IBM Global Technology Services
Thought leadership white paper

The data center impact of cloud, analytics, mobile, social and security

A mandate for infrastructure agility, dynamic optimization and software defined environments

IBM

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Introduction

The consumerization of IT continues to have a major impact on business. Technology forces have emerged that are challenging organizations' ability to respond. Cloud computing, mobility, social business, big data and analytics and IT security technologies are evolving very rapidly, putting an organization's IT agility, speed and resilience to the test. As these technologies mature and converge, they are demanding a total reexamination of the underlying enterprise infrastructure: its strategy and design, its operation and its management framework.

Individually and collectively, these converging technologies are pushing the data center to operate at a much higher level of integration and efficiency. Thus, they are mandating substantive change. Many organizations have already begun optimizing the enterprise infrastructure: consolidating and virtualizing infrastructure resources, then automating the surrounding processes. But for a business to extract the greatest value from these technologies, the infrastructure must be dynamic and hybrid—able to self-optimize for continuously changing workloads with seamless access to a tightly integrated mix of shared and dedicated resources, on and off premises.

A software defined environment provides the foundation for this extraordinarily adaptive infrastructure—and for the next-generation data center. In this environment, software powers the infrastructure dynamically, using policy-driven automation and real-time analytics to configure the most appropriate resources for the tasks at hand. Server, storage, network and facilities resources work together to optimize utilization and workload performance across platforms and across the enterprise. This provides organizations with the rapid-response agility to assimilate changing requirements and capture business opportunities as they emerge.

This paper explores the infrastructure implications of today's converging technology forces and the software defined environment that is essential to capitalizing on them and to becoming a next-generation data center.

Converging forces and their implications for the enterprise infrastructure

Much has been written about the convergence of cloud computing, mobile, social and analytics technologies. Along with security, these trends are dominating the data center conversation, offering incredible potential for the business, so long as IT can deliver the requisite agile, dynamic infrastructure.

The current reality for most organizations, however, is an IT infrastructure that is very different than that. Complex, fragmented and inflexible, traditional infrastructures can make it difficult to take advantage of new technologies and business opportunities—especially in the cloud era.

Even data centers that have kept pace with current technology standards can fall behind without agile development processes in place to support new business growth. DevOps is a product of this call for more collaborative, streamlined development. Still, few IT teams operate in this kind of environment today.

The changing IT infrastructure conversation

In a 2014 study, IBM surveyed 750 IT executives to learn their thoughts on IT infrastructure. We found that the infrastructure conversation is no longer about managing costs or improving efficiency. On the contrary, today's IT leaders view the infrastructure as a make-or-break determinant of business success.

Seven out of ten executives said the infrastructure is an important enabler for competitive advantage and revenue growth. However, only one in ten believe their IT infrastructure is fully prepared to meet the demands of mobile technology, social media, big data and cloud computing.[1]

All of this has raised new and critical questions about the future of the data center and how best to modernize the IT infrastructure for a rapidly changing world. With agility the new order of business, making the shift to a dynamic, hybrid infrastructure that can automatically scale and adapt is imperative. But how is IT to deliver it? The following sections examine how cloud, mobility, social business, big data analytics and security are forcing substantive infrastructure change on the data center and the IT transformation necessary to deliver on their vast potential.

Cloud computing

Of all the technology forces shaping the data center, none is more defining than cloud computing. Today cloud is a mainstream architecture due in large part to the growing recognition of its role as a powerful business enabler for mobile and social business, analytics and innovation.

As the primary force behind hybrid IT, cloud is having a seismic impact on IT operations. By making infrastructure, platforms and applications available as a service, cloud has forever changed the way IT resources are delivered and consumed. But for clouds to deliver on their full potential, they must achieve the best possible utilization of all available infrastructure resources—processing power, memory, storage and networks. Moreover, the network plays a critical role in how efficiently these resources are connected, utilized and secured.

Shift in infrastructure ownership and capital spending

Cloud has caused a paradigm shift in how organizations perceive data center and infrastructure ownership as processing is increasingly shifted off premises to public and private clouds. On premises, IT leaders are finding that cloud enables them to accomplish a lot more with their current hardware. They are seeing higher density and higher throughput. This allows them to reduce capital spending, stabilizing or reducing the data center footprint with similar or even more compute power.

Growth of systems of engagement

Cloud is accelerating the introduction of customer-focused systems of engagement (collaborative, social and mobile applications) developed on and for the cloud. Cloud provides the hyper-scalability these new systems require while lowering the cost barrier for building and running them. Compared with transactional systems of record (enterprise financial, manufacturing and HR systems) running on mainframes, systems of engagement are less centralized, with some amount of processing or storage handled externally in third-party clouds. These clouds are being built by a variety of vendors using a variety of platforms, increasing the integration and management challenge for IT.

New integration requirements

Whether public or private, on premises or off, cloud infrastructures introduced into the data center must be seamlessly integrated with existing systems and each other. This is the essence of hybrid IT. True hybrid integration enables users to access data from cloud and back-office systems in a cohesive way and move data between these systems effortlessly. For example, customer orders placed using cloud-based mobile ordering systems are seamlessly routed to back-end systems for immediate fulfillment. Integration unlocks the customer order histories trapped in these back-end systems and allows for targeted upselling. Without integration, fulfillment takes longer and costs rise.

The need for integration has led to the development of cloud-based application programming interfaces (APIs). APIs extend the usability of the cloud services by providing ready-made connectors to core infrastructure elements, and a well-managed API strategy is imperative.

Increased need for automation and controls

Cloud deployments require a stronger, more integrated service management approach than traditional management tools and processes (designed for siloed, static physical infrastructures) can provide. Because traditional infrastructures rarely changed, manual processes were sufficient. But the dynamics of today's infrastructures require automation to improve efficiency and simplify compliance with growing service level and regulatory expectations.

Automation and controls must be built in to make the best use of the cloud infrastructure. Standardization is a prerequisite, enabling IT services like provisioning, configuration and management to be automated, with codified policies controlling how, when and by whom they can be carried out. This policy-based automation, written into the software, is the basis for the software defined environment. It provides the governance needed to orchestrate the delivery of cloud services and management across platform and enterprise boundaries.

Mobility and social business

The consumerization of IT that has empowered users and raised their expectations is being driven largely by mobility and social business. IT can no longer dictate which devices or applications employees use or how and when they can use them. The "bring your own device" (BYOD) movement is real. Employee-owned smartphones, tablets and laptops used for both business and personal applications continue to tap into enterprise networks in record numbers. "Gartner estimates that as many as 80 percent of enterprise wireless LANS (WLANS) are not designed to support this oncoming surge in demand, which will cause performance problems."[2] The fact is that many enterprise network designs are still focused on supporting wired desktops, even as their numbers decline. These networks are simply unable to provide the persistent connectivity and scalable bandwidth required by the mobile workforce.

More platforms, devices and data to support

For many organizations, the proliferation of devices and explosive growth of mobile and social applications has outpaced investments in IT infrastructure. Modern infrastructures have to support a wide number of interfaces, platforms and devices to meet user demands for anytime, anywhere access to services and data. But most were designed for a far different pattern of use, when access and read requests were sporadic and initiated primarily in the workplace on known devices by authorized users. Today it is difficult for IT organizations to accurately predict the load they will be faced with or the volume of data that even a single marketing promotion or social media event will produce.

Added strain on the network and data systems

Most social interactions occur in real time and support a wide range of bandwidth-intensive applications and technologies (analytics, wikis, video streaming, social networking and so on). They compound the strain on enterprise network and data systems because they have to share bandwidth with traditional business applications.

The infrastructure has to be able to scale to handle the flood of traffic and data generated during these social exchanges, especially with the Internet of Things on the horizon. Throwing more bandwidth or capacity at the problem is no longer the answer. That can get very costly, and it doesn't really address the need to support different modes of collaboration. To provide truly seamless collaboration for users, the infrastructure has to have the on-demand flexibility and scalability to assemble the information they request in real time. It must also be tuned to deliver performance and security across a wide array of applications and endpoints, including mobile devices.

Cloud has proven to be a viable solution in this regard. It provides the on-demand capability to handle big variations in load and traffic without compromising availability or performance. Cloud allows organizations to support a much larger number of mobile users since data processing and storage are handled outside the mobile device. It provides a security-rich environment for enterprise workloads and information, as well as a scalable platform to speed and safeguard the development of new mobile and social applications.

Desktop virtualization is also being used to address the capacity and security concerns surrounding mobility. It uses virtual images to provide a consistent desktop experience from any mobile device, simplifying user access to enterprise applications while helping to address the security issues associated with BYOD. Virtualization gives IT greater control, allowing increased protection for network and application access, plus fully integrated backup and recovery and the ability to lock down the desktop entirely if the situation warrants.

Greater impact on the user experience

As collaboration expands and data becomes more transparent and vulnerable, mobile security measures become increasingly vital. Policies must be developed for access, monitoring and backup that protect the infrastructure without hampering the usability and performance of mobile devices and collaborative applications. The importance of the user experience and its dependence on the infrastructure cannot be overstated. The quality of that experience is fundamental to adoption of mobile and social technology. The infrastructure must be able to support the volume and velocity of mobile and social transactions or risk losing users to competitors.

Big data and analytics

The torrent of structured and unstructured data pouring into the organization is staggering, doubling in size every two years and projected to reach 44 zettabytes—that's 44 trillion gigabytes—in 2020.[3] For the organization to capitalize on it, the infrastructure has to be able to aggregate, correlate and extract meaningful insights at lightning speeds. Moreover, as information is retained longer, storage requirements escalate. Traditional database management tools and data processing applications simply cannot keep up, much less make sense of it all.

The impact of big data and analytics on modern business and science is well documented. The impact on IT operations and management can be just as dramatic. IT operational analytics are providing IT leaders with real-time visibility and insight into application and system performance, creating an immediate awareness of current and potential disruptions,

inefficiencies and failures. Real-time monitoring, analysis and reporting enable key enterprise personnel to assess entire IT and application stacks at a glance. Administrators no longer have to comb through mountains of data to extract insights or determine the cause of an event. Armed with advanced operational intelligence, IT can make proactive and precise decisions about upgrades, migrations and service levels.

Advent of the Internet of Things

The move to sensor-enable everything is heightening storage, processing and energy concerns. IDC estimates that the Internet of Things (IoT) will connect 32 billion things to the Internet in 2020[4], spinning off sensor-generated data from sources as varied as cars, home appliances, webcams, cooling systems and power generators. This data is already massive and multistructured, and most data centers are unprepared for the onslaught. They lack sufficient bandwidth, disk storage and computing power to meet the demand.

Enormous, multifaceted processing requirements

Simply applying a single big data platform like Hadoop doesn't work. The infrastructure has to be able to leverage multiple platforms for data analysis and connect effectively with data warehouses, data marts, clouds and legacy system databases. It has to be able to pull them all together in a meaningful way. The challenge is integrating all of the IoT data with the organization's other IT investments to do things like customer relationship management and fraud detection.

Real-time analytics require the infrastructure to process data that has been collected and stored (data at rest) as well as data that is streaming (data in motion). Such processing demands highly scalable, high-density servers that are optimized for running massive, parallel, computationally-intensive workloads and algorithms. The best of these supercomputers are tightly integrated, modular rack systems that include clustered compute nodes with hundreds of thousands of processors, energy-efficient cooling technology and massive storage.

More and more organizations are tapping into this supercomputing capability via the cloud to ease pressure on the enterprise infrastructure. Cloud provides a more cost-effective way to achieve near-boundless scalability at the speed required. A cloud-based analytics infrastructure can be provisioned almost immediately with fewer resources than a traditional infrastructure deployment. Developers can create a sandbox environment that is preconfigured, avoiding the provisioning delays that can slow innovation. Plus there are the cost advantages of paying only for the resources actually used and releasing the provisioned environment when it is no longer needed.

Increased pressure on the network

No matter where big data is stored and processed, new demands will be placed on the enterprise network. Gartner cites that "Through 2017, 25 percent of big data implementations will fail to deliver business value resulting from performance problems due to inadequate network infrastructure."[5] Traditional network architectures can quickly become oversubscribed, leading to congestion, decreased throughput and increased latency. Additional network investments are likely to be needed to handle increases in data variety and volume, leverage existing data warehouses and data embedded in legacy systems efficiently, and provide simple and cost-effective access to market feeds and third-party data sets (such as financial and industry data). Network or wire data analytics are one such investment, providing the ability to transform raw, fragmented network feeds into a key source of intelligence for IT operations teams to troubleshoot performance issues and detect anomalous activity.

Added management and data protection challenges

Faced with mounting demands for big data and analytics, many organizations choose to outsource due to a lack of in-house skills and experience. As these skills mature and big data projects move on premises, IT will need to address the additional management challenges. That includes finding a way to effectively manage all of the clustered compute and storage nodes being added to the existing infrastructure, as well as all the provisioning and orchestration across those nodes. Every server, storage and network resource needs to operate under a single management framework so that data can be uniformly accessed and analyzed without having to migrate between systems.

Big data management has to include governance to protect, secure and ensure the quality of information assets throughout their lifecycle. IT must understand the organization's compliance and regulatory obligations and its risk appetite to determine how data can be handled and where it can be stored. Policies must be developed to enable data to be managed and protected across disparate systems. They have to be dynamic, with the ability to adjust quickly as new business requirements and regulations arise.

Big data poses enormous challenges for data protection and resiliency. The sheer volume of data needing to be protected and available is rendering traditional backup and restoration measures inadequate. Strong security measures have to be built in to guard against internal and external threats. A robust disaster recovery capability is needed to support real-time analytics. A data disposal strategy is needed to control the cost, environmental and legal ramifications of maintaining data for long periods of time.

New privacy concerns

With users' personal data—habits, movements, interests and communications—being collected and retained with greater frequency, privacy concerns are heightened. As the demand for analytics increases, organizations that do not incorporate stringent privacy practices into their platforms run the risk of regulatory violations and brand damage.

Security

In a 2013 IDC survey, 44 percent of users cited security, compliance and change control as the primary challenge inhibiting their organizations from meeting data center operational and architectural goals.[6] The era of cloud and hybrid IT focuses the spotlight on security, opening the borders of the enterprise to the outside world. In this environment, organizations have to accept that intruders will continually find new ways to breach their defenses, and the infrastructure has to be hardened accordingly.

As previously discussed, the pervasive use of personal mobile devices and social media in the workplace increases the risks to data privacy and security. More business is being conducted over third-party networks using third-party applications. Gartner estimates that "By 2018, the percentage of off-network corporate data traffic will grow to approximately 25 percent."[7] Moreover, the vast majority of employees will use mobile devices to conduct business.

This kind of mass interconnectivity increases the risk of exposure, especially for businesses that are already compromised by rigid security architectures, manual controls and a multitude of dedicated security appliances. Additionally, as cloud enables more business-critical applications and highly sensitive data to be moved off premises, there are

added concerns about data residency and compliance with an increasingly complex web of policies and regulations including HIPAA. So how does IT enhance the infrastructure to maintain security and confidentiality in a business environment where access and ease of consumption are expected?

Better governance and intelligence

Improved visibility and controls are essential for protecting data, applications and infrastructure. Visibility enables specific threats to be detected and mitigated via in-depth monitoring. Security controls allow action to be taken automatically against emerging threats. A cloud-based security intelligence infrastructure can provide this governance, employing continuous monitoring and real-time analytics to safeguard access and proactively detect and prevent threats. It creates a dynamic security environment that can:

- Manage and monitor user authorizations and activities across the extended enterprise
- Capture event data on a massive scale from many global sources, then correlate, consolidate and contextualize it at unprecedented speeds
- Provide actionable and predictive intelligence to stop threats as they are occurring or before they happen
- Learn new threat patterns and adapt security policies and controls accordingly

These security controls take a more granular approach than in years past. They should incorporate many factors—user device, location and situation context, for example—into the policies that block and allow traffic and user access. They also segment data so users only see what they need to in order to complete a task or request.

Aggregated security services

IT security capabilities like identity management, data loss prevention, and security event and log management are increasingly available as a service via the cloud. The advantage is that they can be delivered dynamically in line with demand. They are scalable and kept up to date, providing consistent protection as the infrastructure grows.

Digital video surveillance and analytics

Securing the infrastructure also means protecting physical assets from theft or damage. Digital video surveillance has accelerated the response to threats captured in video recordings, but it only enables organizations to react to security breaches that have already occurred. When digital video surveillance is combined with advanced video analytics, however, it's possible to prevent breaches proactively. As video images are captured, they are also scanned for specific patterns of threat behavior or specific facial and body characteristics, along with situational intelligence. An individual's movements can be tracked in real time. Forensic feedback is provided in a matter of seconds, using analytics to predict what is likely to happen and allowing action to be taken before it ever does.

The rise of the next-generation data center

To keep pace with the increasing demands of cloud, mobility, social business, analytics and security technologies, and to capitalize on their convergence, the IT infrastructure needs to get a lot simpler. Servers, storage, networks and facilities can no longer be viewed as separate domains, tightly linked to specific applications and managed in silos using primitive automation tools. Clouds can't function as detached entities if they are to operate seamlessly with the rest of the infrastructure. The entire infrastructure, however virtual and distributed it may be, must be able to operate as a single

cohesive system. It must be data-centric instead of application-centric, with databases that serve many applications and allow data to be harvested easily, as needed. These are critical prerequisites for the rapid-response agility demanded of today's hybrid infrastructures. The next-generation data center will tackle them through the implementation of a software defined environment (SDE).

A software defined environment integrates and optimizes the hybrid IT infrastructure with automation and analytics. It shifts control of the infrastructure to the software:

- Orchestrating infrastructure resources in real time, enabling the best cloud and legacy resources to be composed and configured for each new workload
- Allowing spontaneous service requests to be addressed and resource priority to be given to the most important workloads
- Dynamically optimizing utilization across the hybrid infrastructure from a single point of control
- Responding to security threats and making changes to repel or compartmentalize them

Governance is instrumental in this environment, deploying the rules and policies that control resource provisioning, configuration and management based on the organization's requirements for availability, performance, security and cost. Because these policies allow resources to be scheduled and reshuffled on the fly in response to rapidly changing demands, they have to understand system and application dependencies. They also have to have the real-time intelligence to know when, for example, it's okay to take a back-end payroll system offline so that resources can be shifted to order and inventory systems in response to an unforeseen surge in online sales.

Why a software defined environment?

Responsive. **SDE enables real-time response, rapidly and dynamically provisioning the most appropriate infrastructure resources for the tasks at hand, based on established policies and business priorities.**

Adaptive. **SDE adapts for changing conditions, automatically reconfiguring resources to satisfy new workloads and unpredictable demand.**

Simplified. **SDE provides centralized, automated cross-domain management of heterogeneous infrastructures, enabling specialized IT staff to take on more strategic tasks.**

SDE relies on real-time analytics and cognitive computing to provide the intelligence and continuous learning required for good governance. Analytics allow the organization to capitalize on trends as they happen instead of waiting for a report or operator analysis of events. Cognitive computing allows policies to be updated automatically, informed by situational intelligence and new patterns of usage. Such dynamic optimization enables the infrastructure to be improved continuously, able to respond with greater speed and precision.

At its core, SDE is cloud-based, enabling massive scalability and responsiveness. It is built on open standards to facilitate interoperability and centralize management across IT domains, providing visibility into all of the physical and virtual elements of the hybrid infrastructure via a single management platform. It brings distributed data centers closer together, integrating and automating heterogeneous IT systems with a uniform set of tools. It also balances workloads across sites, optimizing performance while eliminating single points of failure.

The shift to SDE is as much a cultural change as a technological one. Instead of working in silos, IT organizations need to re-engineer themselves to work holistically. Those that do will be able to bridge the gap that currently exists between developers and IT operations—the intent of DevOps. This will speed the application development cycle and enable IT to be more responsive to business opportunities.

Transformation strategies for the speed of business

Executing the software defined, next-generation data center vision requires moving the legacy IT infrastructure through phases of consolidation, virtualization, standardization and automation. These changes lay the groundwork for the dynamically optimized infrastructure that is at the heart of the software defined environment. For most organizations, this transformation is already underway, but it can take time to unify and integrate heterogeneous infrastructure elements at the depth required. Few organizations have that kind of time.

There are three ways that organizations can speed and simplify the path to the software defined environment: expert systems, modular services and external sourcing. All enable organizations to start small, deploy quickly and scale as needed to optimize costs and keep up with rapidly evolving business requirements.

Expert systems

Expert systems are packaged hardware systems that come fully integrated, with server, storage, networking and virtualization capabilities under a single management platform. They are designed with built-in cloud management to speed cloud adoption and the integration of hybrid IT environments. What makes them "expert systems" is that they have captured and automated what experts do to provision, configure and manage the infrastructure and applications, and they have codified these "patterns of expertise" in the software to automate the IT operation. They can also learn new patterns of expertise, adapting policies as needed.

Because expert systems are inherently software defined, they provide an infrastructure that is better at anticipating resource needs, responding to change and facilitating new development. Since they come pre-configured and pre-integrated, they are quick to deploy and easy to manage. They can also be customized for specific service level and compliance requirements.

Modular services

Modular services enable organizations to optimize the infrastructure by selecting desired services from an integrated portfolio. Service options are available from online catalogs, with standardized delivery to speed deployment and lower the upfront investment. The services are often configurable and include different tiers of service, allowing organizations to maximize business value on their own terms. IBM Integrated Managed Infrastructure services, for example, offers base-level monitoring, management and reporting services, and optional service packs for advanced capabilities like problem management, identity management and capacity analysis.

Both traditional and cloud infrastructures can be deployed modularly. Instead of having to implement capacity all at once to meet future demand, modular data center design enables organizations to add capacity incrementally. By acquiring infrastructure capacity as it is needed instead of all at once, organizations have recorded 15 to 40 percent savings in capital and operating costs.[8] Modular cloud design operates in a similar fashion, enabling organizations to expand the public or private cloud infrastructure by adding virtual machine modules and service modules for optional capabilities like workload balancing, patch management and data protection.

Prefabricated modular data centers go a step further, providing a turnkey private cloud or traditonal infrastructures in a compact, portable container. They provide complete IT service capabilities and an open architecture, enabling them to be deployed in virtually any location and integrated with existing infrastructure. As the demand for cloud, mobile, social and analytics escalates, these portable data centers offer a rapid, cost-effective way to add high-density, redundant and secure computing power without adding floor space.

External sourcing

In the not-too-distant future, organizations will need to manage their public and private clouds as rigorously as they manage an on-premises data center. Integration is necessary for the uniform management of this hybrid IT environment, for analytics to capture and correlate data from many diverse sources, for seamless connectivity between mobile devices and back-end systems—and the list goes on. But integration is growing increasingly difficult, complicated by rapid advances in technology and the need to accommodate more and more endpoints in the form of applications, APIs, devices and trading partners. And it's just one of several competencies requiring specialized skills and support, often on very short notice.

External sourcing offers a logical solution, allowing organizations to capitalize on the knowledge and technology investments of IT service providers. According to IDC, these providers will become the leading investors in data center technologies, operating more than 25 percent of all data center space in 2016, up from 10 percent in 2013.[9] They will provide the quickest path to expertise and sought-after capabilities in the shortened time frame required.

IBM knows infrastructure matters

IBM has long understood that the enterprise infrastructure is the backbone of a successful business. Today that couldn't be more true. That's why we are re-engineering the infrastructure with the agility, automation and intelligence demanded by a rapidly changing business landscape. This new reality demands an infrastructure that can self-optimize and adapt dynamically to speed innovation and value.

What differentiates IBM's approach is that we design solutions for the whole infrastructure, not individual piece parts. Our software defined environment assesses infrastructure patterns holistically in a way that hasn't been done before, managing the complete data center workload across diverse physical and virtual domains. And we leverage clients' existing infrastructure investment rather than dispensing with it.

Through our comprehensive suite of Infrastructure Services, we are helping clients deploy game-changing systems of engagement, integrate across cloud and non-cloud delivery models, and evolve the IT operation to meet escalating performance and agility demands. Our growing array of private, public and hybrid cloud services—headlined by IBM SoftLayer®—is designed to simplify integration with core enterprise systems, forging a path to a true hybrid IT environment. Our broad expertise and investment in all areas of cloud, mobile, social, analytics and IT security enables clients to assimilate these technologies into their business and also capitalize on their convergence for maximum impact.

In IBM data centers around the world, we offer the highest levels of resource sharing, I/O bandwidth and system availability. We size for peak load, building in enough spare capacity for our clients' volatile workloads while providing a highly available, security-rich processing environment for their business-critical applications. With over 9,000 engagements and 1,500 patents in cloud alone, we are remaking the enterprise IT infrastructure for the cloud era, helping clients unlock the economics and efficiencies for future success.

Conclusion

For the business to fully capitalize on rapidly evolving cloud, mobile, social, analytics and security technologies, the data center has to make the shift to a dynamic, hybrid infrastructure, where public and private clouds operate seamlessly with legacy infrastructure elements and where resources are orchestrated dynamically to address changing workload needs.

Software defined environments are designed for this new era of collaboration and responsiveness, simplifying IT provisioning and management through policy-driven automation, cross-domain integration and continuous optimization. Their ability to sense and respond to workload demands in real time, using analytics and cognitive learning to achieve desired outcomes, provides an ideal foundation for the next-generation data center.

For more information

To learn how IBM is helping organizations transform the infrastructure for a dynamic, hybrid world, please contact your IBM representative or IBM Business Partner, or visit **ibm.com**/services/datacenter

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