Ptak / Noel

Distributed virtualization management from big iron

Introduction:

Many enterprises started virtualization efforts to reap the benefits of consolidating their distributed infrastructure. This consolidation, however, has not ended datacenter infrastructure heterogeneity since enterprises seem intent on acquiring different virtualization platforms as well as heterogeneous hardware platforms. As a result, system administrators often experience setbacks in their ability to control and manage the different types of virtual resources in their datacenters.

This paper explores how virtualization 'muddies the waters' for systems administrators. It outlines why systems administrators are wrestling with the issues of heterogeneous virtualization administration, virtual image sprawl, and connecting virtual image deployment to business service management workflows with disconnected tools that are ill-suited for these challenges. It also discusses how IBM is evolving its management solutions to enable heterogeneous virtual server management in a consistent manner (regardless of the virtualization or physical platforms) and the benefits of leveraging Linux on System z as the management platform.

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Virtualization flexibility can cause datacenter management headaches

Enterprises are aggressively using virtualization to consolidate their Windows, Linux and Unix infrastructure and develop new composite SOA-based applications. This consolidation however does not mean the end of enterprise infrastructure heterogeneity since enterprises are also showing a propensity for acquiring different hypervisors. While VMware remains dominant in the datacenter, adoption of other forms of virtualization, such as Microsoft's HyperV, Linux's Xen and Linux on System z, is growing. As a result, several different forms of virtualization are now in use in the datacenter.

These different forms of virtualization provide enterprises with much more flexibility on how to allocate physical resources to applications and workloads, and with much faster speeds for deploying new virtual machines and images. However, these multiple forms of virtualization have introduced more complexity to an already difficult datacenter environment.

Pre-existing conditions were already making the system administrator's tasks more difficult. For example, the datacenter environment has become more complex in recent years making routine maintenance tasks even more time consuming and error-prone, which in turn makes problem solving more challenging. The uneven growth of silos within the datacenter (as different distributed server platforms are managed in silos and mainframes are managed in isolation) has caused costs to rise and the time available for solving business problems or for introducing new business applications to decrease. Simultaneously, IT departments are under pressure to cut costs and increase the service that they provide to the business.

Heterogeneous virtualization technology, when added to the datacenter's pre-existing conditions, is changing the nature of systems management in several ways:

- Basic administration of virtual servers are no longer directly tied to physical hardware
- The importance and complexity of virtual image management is rising
- Flexible virtual resources must now be matched to dynamic workload schedules

Let us look at each of these areas in turn. We will outline the changes taking place and how they result in new solution requirements, delineate how IBM's virtualization management solutions address those changes, and outline how enterprises can leverage System z to provide additional benefits.

Basic administration of virtual servers are no longer directly tied to physical hardware

Virtualization is creating solution consolidation pressures at the systems administration level. We have seen similar tool consolidation pressures in different management areas. For example,

heterogeneous and far-flung networking devices and networked servers drove the consolidation of network monitoring solutions. However, server management tasks such as bare-metal OS deployment, BIOS and OS patching and configuration changes have been historically immune to these pressures. One reason for this was that the physical server hardware and OS were a tightly-coupled package and therefore it made sense for administrators to use management solutions shipped with the server hardware for these tasks.

Virtualization also muddies the waters for systems administrators because it has decoupled the server hardware from the server OS. This decoupling is driving operating system and hypervisor heterogeneity into the realm of traditional server management. This heterogeneity means system administrators, for the first time, truly *need* a centralized management platform to manage virtual systems. The arrival of multiple distributed virtualization platforms threatens to make this situation worse by breaking up datacenter management teams into smaller, and sometimes hostile, groups. Hypervisor choices rarely rest with operational systems administrators these days. Decisions are often made by IT executives looking to lower immediate capital expenditures or by application teams looking to improve performance (e.g. minimizing latency by placing applications on Linux on System z in close proximity to enterprise data) with little consideration of the operational impact. Often, the expectation is that the suite of management tools bundled with the chosen technologies will be used. What this means for administrators is that their toolkit grows by three or more different products, each with overlapping capabilities. The toolkit expansion and overlap greatly increases the potential for human error.

It is not surprising, then, that many enterprise IT organizations see setbacks in administrative control, problem resolution, resource management and staff productivity, in spite of dramatic increases in provisioning speed delivered by virtualization platforms. In trying to avoid these pitfalls, systems administrators are realizing they need to focus on managing their virtual infrastructure more broadly with solutions that can manage virtual machines across all hardware platforms.

Now let us look at what IBM is doing to address these needs. IBM started by evolving IBM Systems Director into a hub for providing basic management capabilities for all virtual resources (server, network and storage) across all platforms. One key advantage for IBM is that the 'all platforms' includes virtualization platforms provided by VMware, Microsoft® Virtual Server, Xen virtualization, the Hardware Management Console (HMC), and the Integrated Virtualization Manager (IVM) as well as hardware platforms, including IBM BladeCenter, Blade servers (x, Power, Cell) AIX, POWER Linux, IBM System i, and Linux on System z. IBM Systems Director can also leverage Tivoli's common agent technology to extend basic virtualization management to non-IBM hardware.

Systems Director's 'pluggable' architecture enables this breadth of coverage. With the right combination of plug-ins and Tivoli agents, systems administrators will be able to use the

Systems Director interface to discover existing virtual machines and automatically create physical-to-virtual topology maps that are useful for troubleshooting both virtual machine and physical platform issues. This approach provides several other advantages. First, it greatly simplifies the effort involved and minimizes the potential for human error in managing multiple virtual resource because all heterogeneous virtualization platforms appear to the administrator in a common format. This is particularly important for the management of System z virtual machines. Systems administrators familiar with managing virtual machines on distributed platforms should be equally adept at managing virtual machines on System z.

Second, it begins to bridge the gap between detailed system management tasks and the workflow automation and service management capabilities provided by other Tivoli solutions (which we will discuss later in the paper).

Another, perhaps more intangible, benefit of locating virtualization management technology on System z relates to the silos that we discussed previously. What better way to break down the silos that isolate the mainframe and distributed virtual machine management than by locating management technology that is going to tie together the entire installation on a System z machine? Perceptive IT executives will recognize that requiring the distributed systems staff to work more closely with the mainframe staff can yield great benefits to the installation. Running the management technology on the mainframe can contribute significantly to breaking down the isolation and the silo that many mainframes exist in today. For example, the installation will be able to bring business benefits to the organization when cooperation between the distributed systems group and the mainframe allows applications to use the strengths of both platforms.

The importance and complexity of virtual image management rises

Virtual image management becomes much more important and much more complex when enterprises use heterogeneous virtualization environments. It becomes more important because enterprise application managers are more interested in deploying virtual images than in the virtual machine builds (i.e. server definition, guest OS and patch level configurations) that systems administrators have standardized. Application managers are interested in packaging the complex layers middleware, applications and custom software configurations with the standard virtual machine definition as a singular virtual image for rapid deployment. As virtualization technology is evolving it is dramatically simplifying the creation of these complex virtual images. The simplified creation process allows application managers to create more images than ever before. As a result, enterprise catalogs of virtual images will grow at a much faster rate. Additionally, without routine catalog maintenance and retirement of inactive images, enterprises are likely to end up with thousands of virtual images and image templates where there used to be hundreds of physically deployed servers. This dramatic increase in scale means the oft used tactic of keeping a spreadsheet of golden image specifications is no longer viable as it cannot

scale up. System administrators will require more sophisticated capabilities to maintain virtual image catalogs.

Virtual image management also becomes more complex because virtualization carries with it promises of providing business end-users a 'direct' interface for provisioning virtual images of new business services and of providing real-time scaling up and down of clusters of virtual images supporting existing business services. These promises are only fully met when systems administrators can automate many other tasks that surround rapid virtual image deployment after they receive a service request ticket. Many IT organizations are learning the hard way about the sprawl created when virtual images are deployed at will with minimal oversight. System administrators need management solutions that make oversight and control workflows as quick and seamless as deploying the virtual images.

Image management for a heterogeneous System z, Power Systems, and System x, and non-IBM environments requires a combination of both IBM Tivoli Provisioning Manager (TPM) products and IBM Systems Director products. IBM Systems Director provides image management specifically for Linux images on System z (leveraging z/VM) and Linux and AIX images on Power Systems (leveraging NIM) with the VMControl Standard Edition plug-in (Figure 1). TPM provides image management for heterogeneous x86-based hypervisors and reusable automation workflows for those control tasks that surround virtual image deployment.[1]

[1] Several workflow templates are freely available on the IBM Tivoli Open Process Automation Library (OPAL). At the time of publication, there were no workflows available on OPAL for Tivoli Provisioning Manager which utilize automation created within VMControl. However, VMControl capabilities are exposed via self-describing REST APIs which can simplify the creation of scripts that can be invoked by TPM. Future plans are for Tivoli to streamline this integration to require less manual effort

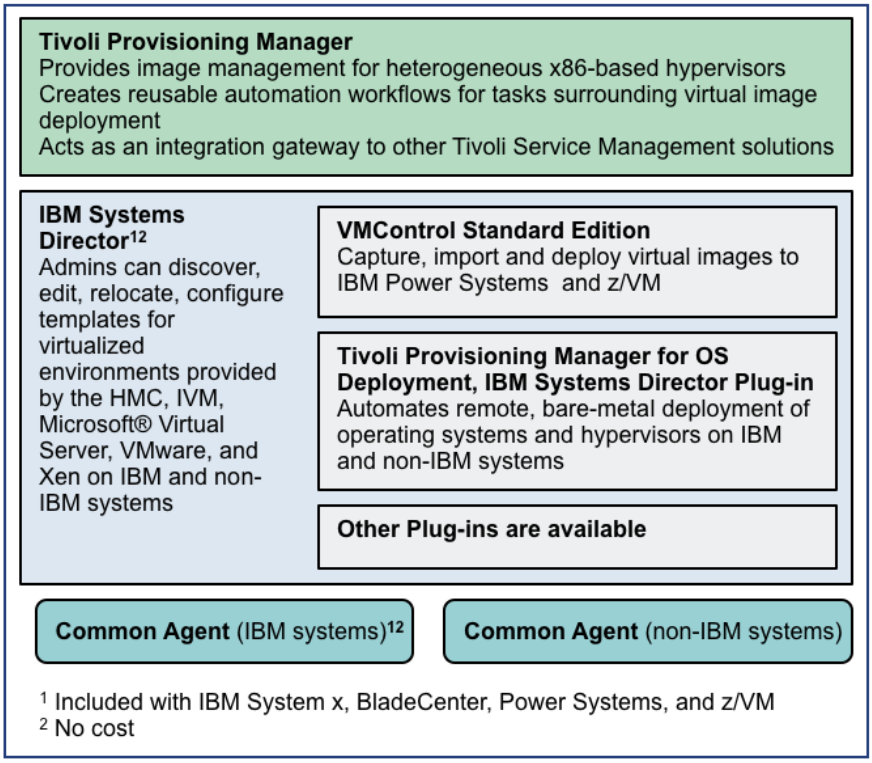

Figure 1 Heterogeneous Image Management with IBM Solutions

In Ptak/Noel's opinion, enterprise IT organizations get the best leverage by using Systems Director to automate the 'how' of image management while focusing TPM on automating the 'when' images should be deployed, patched, moved, etc. To address the 'how' of image catalog creation and maintenance requirements, Systems Director allows administrators to snapshot a running virtual system, supply additional information (such as performance goals, availability requirements, or placement constraints) and store the combination as a "virtual appliance" in a catalog[2]. This appliance approach allows complex software stacks[3] to be deployed, updated and migrated as a single unit. This dramatically simplifies the manual effort required to manage changes to complex software configurations. Systems Director also streamlines deployment from the catalog onto IBM Power Systems or System z which removes some of the traditional barriers between distributed and mainframe management.

TPM has several capabilities that will help IT organizations optimize their deployment capabilities both in responding to business objectives and in adapting to changing corporate and regulatory compliance policies. TPM's orchestration capabilities can be used to automate

[2] IBM plans enable VMControl to export virtual appliances from the library, allowing deployment to other hardware platforms. Ptak/Noel believes these plans hinge on wide-spread adoption of the DMTF's Open Virtualization Format (OVF) to standardize the packaging format for virtual appliances.
[3] For example a typical application server stack consists of custom application code dependent on a highly specific configuration of packaged middleware dependent on a highly specific configuration of a particular operating system

responses when critical business services require additional resources. Systems administrators and service managers can work together to determine specific deployment workflows that should be initiated automatically when specific service conditions or key performance indicators (KPIs)[4] are reached. For example, one workflow would deploy another web server when a particular KPI threshold is reached while another workflow would deploy another application server when different threshold is reached. The service managers can create the appropriate KPI monitoring rules in solutions such as Tivoli Composite Application Manager or Tivoli Business Service Manager which will automatically launch the appropriate TPM workflows. The systems administrator can use TPM's orchestration capabilities to automate any number of deployment workflows[5] required for various service management situations. These TPM workflows also automate any number of pre-deployment process steps such as release targeting and testing and compliance checking. This type of automation multiplies the benefits obtained by IT organizations because it helps busy system administrators consistently follow process best practices, such as ITIL, and their corporate and regulatory policies – which in turn reduces the number of availability, performance and compliance problems requiring manual remediation.

TPM also automates communication and integration with IT's other service management solutions, such as:

- IBM Tivoli Workload Scheduler (which we will discuss later in this paper)
- IBM Tivoli Service Request Manager[6] which governs broader change management workflows, such as obtaining the right change approvals and authorizations, and provides end-user facing capabilities, such as exposing the virtual appliance catalog as a web-based library of IT services for business users.
- IBM Tivoli Change and Configuration Management Database (CCMDB) which tracks IT assets, their configuration details, their relationships in delivering business services, and maintains accurate change histories to enable IT staff.

The growing integration between Systems Director and the suite of Tivoli products and the consistent approaches IBM is providing to manage Linux-based virtualization across heterogeneous platforms raises an interesting issue of where to host these solutions. In Ptak/Noel's opinion the virtualization is swinging enterprises back towards centralized management of dense computing infrastructure (be they Blades, packaged Cloud systems, or mainframes). This makes centralizing management platforms appear to be a natural extension of this phenomena. Enterprises can take advantage of the specialty processor pricing advantages offered by IBM, and the high availability and reliability characteristics of System z by running the management server and database components of Systems Director and Tivoli solutions on

[4] KPIs are typically business oriented rather than technology specific and often are calculated from information collected across a range of technology silos by service-level or application monitoring solutions

[5] TPM can also access the deployment capabilities through Systems Director's web services-based APIs, if necessary.

[6] For example, TPM tasks can be easily included in Tivoli Service Request Manager workflow automation definitions simply by referencing the TPM task name.

Linux on System z. As stored IT management data approaches the terabyte range, even for smaller enterprises, there is the potential for System z's advantages in handling large databases to be significant.

Another significant advantage we see arises as the real-time connection between virtual image deployment and managing business service performance grows. These new requirements mean that the management platform becomes an on-demand system. Image deployment is no longer a low-level administrator's utility that is fired up once in a while to perform a provisioning task within a predefined maintenance window. Business users expect their virtual provisioning needs to be met within minutes or hours, not days or weeks. It is also critical that system administrators maintain their view of the datacenter, otherwise they will not be aware of problems needing attention. It is quite possible that service level agreements will be violated and user requirements delayed during the interval required to restore the management solutions (a distressingly common occurrence in distributed environments). To meet these new demands, the management solution must be constantly available, which plays directly to the mainframe's strengths as a platform. When properly configured and managed, System z can offer unmatched reliability, availability and serviceability which enterprises can leverage.

Flexible virtual resources must be matched to dynamic workload schedules

It is vital that IT organizations become adept at matching increasingly dynamic workload schedules with the resource flexibility afforded by virtualization. However this new environment has made this task more complex. With dedicated systems, it was easier for systems administrators to manually match the workload scheduling requests with times where system utilization was low. With virtualization, this becomes an impossible task to achieve manually. Not only are there many more virtual machines deployed, but the variety of configurations makes resource matching more difficult, and virtual machines can easily be added, moved or changed. As such, system administrators are quickly realizing that they need both a policy-based approach to matching workload needs to resources and the ability to leverage the rapid provisioning strengths afforded by virtualization.

To address these issues, IBM Tivoli Workload Automation family of solutions focus on recognizing virtual servers and their hosts and matching those resources to workloads in a timely manner to ensure the work is completed within the right timeframe. The solution assures business services complete according to their agreements by determining the critical business service path across the entire production plan, taking into account internal and external workload dependencies. It monitors the entire service path, automatically prioritizes workloads at risk of delaying completion of a critical business service path and proactively adjusts workload resources as needed to ensure completion.

Tivoli's solutions enable this service assurance by cleanly separating the tasks of:

- Defining workload scheduling policies (which govern the 'when' a workload should be run). Tivoli's workload scheduling capabilities provide enterprise-wide production planning and calendaring, as well as dispatching, triggering, monitoring, and optimizing both batch and real-time business workloads.
- Defining resource utilization policies (which govern the 'where' workloads run). Tivoli's resource utilization management capabilities enable workload balancing across resources that match specific utilization policies (e.g. use host1 if it is available otherwise use host2, or only use virtual machines based on this particular template or at a particular patching level).

This separation provides two benefits. First, system administrators can focus on the resource utilization policies based on their infrastructure expertise without getting bogged down with scheduling and job description nuances.

Secondly, distributed system administrators manage utilization policies of host and guest resources without getting tied up in mainframe terminology. This becomes particularly important for enterprises that:

- Require a single scheduling solution to control complex workloads that span both distributed and System z platforms[7] Tivoli's architecture allows System z workload schedulers to manage the enterprise-wide scheduling tasks, System z administrators to use IBM Workload Manager to manage resource utilization and load balancing for z/OS, and distributed systems administrators to use Tivoli Workload Scheduler to manage heterogeneous virtualized resources for x86 systems, Power Systems and Linux on System z with Tivoli Workload Scheduler (see Figure 2).
- Wish to leverage TWS for z/OS's advantage of achieving very high workload rates (e.g. three to four million workloads per day in Sysplex environments) with its round-robin scheduling capabilities.
- Take advantage of Linux on System z specialty processor pricing which can lower the cost of completing specific types of workloads.

7 See our case-study as an example. "British-based financial services group automates job scheduling with IBM Tivoli® Workload Scheduler" Ptak, Noel & Associates, July 2009

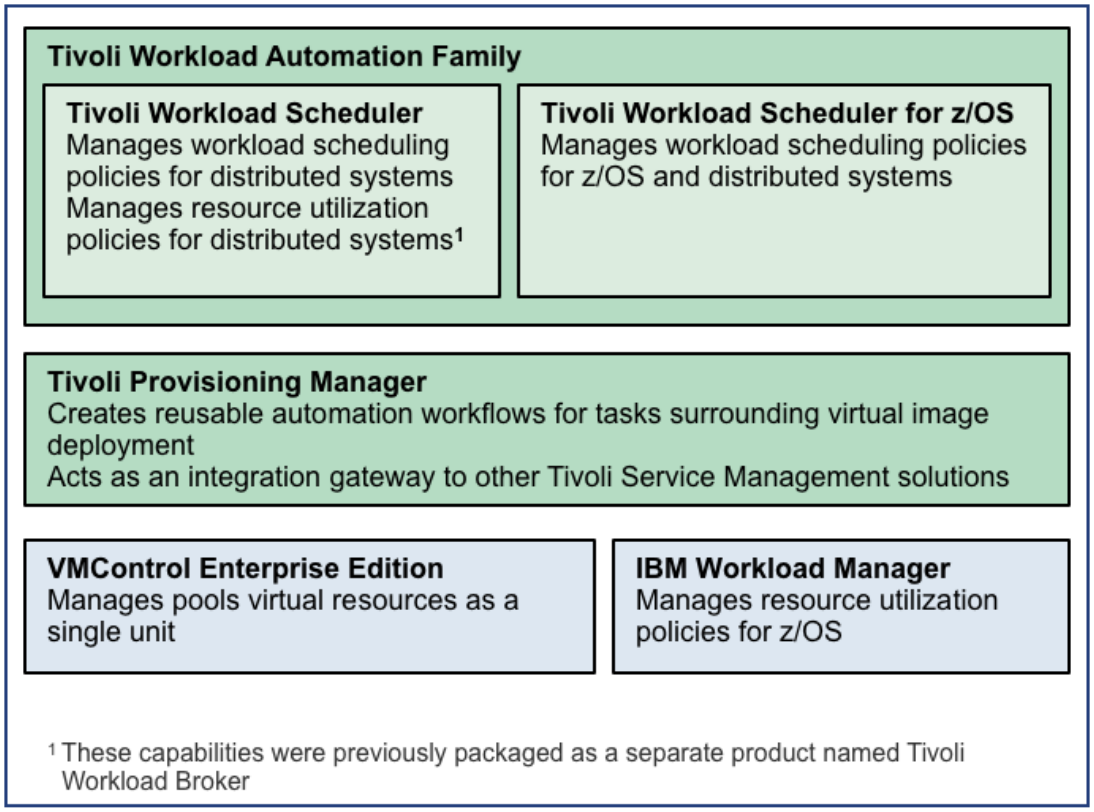

Figure 2 IBM Capabilities for managing how workloads are allocated to virtual resources

Another advantage is the ability to handle situations where no active virtual servers are available to execute the workload, which would cause a delay that jeopardizes the enterprise's service level agreements. When the workload scheduler recognizes this situation it can act in a variety of ways depending on the tools available. For example, it can:

- Notify the system administrator that a new virtual machine must be deployed. The administrator then can use Tivoli Provisioning Manager (TPM) workflows to either provision another virtual server for the workload on any virtualization platform or invoke VMControl Enterprise Edition's ability to manage system pools[8] on Power Systems to allocate resources to the workload.
- Directly invoke a named TPM workflow that the administrator has predefined based on the workload's resource requirements. One benefit of this "named" approach to automation is that the TPM workflow can change (e.g. to meet new compliance requirements) without breaking the interaction between the two products (a habitual problem with manually scripted integrations).

[8] A system pool is set of virtualized server, storage, and network resources that are managed as a single unit.

Final Word

Currently, enterprise systems administrators are wrestling with the issues of heterogeneous virtualization administration, virtual image sprawl, and connecting virtual image deployment to managing business services and workloads. They are struggling because their management tools are ill-suited for these challenges. Therefore it is not surprising that system administrators often experience setbacks in their ability to control and manage the different types of virtual resources in their datacenters. IBM is responding by providing a new breed of systems administration solutions that enable heterogeneous virtual machine and image management in a consistent manner regardless of the physical platform. The consistency provided by this approach improves administrator productivity because it enables administrators to automate more tasks and reuse that automation more effectively. There is also significant potential to lower the total cost of ownership of these solutions and improve their reliability by consolidating these solutions onto reliable platforms such as System z. This results in a win-win situation for systems administrators and IT executives.

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About Ptak, Noel & Associates LLC

We help IT organizations become "solution initiators" in using IT management technology to business problems. We do that by translating vendor strategy & deliverables into a business context that is communicable and actionable by the IT manager, and by helping our clients understand how other IT organizations are effectively implementing solutions with their business counterparts. Our customers recognize the meaningful breadth and objectively of our research in IT management technology and process.
www.ptaknoel.com

About the Authors

Jasmine Noel

Jasmine Noel is a founding partner of Ptak/Noel. She has over 15 years experience as an analyst covering IT management issues. She served previously as director of systems and applications management at Hurwitz Group, where she formulated and managed the company's research agenda. She was also a senior analyst at D.H. Brown Associates, where her responsibilities included technology trend analysis in the network and systems management space. Noel is regularly quoted in and contributed articles to several leading publications on various IT management topics. She holds a bachelor of science from the Massachusetts Institute of Technology and a master of science from the University of Southern California.

Bill Moran

Bill Moran leverages his more than 30 years experience in the IT analysis, technical management and technical education to help clients elevate their solution sales discussions out of the technical weeds. Previously Moran held positions as senior vice president and the research operations manager for Ideas International after the acquisition of D.H. Brown Associates, Inc. (DBHA). While at DBHA, Moran managed the analyst team and led the company's consulting business first as Research Director and then as Senior Vice President. Before joining DHBA, Bill was a senior manager at Coopers and Lybrand leading the team who designed and developed the firm's tax and audit software. Before joining Coopers and Lybrand, Bill held numerous management and technical management positions at IBM. He was responsible for IBM's worldwide large systems support for the IBM World Trade Corporation. He also managed international teams delivering educational content (including several IBM-published RedBooks), providing customer support, and participating in benchmark testing for IBM's mainframe systems.