e-Business Asset Management and Capacity Planning

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ABSTRACT

This paper describes Intel's e-Business data center asset management and capacity planning programs including the business drivers that led to their creation, the technology developed to build and maintain them, and Intel's future plans for them.

As Intel Corporation's Internet presence grew from static content served from a single desktop PC to over 65 externally facing Internet applications running on over 850 servers in multiple states, the need for asset management and capacity planning programs became very obvious. This paper explains these programs in depth. We will first, however, give a brief overview of each program.

INTRODUCTION

Asset Management

Intel's e-Business asset management program is a single web-based source from which all the physical and configuration data for each of the servers in the e-Business production and pre-production environments can be obtained. This program was initially planned with four sequential phases and it is still evolving today. Effective asset management relies on both process and tools coupled with the discipline of the using audience.

There are specific processes created and implemented in order to maintain strong data integrity. Architectural design review boards review the requirements and approve them prior to any assets being procured for Intel's e-Business environment. With each of the processes explicitly outlined in the intranet web site, each engineer is responsible for updating the database when there is a change in the assets.

From a tools perspective, to make asset management easy for engineers, Intel's e-Business team has created a central web application for recording the perpetually changing asset information. This asset management application utilizes two back-end databases that capture physical information as well as configuration data. The two repositories are then seamlessly integrated into a single web portal for engineers to view and update vital server information. The overall infrastructure for the asset management application consists of one web server, two database servers, and a system-side agent for software and hardware inventory. The asset management application can be used by Intel's e-Business team for anything from determining where a system is located to what applications are running on that system. Future goals of the asset management application will be to integrate branding information (system specific documentation), system capacity information, and health monitoring controls and data. In e-Business, asset management is seen as more than just recording serial numbers. Our goal is to provide a comprehensive system that can be easily used to manage, administer, and evaluate Intel's e-Business assets.

Capacity Planning

Intel's e-Business is undergoing exponential growth rates due to the corporate emphasis on Internet commerce. As our Internet business grows, the need to forecast system and facility capacity requirements grows as well. Capacity planning is divided into two very large categories: system management (which includes server, network infrastructure, and storage area networks) and facilities/infrastructure management (which includes physical space, network connectivity requirements, and power and cooling requirements specifically related to the data centers and pre-production labs). Capacity planning is a crucial part of the entire planning process and integration for Intel's e-Business infrastructure because of Intel's demand for 99.999% application availability.

Every year Intel's e-Business more than doubles the number of systems used to support our Internet applications. To prevent our e-Business from outgrowing its facilities, system resources, and network infrastructure, we have to use a variety of methods to not only predict, but to also control capacity. Like asset management, Intel e-Business has invoked programs dedicated to both technical and process-based solutions to allow for effective capacity planning.

THE EVOLUTION OF ASSET MANAGEMENT AND CAPACITY PLANNING

Asset management and capacity planning are viewed as behind the scenes operational processes and tools not often represented in a very public manner. If one does not hear about asset management and capacity planning, it means that the processes and tools are working effectively and are optimally integrated to provide all of the essential business planning and analytical data required at any given time. This, we feel is the true success criteria of good operational asset management and capacity planning programs.

To understand the need for well-defined, integrated, and scalable asset management and capacity planning programs for any business unit is the first step to effective and efficient programs.

These programs are inherently evolutionary. As e-Business and the Internet grow, so too will the requirements to manage assets and plan for capacity.

THE TECHNOLOGIES AND DESIGNS THAT ENABLE ASSET MANAGEMENT

In order to successfully implement an asset management program within e-Business, a harmony must exist between the processes that define asset management and the tools that enable those definitions. This portion of the paper will explain the enabling technologies and designs that were modeled from the processes.

As the processes for asset management were constructed, based on an evaluation of the existing environment and the projected environment, careful consideration was given to the development of an application that would suit both realms. When designing an Asset Management Application (AMA), our first priority was to utilize existing data and processes. We then developed an application that would immediately leverage the current system in use as well as define a system that would enrich asset management as it evolved to the desired state. The following sections of this paper describe the retrofitting and development of a comprehensive application that enabled Intel's e-Business to manage its assets from both a corporate capital and business support perspective.

Re-Developing Asset Management

Effectively managing over a thousand capital valued systems is a challenge for any company or business. To meet that challenge within Intel's e-Business structure, we were chartered with not only retromanaging the existing environment, but also with controlling an exponentially growing farm of servers. Step one of the asset management challenge was to leverage existing data and applications.

The management of assets within Intel's e-Business has gone through as many revisions and evolutions as the Internet itself. The first attempt of asset management was a simple spreadsheet maintained by numerous engineers. Such a static effort was, at the time, all that was needed to manage a business consisting of only a handful of servers. As Intel's e-Business grew, and the value of asset management was recognized, more dynamic applications were implemented. The first draft of such an application consisted of a free-text web form with a simple one-table database. Although this development was pointed in the right direction, the demands of e-Business and Intel Corporation soon overcame its capabilities. To address the obvious needs at the time, management created an internal group that was chartered with corralling and coordinating Intel's e-Business assets. This newly formed entity consisted of both process and application developers.

Once processes were developed that outlined asset management, the application developers needed to implement a cost-effective solution. Third-party applications were considered briefly. However, the needed level of scalability and customization together with the inflated costs of outside applications quickly paved the way for an in-house solution.

It was determined that the first step in instigating asset management was to create a system that would not only host all the needed information, but also make the acquisition of that information as simple as possible for the users.

Creating a Dependency

To create such a system, first a database was designed that could hold physical asset information as well as integrate links to other systems and information that were used by engineers. The reasoning behind such cross-functional integration was the realization that an engineer rarely needs corporate-level asset information. By integrating asset management into more daily processes and applications, Intel e-Business created a dependency that would enforce the discipline required by asset management processes.

One logical opportunity to create such a dependency was the already existing process for system space and networking requests. In order for a system (asset) to land within Intel's e-Business environment, an engineer must have two things: physical space assigned to place the system in the data center and an IP address with the accompanying DNS entry. By taking advantage of these two necessities, the application developers were able to enforce the collection of asset information. In order to acquire rack space and networking needs for a landing server, an engineer must first pass through the asset management processes.

To facilitate this dependency, the developers formed an alliance with the facility and networking groups. This

new alliance not only benefited the asset management process but also improved the efficiency of the joining partners. By integrating multiple processes and interrelating the data within, duplicate efforts were eliminated, and valuable data were joined.

Adding Features

Through dependencies, the asset management effort was assigned to the e-Business Integration Engineering group. However, to implement a successful application and process there needs to be tangible benefits to the user. As mentioned previously, the typical engineer will not likely benefit directly from asset management. Therefore, to truly create a business-wide need for asset management, the developers needed to create business-wide functionality.

An opportunity to do just this presented itself in the form of the integration of systems management. Intel's e-Business had an existing system for dynamically accumulating system and application data. The systems management infrastructure consisted of a system-side agent that inventoried software and hardware configuration data for each server within the e-Business environment. The asset management program developers realized that if they could provide a portal to the asset data within the asset application, they would be adding value to everyday operations. By altering the installation of the systems management tool to incorporate a logical link to the asset management database, a virtual conglomerate system was created. With the marriage of configuration and asset data, engineers now had an everyday use for the e-Business asset application.

The creation of dependencies and the addition of every day functionality to Intel's e-Business AMA has significantly contributed to the success of the asset management program. However, limiting the scope of the application and its user interfaces was not part of the application's design. Further development and interfaces are on the horizon.

FUTURE DEVELOPMENTS

Within Intel e-Business we are constantly pushing for tight integration of applications, of which asset management is no exception. Although the AMA is now coupled with our systems management data, there are even more opportunities for integration. The goal of the AMA is to provide a comprehensive portal to all and any system data. The portal will eventually be the one interface engineers and managers alike will visit in order to view any system information. The end result will be the transparent integration of all system data ranging from a system's physical and financial data to a system's configuration and build documentation.

The next step for the AMA is to link the interface and data to branding documentation. Intel e-Business maintains a document for each system within the environment. The branding documentation outlines all the steps used to build and configure a system. Branding information is crucial to controlling and building our production environment. Today, branding is viewed through shared directory browsing. A project is now in place to improve the branding process by initiating content control through version control. In addition to version control, branding documents will be managed through a central database.

The AMA developers see the upcoming branding application as yet another component that can be integrated into the AMA portal. By adding the branding component we will create even more dependencies and increase the functionality of the AMA for our end users.

With the linking of branding and systems management applications, the AMA will be an advanced infrastructure consisting of a web server and three back-end databases. The real benefit the AMA will provide will be the seamless joining of multiple data repositories. Where databases and the data once stood alone, they now will be fully integrated into one portal (see Figure 1).

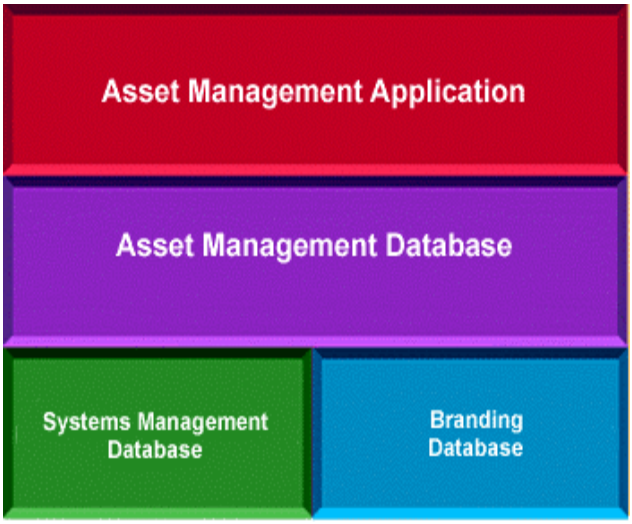

Figure 1: A view of the AMA components as they are scoped for today

After branding information is brought into the AMA there are even more possibilities on the horizon. Plans are being considered to also incorporate our capacity management and monitoring applications into the AMA portal. Assuming Intel e-Business can create this immensely conglomerated system, the AMA portal will undeniably be the one-stop interface for complete systems, asset, capacity, and monitoring management (see Figure 2).

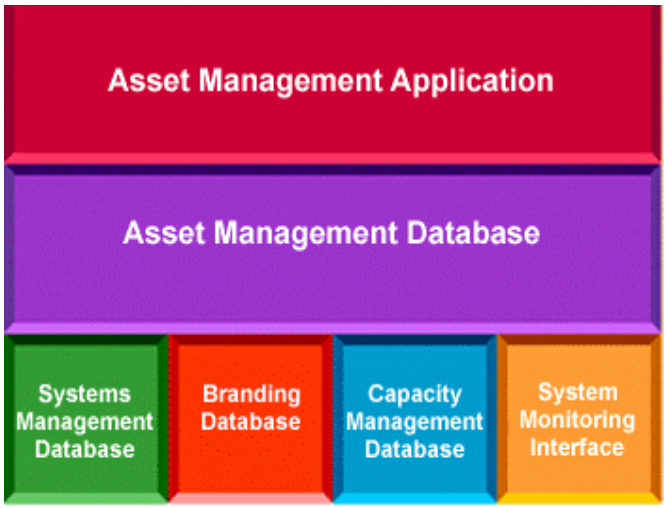

Figure 2: A view of the AMA components as they will be viewed in the future

CAPACITY AND SYSTEMS MANAGEMENT

Efficient management tools can greatly ease the management load in any computing environment, especially with an architecture that includes large numbers of systems. The Intel e-Business infrastructure includes over 850 servers, approximately 60% of which are part of the production environment. All servers are remotely monitored for CPU, memory, and disk utilization. This helps management staff plan for upgrades and provides useful baseline information for sizing new systems and applications. It also helps ensure that overtaxed systems are discovered before they suffer unnecessary failures or performance degradation.

In order to proactively monitor the capacity of systems within our e-Business environment, Intel's IT group has developed a server-side agent that captures dozens of system performance counters every five minutes. The performance data are then aggregated on several large databases exceeding a _ terabyte of performance data (Figure 3). Intel e-Business then runs daily reports for each of its systems, which are routinely reviewed by production engineers for potential capacity issues. The performance data and reports allow us to predict as well as prevent capacity problems within the environment (see Figure 3).

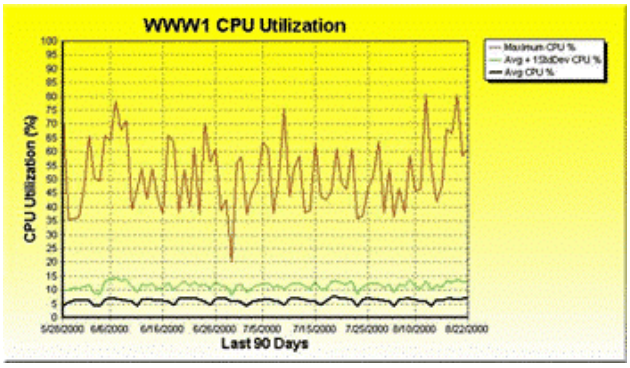

Figure 3: An example of reports used by e-Business to monitor capacity

In addition to monitoring system capacity Intel e-Business also uses a third-party agent and infrastructure to collect system configuration data. Knowing how a system is built and what applications are running on that system is an important component to managing and controlling a large e-Business site. E-Business systems are routinely scheduled to query their own hardware and software configurations and relay those data to a central repository (Figure 4). Once in the repository, engineers can query and review the dynamic data. This gives Intel e-Business the ability to identify, on a large scale, the systems that either need upgrades or configuration changes.

Intel IT has also developed a custom application called Metrios® that performs functionality testing. Metrios accesses e-Business systems in much the same way a user would and verifies system responses. It can run Active Server Page scripts and even dial out to test connectivity from the Internet. Metrios can be configured for automatic monitoring and will page out to notify staff of problems requiring immediate attention (see Figure 4). Once notified, Intel IT staff use Microsoft's Terminal Server* and the Intel® LANDesk® Server Manager 6.2 for remote system management. Staff members can dial in from their desks or homes to access and manage systems throughout the e-Business computing environment. These tools are essential components for maintaining the Intel e-Business infrastructure and enabling efficient control of widely distributed systems.

* Other brands and names are the property of their respective owners.

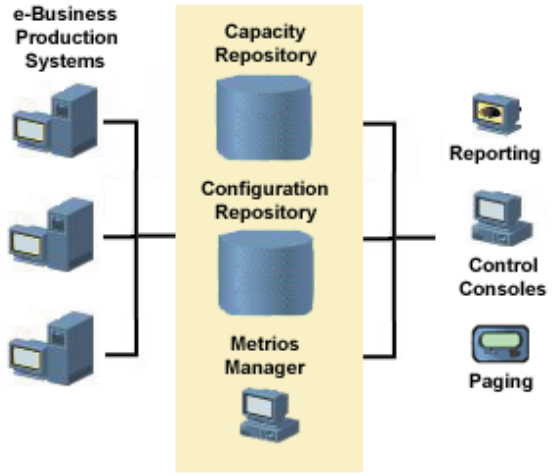

Figure 4: Comprehensive e-Business systems management obtained through an integrated infrastructure

FACILITIES AND INFRASTRUCTURE MANAGEMENT

The e-Business environment is becoming increasingly complex and in so many cases challenging Moore's Law. This growth is exponential in the speed of new applications being introduced and existing applications being upgraded. These requirements are being driven by the very intelligent end-user, who also happens to be the one developing the architecture. Along with asset management and systems capacity planning, facilities and infrastructure management was identified as a key contributor to planning Intel's e-Business success strategy.

Facilities and infrastructure management is defined as the physical space (data center and labs), the network infrastructure, and the power and cooling requirements to house all of the systems in a given space. These three major components are wholly dependent on each other in order to accommodate a single system. One cannot land a system in the data center or any of the pre-production/development labs without having all three components in place.

In summary, facilities and infrastructure planning is so tightly integrated with asset management and capacity planning in Intel's e-Business environment that it cannot be treated as a separate issue.

Challenges

The single most challenging problem with facilities and infrastructure management planning is how to plan for growth and how to decide how much growth to plan for based on cost and return on investment. It is a very peculiar and confusing state to be in. Do you plan for two, four, or six years? Can you even plan for any further than four years out? Based on trend analysis of system procurement and the change in systems, how much density do you plan for? What is your focus and how will this investment be returned? What are the success criteria of a data center or lab design? Once these questions have been answered, you can start the management process.

The problems with managing facilities and infrastructure are, in fact, in most cases the most costly and the most time consuming to react to and fix. We are trying to expand our power/cooling capacity in the data center to accommodate the amount of physical space and network capacity we currently have available. Power and cooling requirements seem very basic, but they can be the deciding factor in the installation of systems in a specific lab or data center. The design and planning of power and cooling capacity are essential and are very sensitive to our ever expanding e-Business infrastructure.

In order to understand the requirements of the pre-production labs and data center, we first prepared an historical trend analysis specific to the data center, production system growth, and pre-production system growth. We factored in the understanding that the growth rate of systems in our e-Business environment has been doubling every year, and the system platform physical vertical size has decreased to 1/3 or 1/2 of the size from one year ago. We also factored in our intention to make sure we would reduce the complexity of application deployment (support, launches), support processes, network infrastructure (less reliance on WAN, MAN, routers), instrumentation, metrics, analyses, security administration, and capacity management. In addition to reducing complexity we also wanted to avoid indirect costs of load balancing and network infrastructure optimization, increased support costs, and increased remote administration.

An overall facility and infrastructure roadmap was designed with a consistent physical capacity, network capacity, and power/cooling capacity architecture and framework. Each of the pre-production labs are now outfitted with cabinets and racks to accommodate all types of systems – tower or rack mounts – as well as with the network and power/cooling capacities which are scalable at a equal rate to each other.

The data center power/cooling capacity has been retrofitted to accommodate the physical capacity required by e-Business production.

RESULTS

The success criteria of facilities and infrastructure management is when the design of the lab or data centers factors in the correct ratio of physical space to network capacity to power and cooling capacity, and all of these are scalable at an even level. For example, the capacity remaining for network, physical space, and power/cooling is identical. In a facility design, you do not want to be in a position where you have a large amount of one component and none remaining of another component.

The design of the Intel e-Business data center and pre-production labs is complete. The pre-production labs are in operation and are using the new facilities and infrastructure strategy. The data center will soon be online with the new infrastructure strategy.

With a long-term business strategy in place and a complete understanding of the components of the facility and infrastructure, Intel e-Business will be able to scale the data center and all of its pre-production labs with zero interference to business.

The importance of proactive facilities management and the understanding of infrastructure scalability has been recognized and will always be an integral part of

e-Business strategy planning.

CONCLUSION

As e-Business strives to provide the most successful and available Internet presence to the world, behind the scenes are the operational processes and tools enabling it to do just that. Integrated, scalable, and very accurate asset management and capacity planning programs are essential. Without these programs in place, there is no platform on which to build the business strategy. The initiation and development of an asset management solution and capacity planning program will pay off in the most rewarding ways. With these programs in place you will be able to successfully reduce the complexity of the e-Business environment with consistent processes and tools. Resources will be used effectively (both assets and personnel); system and application performance and availability will increase; and consequently, time to market will decrease. The result is an overall reduction in cost for Intel.

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