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WHITE PAPER: Infrastructure Services-Oriented Architecture

Delivering on the Promise of Next-Generation IT Application Deployment and Performance

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Executive Summary

IT application deployment technologies are changing at a staggering pace, advancing exponentially with the success of emerging standards and virtualization. At the same time, IT organizations increasingly confront the dual challenges of reducing costs while enhancing the overall business effectiveness of an extended enterprise. Partnering with a managed services provider (MSP) with an established framework and vision for delivering service-oriented IT functionality presents a compelling opportunity to achieve enterprise success in this dynamic environment.

This paper introduces the concept of an Infrastructure Services-Oriented Architecture (ISOA) as a framework for enabling enterprises' current and next-generation application deployment and support, via a managed services provider. As a natural extension of service-oriented IT and related architectural strategies, ISOA presents a meaningful construct to define, design, and organize services that an MSP delivers to support enterprise IT functions ideally suited to outsourcing. Through the use of advanced service provider technologies and highly integrated, process-driven interface portals, the benefits to the enterprise extend well beyond reduced cost structures, providing enhanced application visibility and control to ensure optimized IT performance.

The IT Challenge

Sink or Swim Against a Tidal Wave of Changes and Rising Expectations

CIOs increasingly find themselves front and center to deliver in multiple areas — obliged to align directly with business process imperatives to provide strategic value across the enterprise, reduce cost, increase security, comply with regulatory requirements, and adapt to quickly changing operating environments. The goal is to optimize the business for a competitive edge while adhering to stringent cost management controls and ROI metrics. This is no small task when considering the array of technology, compliance, and budget-cutting forces currently reshaping the IT landscape.

Today's business environment includes a diverse set of applications, operating systems, and platforms, all of which are expected to work together seamlessly to achieve business results, not the least of which includes improving internal process automation and ensuring data integrity. The scale of required systems, demand variability, and constantly evolving technologies — more often for the same business function — have upped the ante on IT responsiveness due to growing systems management complexity, including configuration management, capacity planning, and performance management functions.

Additionally, widely available connectivity and open protocols have unlocked the potential for deploying system development metrics based on application architecture standardization, particularly at higher layers of the application stack. Consequently, applications are becoming decoupled as both static and run-time bindings are established with functions not developed under a common span of control, often defined by standards organizations, further complicating the systems management task.

Tomorrow's business environment is even more challenging. Web 2.0 technologies are empowering communities of web users to co-develop new services and consume vast amounts of user-generated content. Service-oriented architectures are decomposing complex business processes into vast libraries of discrete objects that can be mixed and matched to meet business needs. Application development models are shifting from massive "big bang" approaches to rapid response teams tightly linked with business units. The result is a business model and IT strategy built around continual and rapid change.

With mounting focus on supply chain interaction, the enterprise is becoming increasingly open, connected, and transparent to enable improved inter-partner business processes and customer engagement. As a result of this growing interdependence, application functionality that extends beyond the enterprise firewall becomes susceptible to external events, such as unexpected load increases or decreases due to upstream activity.

In the midst of these dynamics, security and regulatory mandates continue to drive heightened procedural accountability around information protection, financial reporting, and corporate governance. For example, the security and configuration control requirements of the Sarbanes-Oxley Act (SOX), coupled with industry-specific compliance standards, have placed an added burden on enterprise-wide processes, infrastructure and security solutions that will increasingly need to be application-aware.

In short, the manic pace of business change and rapidly developing oversight regulations are directly impacting IT operations from all sides.

Rising to the Occasion

Maximizing IT and Business Alignment for Optimized Services Delivery

In response to this rapidly morphing environment, enterprises are rethinking how they build and support corporate applications to optimize business processes and deliver essential organizational synergies. Compelled to focus on what really matters to the business, CIOs are embracing emerging opportunities to ensure IT organizations satisfy future business demands freed from the impediments of inflexible IT infrastructures.

To illustrate, consider the following defining events that are rewriting the book of IT. The adoption of best-practice standards, such as the Information Technology Infrastructure Library (ITIL), has driven improved overall user satisfaction, regulatory compliance, and organizational responsiveness. Innovative technologies that exploit a high level of functional virtualization and expanding resource capacity are engendering more demand-sensitive application deployment options. Concurrently, many hardware components are being commoditized as the requirements for specific brands and functions are negated by functional standardization and plentiful resources in standard hardware platforms. Finally, new concepts in logical, physical, and deployment architectures for application design are being adopted to hasten development of new system functionality.

Supporting a Dynamic Enterprise with Service-Oriented IT

Further bolstering an enriched IT-business linkage, IT strategies have progressed recently to include adoption of standardized application architectures, such as Service-Oriented Architecture (SOA). Once constrained by a lack of commonality and interoperability in execution environments, SOAs are now producing tangible benefits for application architects thanks to the successful penetration of common network protocols combined with emerging Web Services standards. Indeed, SOA has garnered a great deal of industry buzz in recent years based on its strong potential to drive business process agility and adaptability in the face of continuous change. Simply put, SOA is a conceptual framework or blueprint for the design, deployment, and management of software applications. Realizing the full benefit of this framework requires an infrastructure that delivers real benefits for business process integration, automation, security, flexibility, visibility, and control.

SOA is premised on a modular approach to architecting applications relative to the business processes they support using software chunks or components that are linked through well-defined, open application programming interfaces such as Web Services standards. Fostering horizontal integration of company processes, SOA aspires to break down rigid IT "silos" into loosely coupled, reusable business processes recast as "services". Essentially achieving more with less, SOA accelerates application development cycles by sharing and recycling previously developed services code that is extensible across multiple areas of an enterprise and beyond to its customers, partners, and suppliers. SOA applications are inherently adaptable as well, designed to work with any type of computing platform regardless of the operating system. As a result, companies benefit from enhanced business productivity and process consistency while leveraging existing IT assets to achieve cost efficiencies.

Extending the Value of SOA into the Network

Visualizing service-oriented IT and business process transformation from a network-centric perspective, IP networking solutions provider Cisco introduced its Service-Oriented Network Architecture (SONA) framework in December 2005. SONA essentially provides a roadmap for Cisco's evolving line of products and services focused on delivering the "Intelligent Information Network".

Cisco illustrates SONA in a three-layered design inclusive of all required networked components. A networked infrastructure layer encapsulates all IT resources (network, servers, storage) connected across a converged network foundation. A middle tier, the interactive services layer, enables allocation of resources to applications and business processes via the networked infrastructure. And the applications layer houses business and collaborative applications that draw upon the interactive layer's efficiencies for quick deployment, maximum performance, and reduced integration costs.

Think of SONA as Cisco's vision of a network infrastructure for SOA with a twist, whereby the power of the network enables successful communication between applications, processes, and networked resources. As the SONA moniker implies, the network is at the very core of all IT, binding every aspect of IT infrastructure. SONA, like SOA, relies on technology standardization and virtualization and aims to strengthen the relationship between IT and the business. But by placing the intelligence in the network via the integration of devices, applications, and

services — rather than relying on the software to perform this function — SONA proposes to offer a less complex and more cost-efficient way to design and manage applications. That is, by assigning select IT functions to the network, an IT organization saves money by being able to share resources.

Gaining Muscle, Not Fat

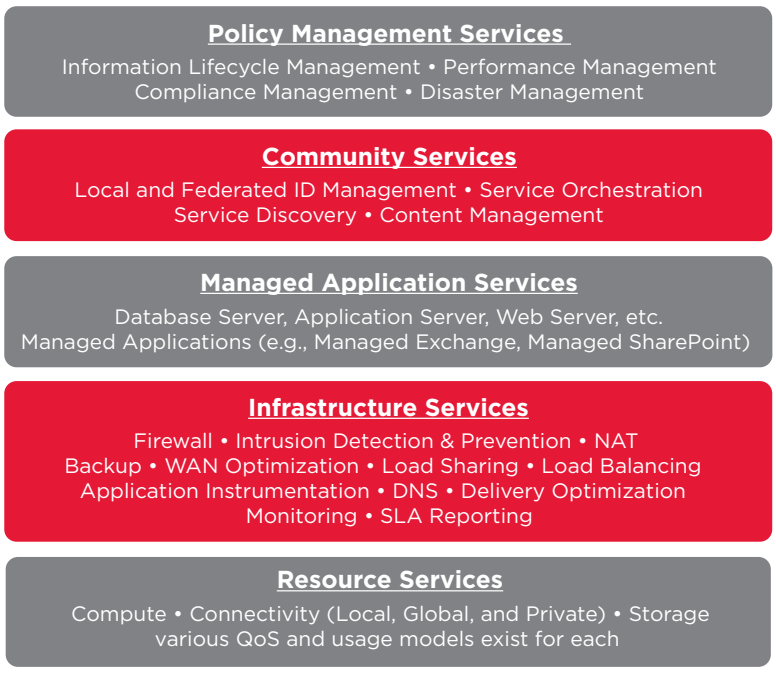
Envisioning Advanced Service Provider Technologies for Next-Generation IT

Considering all the forces and opportunities mobilizing to reshape the IT environment, the successful IT organization will invariably seek out meaningful engagements to not only benefit from, but decouple itself from rapidly changing technology and related support processes; leverage industry benchmark tools and processes; and participate fully in standards-compliant execution environments that simplify inter-organizational processes and increase application security. Visionary managed services providers (MSPs), with proven operations and automated management tools, are best positioned to assist enterprises in all of these areas.

Building upon the foundational principles of service-oriented IT, Savvis introduces the concept of an Infrastructure Services-Oriented Architecture (ISOA) as a reference architecture for current and next-generation applications. More specifically, ISOA is the enterprise prescription for building, deploying, and managing integrated server, storage, and security devices across a fully converged, intelligent network that delivers a responsive, secured, and cost-effective IT infrastructure for running business applications.

As depicted in the illustration below, ISOA is a framework of services designed to enable enterprises to leverage service providers to improve their application performance and business agility.

Infrastructure Services-Oriented Architecture Framework



It is important to note that the ISOA framework is entirely consistent with emerging SOA standards. It does not require fundamentally new application design principles or specifically designed applications to be beneficial, however, applications and infrastructure management processes designed to leverage the services provided in the architecture will derive even greater benefit.

ISOA is optimally viewed as a way to leverage MSP services to gain access to new technologies, best practices, and shared community services to help application managers run their applications better – more economically, more securely, with enhanced end-user performance. At lower levels of the ISOA, resource services can be based on very conventional technologies or leverage new technologies to achieve improved cost and performance. At the highest level of the architecture, management and policy services combine with lower-level services to implement run-time and best-practice policies to optimize application performance, satisfy audit and control requirements, and enforce contractual agreements.

An overview of the functionality present within each ISOA layer is provided here for further illumination.

ISOA — General Architectural Overview
Bearing in mind that architecture is the process of defining components as part of a complex system and their interrelationships, ISOA components are the services that are delivered by an MSP. Their interrelationships are defined by both industry standards and MSP processes, which provide programmatic and business interfaces to the ISOA framework. Organized in layers, the services most fundamentally related to deployment resources — that is, most closely linked to hardware components — are positioned in lower layers, whereas those more closely aligned with business application and business process occupy upper layers. Although higher layers of the architecture functionally depend on lower layers, the opposite does not occur.

An MSP's products, represented as "services" in the architectural diagram, may correspond to individual services or result from combinations of services across multiple layers. For example, conventional server hosting can be seen as a single service within the Resource Services Layer as would a more usage-based server model. Alternatively, a federated identity service would be hosted within lower-layer services and governed by policies established at the highest level.

ISOA — Resource Services Layer
The Resource Services Layer houses all technologies providing basic application resources (e.g., storage and backup storage, computing, and local and global connectivity). Traditionally, application architects have dictated specific vendor components in each category in this layer to ensure application performance. But emerging mature abstractions such as Layer 3 VPNs, virtual machines, storage protocols, and operating systems, have diminished application performance dependence on vendor-specific features in these lower-level components. This serves to open up new feature enhancement opportunities.

In fact, as a consequence of this maturation, virtualization has moved to the forefront in an effort to completely decouple the application from specific hardware components and vendors. Granted, virtualized network interfaces have existed for several years, but virtualized server and storage solutions are now appearing from both hardware and software vendors. While the potential for enterprise benefits is considerable, so are the challenges. As an example, consider that different models for server virtualization are emerging — each of which may play a role in future enterprise application deployments — and that business processes and tools developed to support the combined logical/physical server may not extend to virtual servers.

This architectural diversity in compute technologies, as opposed to simple vendor diversity, likely will further complicate the task for enterprise IT departments relative to lifecycle management processes — all of which will require customization to deal with these new technologies. Given their core competencies, MSPs are favorably positioned to absorb this diversity — deploying new technologies more efficiently, integrating processes related to lifecycle management, and integrating operations with automation support more efficiently than enterprises facing the same tasks. A similar evolution is occurring in all primary resource technologies.

Furthermore, the MSP can incorporate these innovations within service contracts, monitor infrastructure performance against these contracts (see ISOA Infrastructure Services), and initiate performance improvements such as automatically increasing network bandwidth to a poorly performing network path (see ISOA Policy Management Services). In other words, in the process of creating a service/product, the MSP narrows the enterprise's concern to only the important attributes of the resources (abstractions), codifies the expected behavior of the abstraction (Service Level Agreement parameters), and makes automated policy-based responses possible. All combine to improve the end-user application experience. A well-defined approach to infrastructure management, involving both in-band and out-of-band technologies, will be essential for achieving the best results from ISOA.

Looking ahead, it's reasonable to assume that with virtualization developments in the Resource Services Layer — both in technologies and application design such as grid computing — the nature of these services will change substantially and likely involve products most effectively delivered to enterprises by MSPs.

ISOA — Infrastructure Services Layer
Moving into the ISOA Infrastructure Services Layer, we find services to allocate, access, distribute, monitor, and protect services provided by the Resource Services Layer. These managed services are differentiated from resource services in that their administration conforms to a policy. For example, a managed firewall conforms to a security policy. Additionally, they do not involve a primary application resource, such as compute, storage, connectivity, etc.

ISOA — Managed Application Services Layer
The Managed Application Services Layer contains services that allow clients to benefit from MSP management of significant application components — namely managed database servers, application servers, and web servers — as well as complete application management of non-core applications, such as managed

Microsoft Exchange. In this layer, service providers offer best practices and configuration expertise, as well as ongoing configuration management and performance tuning to ensure correct operation of critical, but non-differentiating application components, thus freeing the enterprise from the burden of maintaining deep skills in these areas.

ISOA — Community Services Layer
Services that participate in application run-time functions are present in the ISOA Community Services Layer. These assist with discovery of advertised services by other organizations, connection to services discovered thusly, and representation of authenticated services and individuals to other collaborative service participants (ID federation). Functions here can also include performance enhancement services, such as caching.

Other than optimization services, most of the services in this layer will emerge with the proliferation of SOA-based applications and naturally migrate to MSPs for permanent hosting due to their need to be generally available to other application services. Examples of these services, which are most easily and correctly accomplished by an MSP, include provisioning an application management platform cognizant of all service providers in an orchestrated SOA-based application (i.e., an application consisting of late-bound services from multiple providers, performance data reporting, contract monitoring for contract violations, and problem resolution).[1]

ISOA — Policy Management Services Layer
Services allowing clients to define, monitor, and apply policies to govern the use of underlying services reside in the Policy Management Services Layer. Contract SLA violation reporting, adaptive resource management policies, performance optimization policies, maintenance and operations policies, and security/access policies exemplify the services offered here.

Integration of performance policy definitions with underlying measurement systems enables the creation of Dynamic Policy-Based Infrastructure (DPI) services. DPI establishes a closed loop, fully automated application performance management capability essential in application environments with unpredictable loads and minimum performance requirements. By employing DPI, all of the services in lower levels of the service architecture can be tuned to better satisfy cost and performance requirements.

In this layer as well, the expertise of the service provider can be applied to the definition of policies related to applications and supporting infrastructures. Effective service providers offer codified best practices and designs that leverage their abundant resources to improve data migration and management; system performance; compliance; and problem, availability, and capacity management processes. Execution of these processes through policies ensures the highest level of performance and traceability.

[1]Keller, Alexander, et. al, Managing Dynamic Services: A Contract Based Approach to a Conceptual Architecture, Proceedings of the 8th IEEE/IFIP Network Operations and Management Symposium (NOMS 2002), Florence, Italy, April 2002.

Considering All Options

The MSP Model Comes of Age

In the new world order, enterprise adaptability and agility are vital to competing in today's global marketplace. Within this context, identifying truly strategic IT functions and considering outsourcing for others is clearly gaining wider acceptance. Many organizations have already taken this step in areas such as network management, server and storage hosting, and datacenter management. While savings for these types of arrangements can be largely operational, an additional benefit to the organization arises as development personnel become decoupled from operational responsibilities and, thus, more productive. Unfortunately, today's enterprises are often forced to evaluate these benefits in a tradeoff analysis that contemplates the consequences of a loss of control and the resulting potential for a negative end-user experience. The ensuing decision is often to forgo the benefits offered by an MSP, accepting reduced overall IT organizational performance.

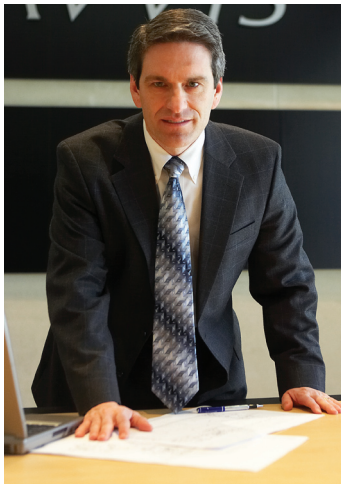
But, in the presence of advanced service provider technologies, as previously discussed, and highly integrated, process-driven interface portals to enable policy-driven service performance, added breadth in the enterprise-MSP relationship is attainable. As such, the enterprise will derive substantial benefits beyond marginal savings, increasing visibility and control of critical infrastructure management. This translates to an explicit win-win for both the enterprise and MSP.

Certainly, in evaluating a full slate of options, enterprises may choose to leverage MSPs to initially supplement internal resources to maintain and scale their application infrastructures. Proceeding down this path allows the enterprise to assess the lower total cost of ownership achieved through partial outsourcing while benefiting from the external technical expertise that can address targeted application and infrastructure performance improvements as needed.

Conclusion

As technologies related to application deployment continue to evolve and leverage the success of virtualization, enterprises are increasingly challenged to stay abreast of opportunities to reduce cost and increase overall business effectiveness. The Infrastructure Services-Oriented Architecture (ISOA) illustrates how a progressive-minded managed services provider integrates a range of services supportive of today's applications while optimally positioning future service development to support emerging SOA-based applications. The ISOA framework is intended to convey how enterprises can both improve their applications management over current internally provided solutions and position their next-generation applications to benefit from emerging standards and technologies without requiring the enterprise to become expert in these non-core areas. Leveraging MSP services to gain access to new technologies, best practices, and shared community services can help application managers run their applications better — more economically, more securely, and with improved end-user performance.

About the Author



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About Savvis

Savvis, Inc. (NASDAQ:SVVS) is an outsourcing provider of managed computing and network infrastructure for IT applications. By outsourcing to Savvis, enterprises can focus on their core business while Savvis ensures the quality of their IT infrastructure. Leading IT organizations around the world have selected Savvis to help them improve their service levels, reduce capital expense and deal with the rising costs of bandwidth, energy, real estate, staff and expertise. As a pioneer in utility computing, Savvis understands and harnesses the latest advances in technology like virtualization, cloud computing and support process automation.

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