

IBM® PureFlex™ System: The Future of Datacenter Management

Summary:

IBM introduced its new IBM® PureFlex™ System as part of its family of “expert integrated systems”. In this paper, we describe the system and the unique management capabilities of the IBM Flex System Manager. IBM’s goals in designing and building these systems were to return agility, efficiency, simplicity and control to data center operations. This paper will help understand how IBM achieves these goals.

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Table of Contents

Introduction – Management Overview	3
The Challenge.....	4
IBM PureFlex™ System: An Expert Integrated System.....	4
The Management Challenge	6
A Dedicated Management Node	6
IBM Flex System Manager	6
Leveraging the IBM Software Portfolio	8
Patterns of Expertise	9
Payoff and Benefits.....	10
Conclusion	12

Introduction – Management Overview

IBM® started talking about a Smarter Planet in 2008. Then, their [definition](#)¹ referred to the explosion in technology-driven instrumentation (expanding data gathering and increasing operational control) accompanying an increase in the interconnectedness of ‘everything’, a direct result of a migration from wired to near ubiquitous wireless networks. IBM predicted ‘intelligence’, derived from the data, would infuse the processes and systems making the world work. They forecast and participated in innovation that redefined whole industries, and IT itself.

In 2011, IBM introduced [Smarter Computing](#)² as IT infrastructure designed for data, tuned to the task and managed in the Cloud. By data, they meant terabytes of increasingly unstructured³ data. By tuned to task, they meant optimized systems exploiting every aspect of the infrastructure and system to improve task (workload, application, service, etc.) performance. By Cloud, they meant abstracting the delivery of computing infrastructure, software and services into a dynamic range of logical (not physical) configurations to optimize performance and utilization. Managing in the Cloud means managing the creation and allocation of assets to assure the availability, capacity and performance, as needed, to meet the evolving computing needs of the business or enterprise.

The result has been an explosion in creativity that extends and accelerates a redefinition, already underway, in the architecture, the structure and the application of the infrastructure of computing. Every aspect from service definition to development to underlying business and operational models are being re-thought and re-configured to put service delivery as the highest priority.

The operation and management of the infrastructure is fundamentally altered. Management is evolving from primarily monitoring and infrastructure availability to pro-actively ensuring the combination of infrastructure, assets and resources and delivering the performance and capacity required to assure the consumer/customer of a service has an exceptional experience.

Smarter Computing led to an upheaval in the business of Information Technology. IT could no longer function as a back-room operation solely bound to infrastructure, focusing on process automation to control costs and using mostly structured data. Traditional operating processes and workflow schedules had to be upended and transformed.

IT had to adapt to operating at the center of core business operations; reshaping itself to act proactively to anticipate and respond to an evolving service demand that is more volatile than predictable. Systems infrastructure management, at all levels, had to change from being process-oriented ensuring infrastructure availability and configuration consistency to being service-delivery oriented.

¹ <http://www.ibm.com/smarterplanet/us/en/overview/ideas/index.html>

² https://www-304.ibm.com/partnerworld/wps/servlet/ContentHandler/pw_sol_sol_smp_smarter_computing_what

³ Unstructured data has no fixed format. It includes data such as conversations, video, free-form text, notes, blogs, .pdf files, pictures, etc. as opposed to structured data which conforms to a pre-defined data model or tabular format such as a database, matrix, data table, etc.

This paper discusses the IBM PureFlex™ System and the IBM Flex System Manager. This newly architected hardware and software system provides more intelligent, powerful and flexible computing. We discuss how this game-changing platform uses built-in expertise and integration by design to simplify the application of technology to address the challenges of an increasingly competitive, complex and dynamic business and IT operating environment.

The Challenge

The proliferation of mobile devices that collect and share volumes of increasingly unstructured data led to an explosion in information. As a result, data and information volumes are exploding from gigabytes to zettabytes. Consuming this information are users tutored by personal experience to expect fast response to demands for new, innovative services delivered with exceptional performance. Companies lose competitive advantage and revenue drops if IT takes too much time to satisfy a service request or develop and deliver new services. Increasing competition meant response cycles had to be cut from months and weeks to hours and days.

The result is a global corporate IT environment of mind-boggling complexity and burdened with severe constraints on budgets and continuing skill shortages. Some 70 percent of the \$2.5 trillion global IT budget is spent just to assure the status quo works – an unsustainable operating model.

Why must it be addressed?

Traditional IT ways of managing system and service optimization were slow and risky. Oriented around manual processes, they are difficult and expensive to program, reconfigure and implement. Alternatives, such as appliance-based solutions – were simple to use as well as fast and easy to deploy, but designed to support a single application with little ability to scale. Clouds are highly flexible and extensible, but with the inherent risk of shared resource dependency.

All these computing models have drawbacks. None could meet the challenge alone. But, neither would they disappear. They were too ingrained and useful to be targeted for a ‘rip ’n replace’ or ‘total refresh’ solution to be reasonable. Anything new had to be able to leverage, integrate and inter- operate with the existing models.

IBM PureFlex™ System: An Expert Integrated System

The IBM PureFlex System™ meets the need and addresses the above challenges. It is designed to simplify data center operations and management while preserving the benefits of all three delivery models.

The system is built around three specific capabilities. These are:

1. Integration by design – a single, ready-to-run system with all pieces of the operating infrastructure deeply integrated and tuned to work together;
2. Built-in expertise – workload-oriented patterns of expertise that automate system operation to optimize agility, simplicity and control;



3. Simplified experience – a collection of processes, procedures and support that makes the IT lifecycle easier with integrated total system management and supported by an open ecosystem of solutions optimized for the platform.

IBM PureFlex system uses both x86 and POWER7 compute nodes. The physical servers can all be of a single type or a mix of server types, with a broad choice of operating systems and hypervisors⁴. It has the flexibility and control of client-tuned systems for optimized infrastructure performance and utilization for specific workloads. It has the appliance benefits of a complete, ready-to-run, and rapid-time-to-value compute environment that is simple to install, implement and operate. It has the agility and elasticity of the Cloud infrastructure to allow rapid adjustment of resources to meet business and operational needs. Finally, the IBM PureFlex System will easily integrate and interoperate with existing infrastructure, thereby preserving that investment value.

PureFlex System includes the IBM Storwize® V7000⁵ storage node able to access and virtualize third-party storage and high availability data recovery (DR) devices. It improves the performance of applications using solid state drives and IBM System Storage® Easy Tier™ technology.

Integrated network resources for IBM PureFlex Systems have been designed to simplify management and assure high performance though optimized, automated, integrated network control and management. Designed to significantly reduce latency, they directly contribute to improved application performance. Network modules are optimized, automated and integrated to provide simple, flexible performance. In keeping with the overall platform design goals, they automatically optimize performance in virtualized and Cloud environments.

Network modules have been optimized to meet current needs yet grow smoothly with service demand. Options include 1Gb, 10 Gb and 40 GB scalable Ethernet Fabric switches, 16Gb, fixed and dynamic port Fibre Channel scalable switches and multiple, high capacity InfiniBand Fourteen Data Rate(FDR) and Quad Data Rate (QDR) switches.

A designed-in ability to automatically adjust capacity and pay-as your grow/go is available with some switch options to maximize overall network investment. Policy-driven automated licensing allows dynamic adjustment with ports- on-demand to expand available bandwidth and number of ports.

Tightly integrated infrastructure management moves the focus from managing individual components (whether network, storage or server) to managing the complete infrastructure to satisfy the business requirements of service delivery. The result is effort directed at optimizing

⁴ Operating systems include IBM i, AIX®, Microsoft Windows®, LINUX from Red Hat and SUSE, as well as hypervisors KVM, PowerVM, VMware and Microsoft HyperV.

⁵ http://www-03.ibm.com/systems/storage/disk/storwize_v7000/index.html

workload performance. This allows for operational environment-aware automated smart placement and provisioning for optimal performance of the workload.

The Management Challenge

IT infrastructure management poses its own set of challenges as software and systems became increasingly integrated, dynamic and complex. Capacity requirements undergo dramatic shifts due to unpredictable demand. The increasing diversity of devices and platforms accessing highly distributed services add to management costs and complexity. Management solutions, separated, uncoordinated and siloed by device or platform is inadequate to the task. Coordination across multiple interfaces is becoming impossibly difficult to effectively, let alone efficiently, deliver.

The architecture and philosophy of management had to be updated and adapted to deal with the new realities. Traditional process-oriented approaches had limited vision. The need was for proactive, intelligent, informed management of a dynamic pool of resources. Management had to exert control with an end-to-end understanding of evolving business and operational conditions affecting service delivery and infrastructure availability. In short, an expert integrated system.

However, such a system dramatically expands the role and range of required management functionality and intelligence. The ability to integrate and automate business and IT processes was now only a small part of the management function.

A Dedicated Management Node

Expert integrated systems with multiple levels of response and action needed to fulfill design goals added to the management challenge. The system needs integrated, end-to-end management of all assets, resources and services to assure it will optimize operations, capacity, availability and performance to meet business and IT needs. The infrastructure systems management had to be able to discover, collect data, analyze and proactively initiate or recommend action. It needed to be able to manage the diverse components and capabilities in an automated, effective and efficient manner.

And, it had to provide straight-forward access to sophisticated management capabilities that functioned reliably and consistently. The user interface had to be easily accessible and simple to keep training costs down and avoid the need for expensive specialists. It must accomplish this and still easily integrate, interface and interact with existing infrastructure. No off-the-shelf product existed able to satisfy all requirements. A new management solution was the answer.

IBM Flex System Manager

IBM applied its decades of experience in building systems management solutions to build IBM Flex System Manager. Over 40 years of platform and virtualization management experience as applied to platforms, networks, virtualization, storage and many other areas are the foundation for the functionality, value and capability of the management node.

IBM Flex System Manager is designed specifically to manage all resources of the IBM PureFlex System from a single management node. It comes pre-loaded and configured with the expertise necessary to manage the diverse assets and capabilities of the system. It is a single point of control maintaining an integrated view of the entire IBM PureFlex System, physical, as well as virtual, including servers, storage and network devices.

IBM Flex System Manager manages the pooling of all resources. Intelligent automation and integrated management capabilities for chassis resources and assets are detailed in the following paragraphs. Management includes application of policies and best practices to assure optimal resource utilization.

It includes extensive built-in data collection and analytics capabilities that works with infrastructure-based patterns of expertise that supply operational insight that simplifies and automates the optimization of resource performance and utilization. It also includes built-in management processes that simplify and automate the handling of routine, repetitive tasks. This includes automated failover and maintenance of backup processes to assure smooth running of all applications running on virtualized infrastructure.

IBM Flex System Manager will auto-discover new and existing components, as well as automatically initiate and perform set-up tasks. As part of this discovery process, IBM Flex System Manager prepares and maintains complete, detailed front, back and chassis map views of each chassis and all physical compute nodes and virtual servers that exist in the rack.

Management and control of the physical and virtualized infrastructure includes initiating the detailed tasks required for full life-cycle management of virtualized devices, including their creation, provisioning, configuration, operation and de-provisioning. It can build and maintain a library of pre-defined virtual devices. This allows fast automated, on-demand adjustments in server, storage and network capacities in response to changing business and operational needs.

The built-in network provides a reliable and secure communications path for management and inter-rack data sharing. Sophisticated network resource management moves the focus from managing the network to managing for the workload. The complete infrastructure is managed to assure maximum workload performance. This allows for operational environment-aware automated smart placement and provisioning of the workload itself. The emphasis is on optimized, automated, integrated network control and management.

The management node acts as a single-point of support across all assets and resources in IBM PureFlex Systems for the complete range of management tasks, including service requests, incident handling and problem resolution. It can handle specialized management tasks in connection with security, performance, resource allocation, application version control, etc.

Using built-in and extendable patterns of expertise along with predictive analytics, IBM Flex System Manager verifies each workload has sufficient resources to meet performance commitments. It performs proactive analysis of both physical and virtual servers to track resource utilization and performance. If it detects a potential problem, either because a physical resource is over-committed, or because a virtual resource is over-loaded, it proactively acts to avoid or minimize the potential impact.

The Flex System Manager initiates action to proactively reallocate resources or move workloads across chassis to assure that the performance and availability commitments of individual workloads are met. It proactively monitors operations to detect deviations from normal operating patterns. Such deviations can be early indicators of problems, such as device failure or over-load that will affect performance. Flex System Manager can alert, initiate action or do both, to avoid a service interruption or workload performance failure.

Working from a built-in store of historical expertise about best practices and optimization techniques represents a significant advance. But change is constant. A management system operating with only its own expertise runs the risk of missing out on advances or increasing knowledge for optimizing operation. Expert integrated systems and the underlying management policies can change. IT staff will constantly monitor applications, workloads and operations to identify ways to improve and optimize them. IBM provides for such best practice changes to policies and practices to be integrated into the system and patterns of expertise as staff increase their familiarity with operating needs and workload characteristics.

IBM Flex System Manager's full integration and interoperation with IBM's extended software portfolio is described in the next section. In addition, it will work and interoperate with the major systems management solutions available on the market today. There is no need to 'rip 'n replace' existing hardware or software assets. The built-in virtualization management integration allows straight-forward consolidation of external storage and networking resources into 'resource pools'.

Leveraging the IBM Software Portfolio

The IBM Flex System Manager management node is further enhanced by its ability to leverage all the capabilities of the extended IBM software portfolio. These capabilities are not only appropriate for clients interested in bringing their new IBM PureFlex System into their existing service management processes, but also for clients interested in extending the service management capabilities for the workloads running on the platform itself.

The service management portfolio of products provided by IBM Tivoli® is fully supported by the IBM PureFlex System. Capabilities like automation, provisioning, storage and security can be completely integrated into a customer's existing process by integrating with the IBM PureFlex System and with the IBM Flex System Manager node. For example, the automation products can help the IBM PureFlex System leverage an existing external monitoring infrastructure and events can be forwarded to an existing IBM Tivoli Netcool®/OMNIBus installation for root-

cause analysis and integration with Service desk ticketing. They will also incorporate workloads running on IBM PureFlex systems into Business Services views that represent the business impacts of IBM PureFlex System-based applications. From a storage perspective, IBM PureFlex System storage can be managed by the on-board Storage Control or integrated into an external [IBM Tivoli Storage Productivity Center](#)⁶ for overall optimization.

The service management capabilities align with IBM's four client initiatives: Consolidate. Optimize. Innovate. Accelerate Cloud. Here are some examples of how this is done:

- 1) Consolidate: [IBM Tivoli Storage Manager](#)⁷ and [IBM SmartCloud Monitoring](#)⁸ ensures resiliency and achieves high levels of virtualization density while managing risk as customers move to IBM PureFlex Systems and seek to reduce costs.
- 2) Optimize: IBM software enables provisioning, comprehensive image management, storage optimization and security for workloads to improve performance and reliability.
- 3) Innovate: IBM provides application level instrumentation, business perspective views, event consolidation and a complete view of the client's storage environment.
- 4) Accelerate Cloud: Leveraging the [IBM SmartCloud Foundation](#)⁹ portfolio, dynamic provisioning, charge-back or show-back, and security for virtualized workloads are all features that help to accelerate cloud deployment and delivery.

Patterns of Expertise

A few words have to be said about patterns of expertise. These built-in patterns are based on decades of IBM's interactions with customers in a wide range of projects. They have been extensively tested in real operating environments. They are derived from proven best practices combined with extensive experience at running complex tasks. Both the basic patterns and complex operational policies can be expanded and tuned by administrators and workload experts.

The three types of patterns of expertise:

1. Application patterns of business application expertise focused on specific workload types, e.g. Web experience, Business Intelligence, Business Application (e.g. SAP), etc.¹⁰
2. Platform patterns that define optimized platforms of various infrastructure and middleware configurations for specific operations, e.g. demand driven elasticity, data mart deployment, transactional database deployment¹¹, etc. These are part of the IBM PureApplication System.

⁶ <http://www-03.ibm.com/systems/storage/software/center/>

⁷ <http://www-01.ibm.com/software/tivoli/products/storage-mgr/>

⁸ <http://www-01.ibm.com/software/tivoli/products/smartcloud-monitoring/>

⁹ <http://www.ibm.com/cloud-computing/us/en/>

¹⁰ Available through the "patterns of expertise" catalog

¹¹ The three mentioned along with simplified system setup and install, web application deployment, policy-based system management and simplified application migration are included with the IBM PureFlex System purchase. Web experience is available through the "patterns of expertise" catalog.

3. Infrastructure patterns (included with the IBM PureFlex System) with expertise applied across computer resources, e.g. optimizing for provisioning and automation tasks, optimizing storage systems, or tuning for scalability and upgradability.

The patterns of expertise available with the PureSystems (PureFlex and PureApplication) will vary. The information in the footnotes (10, 11) is correct at the time of publication.

Payoff and Benefits

IBM PureFlex System platforms and IBM Flex System Manager node have been specifically designed to be operated as an integrated, intelligent system. As one would expect when a design goal is to reduce costs, improve efficiency and simplify the process from acquisition through to operations – significant savings can be realized at multiple levels. There are also the clear advantages for operations to reduce costs and improve efficiency as a result of the automated execution of built-in knowledge to optimize infrastructure performance and utilization.

First are the well-known and frequently reported benefits and problem avoidance that result from automation that eliminates error-prone manual tasks. Automation speeds the completion of repetitive tasks as well as increases the consistency and accuracy at applying policies, best practices and processes for maintenance adjustments, updates, patches, configuration, provisioning, scheduling and placement of services, etc. The result is a dramatic reduction in errors, faster time to problem resolution, device downtime, etc. All this translates to more efficient, cost effective operation as utilization and overall operational efficiency increases. The productivity and, frequently, the job satisfaction of operating staff improve as they are freed from boring and routine tasks to apply their efforts to more interesting, productive and creative tasks. All these also contribute to an improved customer experience and, hence, their satisfaction. All of these results will contribute toward building service differentiators and help to strengthen any competitive advantage.

Other benefits resulting from the IBM Flex System Manager include:

1. Resource pooling with integrated management that monitors and controls all virtual resources within and across chassis and racks means workload placement and resource utilization is optimized for top performance.
2. Built-in intelligent management of virtualized infrastructure (servers, storage, networks and applications) assures optimal utilization of assets and minimizes service disruptions and outages due to overloaded assets and resources.
3. Automating configuration management for networks and servers reduces the time to provision, configure and deploy assets to adapt to changing environment conditions and shifting business priorities.
4. Automated population and maintenance of a library of virtualized assets will further cut time to respond when additional capacity is needed to meet demand and balance workloads.

The net effect is to help achieve the optimal utilization of existing assets. This improves the management of capital expenditures by minimizing over-provisioning and lowering the risk of under-utilization. Optimal utilization of assets helps to determine when to purchase additional or upgraded infrastructure. This is best done when driven by real operational need and not motivated by fears of under-capacity. The result is better control of the cost and timing of acquisition, as well as overall operations and maintenance.

Integrated, within and cross-chassis management assures optimal resource utilization, consolidation and setup into efficient rack configurations supporting a heterogeneous collection of operating environments and hypervisors.

IBM Flex System Manager monitors all virtualized and physical resources. It automatically checks and will proactively implement load-relocation and balancing to prevent over-commitment of resources to avoid the threat of performance problems and SLA violations. This minimizes service disruptions and prevents customers from suffering with response problems.

The server (physical and virtual) on which a workload or service runs becomes a business decision based on the priorities and needs of the business and the service, not simply based on the available infrastructure. This puts business and workload needs in charge of asset allocation. The result is that IT staff has more visibility into the relationship between what they do and the success of the business. They can become more sensitive and responsive to the needs of business operation. They can see the impact not only of their day-to-day activities, but also can recognize the potential contribution of IT to business success.

The IBM PureFlex Systems design reduces costs and increases operational productivity in multiple ways. For example, installing and integrating management contributes to Day 1 availability as the ready-to-run system speeds time to value. Integration by design with built-in expertise dramatically cuts installation and implementation time from days to hours.

Consolidating management and administration tasks into a single, consistent interface while automating many task processes across x86 and POWER7 compute nodes simplifies the job of administrators to manage and configure servers, storage, network and other resources. Whole rack management of energy, cooling, etc. reduces cost, cuts downtime while the systems operate at higher performance levels and are more consistent in operation. The single interface eliminates the need to have different administrative support and skills for each platform, thus reducing training costs.

Managing with a complete end-to-end view of the infrastructure and across the complete life-cycle of the virtualized devices lowers the costs of hardware, as well as costs associated with commissioning/decommissioning those devices as it increases infrastructure utilization.

Management of consolidated servers using IBM Flex System Manager in a single, integrated chassis with shared access to power and networks simplifies intelligent control and management to optimize the system's power, cooling and energy requirements. The integrated chassis with built-in storage, network and servers reduces wiring and maintenance complexity while minimizing the required floor space. All combine to contribute to significantly reducing operational and maintenance costs.

Conclusion

With the announcement of IBM PureFlex Systems and IBM Flex System Manager, IBM provides the industry with a totally new category of computing. The 'Expert Integrated System' delivers a combination of hardware, software and built-in expertise that makes implementing and applying the power of computing simpler, easier, faster and more effective than ever before. And, it does all this while preserving the investment in existing hardware and software infrastructure with its extensive capabilities for integration and interoperation with computer, storage and network devices.

The design goals of this new system were many. IBM wanted to reduce the time it took to start getting value from their purchase, i.e. increase agility. It was to reduce costs by getting the maximum from available resources, i.e. increase efficiency in operations and acquisition. It included a desire to simplify all aspects of acquisition, implementation, operation and management, i.e. reduce the skill level needed to operate the data center effectively. And finally, they were designed to reduce the errors in all aspects of computing and thereby lower operational risk, i.e. restore control in data center operations. It appears to us that IBM has made exceptional progress toward achieving these goals with IBM Flex System Manager.

This new generation of systems provides easier access to the power of heterogeneous computing. IBM Flex System Manager simplifies management, facilitates faster implementation, reconfiguration and provisioning management of server, storage and network resources. And, it does this without forcing an infrastructure 'refresh' or 'rip 'n' replace of existing data center resources.

The introduction of IBM Flex System Manager and IBM PureFlex System establishes them as the leader in defining new ways for customers and partners to realize more benefit at lower cost from the data center. They redefine IT's role away from focusing on the idiosyncrasies of the physical infrastructure to being focused on how to create new services and squeeze value from that infrastructure.

IBM is providing solutions to IT and organizational (typically business) problems, not arguing the fine points of one server over another. The point is to get the best out of the infrastructure to address problems and create services. They do this by intelligently automating and consolidating operations, management and maintenance functions where it makes sense and is possible today.

Finally, with IBM Flex System Manager and the patterns of expertise, existing IT staff benefit from an enhanced ability to leverage an enormous base of expertise in applying computers to the solution of a broad range of problem patterns in applications, infrastructure and platforms. The heritage and ingenuity embedded in IBM PureFlex Systems is purposely not static; it will continue to grow and extend beyond current capabilities with contributions and enhancement made by both the consumer's IT staff and IBM.

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