Enterprise Common Collector maintains its own local copy of the data and makes it available to a number of tools besides just monitoring. The local copy of the data is kept current to the best degree possible by listening on notifications that inform the Enterprise Common Collector about property or status changes. Periodically, complete inventory scans allow the Enterprise Common Collector to fully synchronize its copy of the inventory with what is actually defined currently at the HMC. This approach not only provides fast and almost immediate access to the HMC data, but also avoids that each individual tool interested in performance or inventory data, needs to contact the HMC directly – which is against many installations' policy to not give broader access to the HMC. Not to speak of the fact that in such a case the HMC may have to handle multiple similar requests that unnecessarily increase CPU load and network traffic while preventing it from doing the work it is supposed to do primarily, namely managing the Ensemble.

The Enterprise Common Collector utilizes the new HMC Web Services API that is documented officially as part of the HMC publication library. For that, a special account has to be established on the HMC with permissions to access the Ensemble resources for monitoring. Once logged on and authenticated, the Enterprise Common Collector can perform data collection requests and stores the response in its internal buffer for use by the TEMA.

The monitoring solution provides the same capabilities like all the other products in the ITM family. The data is presented on various workspaces on the Tivoli Enterprise Portal (TEP), the central monitoring console of all ITM, ITCAM and OMEGAMON products. The workspaces have graphical and tabular views that can be customized flexibly to accommodate the needs of the user. Situations, both, those provided with the product and user defined ones, allow you to monitor utilization and goal fulfillment within the Ensemble. Situation events, for example, can be generated when the operational status of a virtual server or a blade changes to an unexpected status. Similarly, a situation event can be generated when a Service Class does not meet its goal. Such events are displayed on the TEP but can also be forwarded to an event console, like for example, Tivoli Netcool® OMNIbus, on an individual basis, where they can be managed from a single and central point of control within an enterprise.

The data collected by the monitor can not only be used for real-time performance analysis or problem determination. Like most other monitors, the zEnterpise monitor also provides support for historical data collection. The data is kept in a short-term history file and will be periodically offloaded into the Tivoli Data Warehouse, a database for long-term history data. The historical data can then be accessed from the
TEP or by generating Tivoli Common Reporting reports to perform tasks like capacity planning or simply following trends in resource utilization over time, for example.

A final highlight of this monitoring solution, however, must not be forgotten. A truly integrated monitoring console does not just give users access to workspaces from different products. It also allows users to navigate from a workspace in one product to a related, more detailed workspace in another product. This is also the case for the zEnterprise monitor. For example, when doing the analysis of virtual server performance in the scope of a Workload Resource Group, the user can simply navigate from the virtual server’s view into an operating system overview workspace that provides details collected by an ITM OS agent running inside the virtual server. This capability leverages the existence of agents that are already in place to monitor the platform and the applications and seamlessly integrates this for monitoring the underlying virtualized infrastructure as well.

Sample scenario
To be a bit more concrete, let us consider the following scenario: A user of the Banking application is calling the help desk complaining about bad response times. Sarah, the operator opens up the TEP to look at the different Workload Resource Groups that are defined in the enterprise and searches the Banking Workload Resource Group. Looking at the Workload Resource Group Summary workspace, she sorts the workloads by name to locate the Banking workload. The zEnterprise monitor provides Sarah a single calculated field, called Workload Service Level Index, that reflects how well the overall Workload Resource Group was performing relative to the goals of its Service Classes and relative to the importance of the most important Service Class that missed its goal. So, Sarah can easily determine, whether the business goals set for the Banking workload are missed or not and what the criticality is, if goals are not met. See Illustration 3: Workload Resource Group Summary Workspace below for an example of the Workload Resource Group Summary workspace.
Sarah can then drill down into the Workload Resource Group Details workspace to get a better understanding what the virtual servers are, that participate in the Banking workload. From there, she can see individual virtual server operational status, CPU and memory utilization, as well as the Service Class each virtual server is associated with. If a particular server is highly constrained on CPU, Sarah can navigate into either the Virtual Server Details workspace for Power® or x-Hyp to understand the characteristics of that particular virtual server. Alternatively, she can navigate into the Virtualization Host Details workspace for either Power or x-Hyp to see more details about the hosting environment of that particular virtual server. The first workspace will help to identify whether the virtual server is just short of capacity because the number of virtual processors (or processing units) is simply too low, while the latter workspace gives Sarah an understanding about the physical CPU contention on the hypervisor layer.

In either case, Sarah can now recommend to change the processor configuration or move that piece of the Banking application to another bigger blade to solve the user's problem.

Conclusion

The new IBM Tivoli zEnterprise monitoring solution completes the set of IBM monitoring tools that allows you to monitor a zEnterprise environment on the infrastructure, the platform and up to the application layer. It gives the necessary insight into Ensemble resources for performance management and problem determination while integrating with and providing similar capabilities as all other products in the IBM Tivoli Monitoring family. Yet it is unique in the sense of following a different approach for deployment and making the administrator's life easier when zEnterprise systems grow from inside by adding more virtual servers to them or by growth in hardware footprint as more zEnterprise systems are added to the Ensemble or even as multiple Ensembles are created.

About the Author

Jürgen Holtz is a Senior Software Engineer for Tivoli within IBM's Software Group. He has more than 20 years experience in system software development for System z, in particular in the areas of automated operations, high availability, performance and workload management. Jürgen is a member of several IBM architecture teams and also Lab Advocate for a number of clients.