

MICROSOFT'S CLOUD COMPUTING INFRASTRUCTURE VISION & APPROACH

1. Cloud Computing – The New Platform For Next Generation Business

There has been a lot of hype in the industry around cloud computing. We're seeing a proliferation of cloud service providers claiming to provide infrastructure, platform and application services consumable via the "cloud".

What does this really mean from an IT perspective? Microsoft believes the industry is going through a significant transformation across the entire stack:

- **Datacenter and Hardware Model** – We're seeing significant advances and standardization in the Datacenter and associated IT equipment/hardware. From large monolithic datacenters that take significant time and cost to build out, various alternative models including containerized and modular/ pre-assembled datacenters are emerging. Hardware is becoming incredibly efficient and delivers large computing power at a fraction of the cost.
- **Application Model** – Cloud computing provides the ability to quickly deliver highly-available, secure and infinitely geo-scalable applications and services while offering a rich end-user experience from anywhere and any device.
- **Operational Model** – Cloud services have inherent resilience to hardware or software failures due to redundant/self-healing service models combined with deep integration between ops & development/ test. These factors make it easy for operations to run & manage cloud apps with 24x7 availability without having to be "lights on" always.

2. Business Benefits Offered By Cloud Computing

Once these cloud driven transformations become mainstream, enterprise IT will experience breakthrough business benefits, many of which Microsoft has been advocating as part of its multi-year "Dynamic IT" vision:

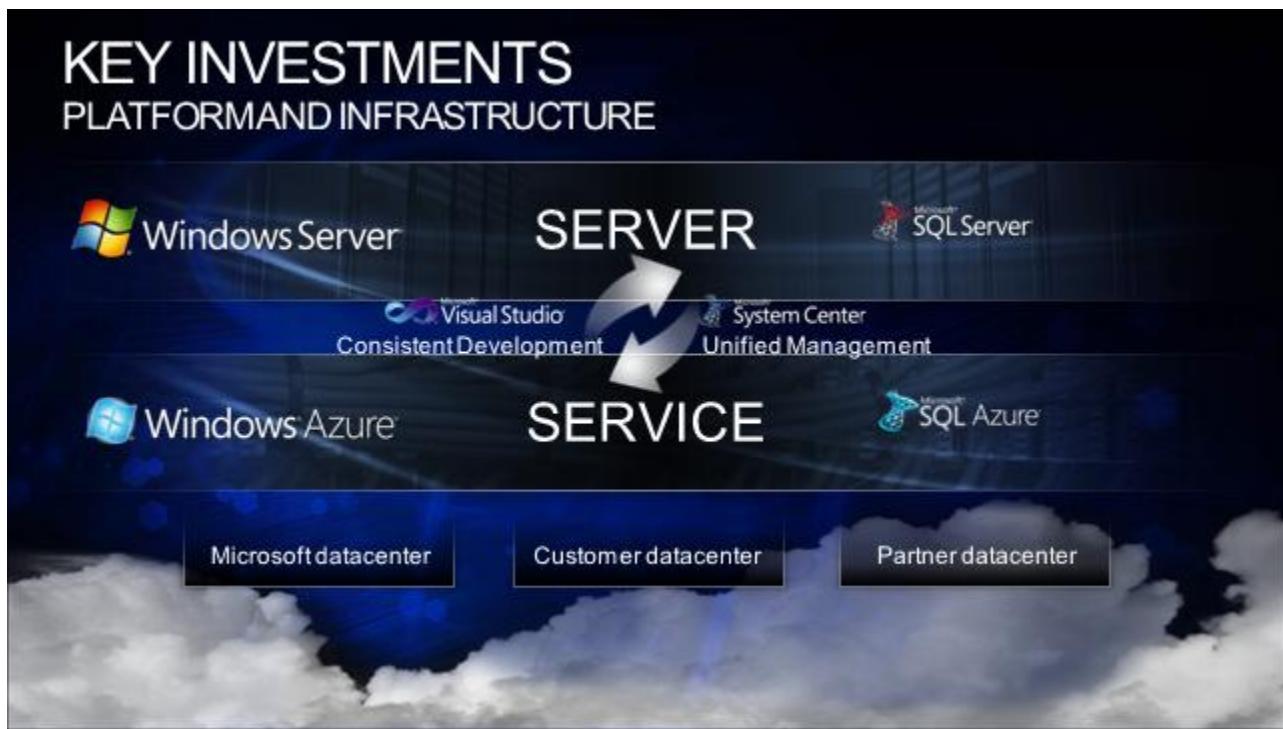
- **Increased business agility** – Applications and services can be delivered to market in an extremely agile manner with the end-user & developer empowerment that cloud computing unleashes.
- **Costs/Operational Efficiencies** – Cloud apps/services will be significantly cheaper and efficient, be it capital expenses (e.g. hardware/datacenter) or operational expenses (e.g. service management).
- **IT Maturity** – Standardization will lead to much greater levels of IT maturity thus transforming the relationship between IT and the business from that of service provider to trusted advisor.

3. Microsoft's Approach To Help Enterprises Realize Cloud Computing Benefits

Microsoft has been providing industry level thought leadership to all of the above (based on running our cloud services out of our datacenters) and is investing in product capabilities so you can derive these benefits within your datacenters in the future.

We will use the following principles in our approach to leading cloud innovation:

- Invest in our entire stack from infrastructure to applications with a *service centric* focus
- Bridge the public & private cloud gap:
 - Ensure applications can run consistently across server and cloud – Provide the same development tools/ technologies for cloud & on-premises environments
 - Providing unified management for apps/workloads across on premises and cloud environments (System Center will manage workloads across on premises and off premises)
 - Enable workload federation to enable hybrid cloud models
- All the above principles will remain true whether it's your assets or if you're working with a service provider (e.g. a Microsoft hosting partner) or deploying to Microsoft's datacenters (e.g. Windows Azure).



Only Microsoft has the developer tools, management, server and cloud assets to achieve the above described consistency between private and public cloud solutions.

4. Private Cloud

There has been a lot of recent excitement around the potential benefits enterprise IT can derive by implementing a private cloud (or internal cloud) within their firewall. To better understand this aspiration, let's look at some characteristics of Microsoft's cloud services (e.g. Windows Azure) that we operate out of our datacenters:

- *Standardization* – Homogeneous infrastructures with vertical integration across server, network, storage and OS. This is achieved by implementing a shared pool of virtualized hardware pools with centralized administrative control over apps/workload additions.
- *Service Focused* – It's all about delivering the application or service that the business demands and not the component services (e.g. infrastructure).
- *Automation* - Significant levels of automation, based on cloud principled philosophies like resiliency, scalability and elasticity.
- *"Lights out" Operations* – Scale through the app design and abstraction from infrastructure.
- *Utilization based chargeback*

We believe there is an opportunity to bring in some of these characteristics and best practices to the enterprise datacenter and enable it with "cloud like" capabilities. Towards that, we're investing in the following software enabled models:

1. ***Standardized, Virtualized Hardware Model*** - Standardize Datacenter infrastructure across compute (server), network, and storage through *Virtualization*. By standardizing, infrastructure resources can be pooled and consumed by any of your apps and services. While Virtualization is a key enabler to hardware abstraction, it alone will not solve the "virtualized silos" problem – we are referring to truly centralized IT resource sharing across business units.
2. ***Virtualized, Abstracted Application Model*** - Most Datacenters have lots of apps and these were written for existing infrastructure. *Application virtualization is a key technology enabler that helps abstract the application model from the underlying infrastructure*. This creates application scale up/scale down flexibility by giving control over how services consume the pooled infrastructure. In addition, the application layer becomes distinct from the infrastructure layer thereby greatly simplifying management.
3. ***Service Centric Operational Model*** – Ability to *compose, deploy and manage* services exactly the way cloud apps are developed and deployed today. Need to have virtualized app/workload and infrastructure images that can be rapidly composed followed by "one click" deployment. End-to-end Service management – e.g. provisioning, monitoring, patching, configuration management, backups/restores - is accomplished with integrated *automation* and *orchestration* between various tasks and IT processes.

Finally, IT organizations will need to ensure their infrastructure management teams have a common view of the services (e.g. via software based service models, standardized service catalogs etc.) they offer their businesses while still retaining control of the resources they own and manage.

5. Evolving Your Datacenters To Derive Cloud Like Benefits Today

Microsoft customers can begin their journey to the private cloud today by deploying the Microsoft products and technologies they know and trust. We have recently made Opalis and Service Manager available as part of System Center to help customers build deeper orchestration and IT process automation for their private cloud environments. As mentioned in earlier sections, Microsoft is fully committed to deliver richer private cloud capabilities mentioned above as part of the Windows Server and System Center roadmaps.

Presently, Microsoft is enabling customers build the foundation for a private cloud infrastructure using the Windows Server and System Center family of products with the Dynamic Datacenter Toolkit (availability currently scheduled for June 2010). This will allow you to further leverage your existing investments in the Microsoft infrastructure platform while maturing your IT capabilities to consume advanced cloud capabilities in the future.

The Dynamic Datacenter Toolkit is a free, partner-extensible solution that will enable datacenters to dynamically pool, allocate, and manage resources to enable Infrastructure as a Service. Whether you're an enterprise customer, a systems integrator, or an independent software vendor, the toolkit will help you create agile, virtualized IT infrastructures and enable business agility, reduced management complexity and operational efficiencies.

Some key Dynamic Datacenter Toolkit capabilities:

- Automation and Guidance - To assess, plan and design your private cloud foundation infrastructure
- Customer/business unit on-boarding - Automated workflows to onboard LOBs to your virtualized shared resource pool
- Dynamic provisioning engine – To rapidly provision virtualized infrastructure in conjunction with System Center and Hyper-V
- Self-Service portal – To empower consumers of IT request infrastructure for their apps/services

Our Systems Integration partners can also offer you guidance on deploying your private cloud infrastructure using the Dynamic Datacenter Toolkit.

For questions or feedback, please write to **Cloud Infrastructure Talk** at cloudinf@microsoft.com.

This document is provided "as-is." Information and views expressed in this document, including URL and other Internet Web site references, may change without notice. You bear the risk of using it.

Some examples depicted herein are provided for illustration only and are fictitious. No real association or connection is intended or should be inferred.

This document does not provide you with any legal rights to any intellectual property in any Microsoft product. This document is confidential and proprietary to Microsoft. It is disclosed and can be used only pursuant to a non-disclosure agreement.