

Virtual SMB Data Center in a Box?

What types of organizations have the most efficient IT operations? Data centers that provide highly available and resilient services with a minimum of human intervention and management? IT shops that can deploy new applications quickly and scale existing workloads to handle unpredictable demand spikes? And, just as importantly, which shops can do all of the above while controlling personnel and facilities costs and not spending the overall organization into oblivion?

Most readers would associate these attributes with large enterprise data centers that have the scale (read: budget dollars) to pay for the best equipment, the most comprehensive IT management infrastructure, and regiments of highly-trained IT specialists. Until fairly recently, SMBs (Small- and Medium-sized Businesses, generally under 1,000 employees) were relegated – mostly by a budget and skills gap – to putting together piecemeal IT infrastructures that were, in many cases, held together with a creaky combination of miles of Cat5 cable and hope. That was good enough to provide basic connectivity, transaction support, and records storage, but SMB technology needs are changing radically. SMB value propositions and competitive advantages are now built on technology foundations, and the use of technology is one of the main weapons SMBs can deploy to level the playing field against larger, more entrenched competitors. In fact, SMBs now have the same problem as the ‘big guys’: how to build an IT infrastructure that’s efficient, scalable, nimble, secure, and highly available. And, oh yes, to do it on an equipment/maintenance/staff budget that won’t break the bank.

The IT market is responding to these needs, and it’s getting easier to be a technically solid SMB. Three broad trends have come together to make large enterprise-quality technology accessible to even the smallest organizations.

Trend #1: Processor & Software Wars

As Intel and AMD race to provide higher-performing processors at lower prices, the real beneficiary is the customer. Today’s quad-core chips provide more than double the performance of processors from just a few years ago at comparable per-processor cost. These processors also generate less heat and take much less power to operate. This isn’t just a good thing because it saves electricity; it also enables system vendors to package dense systems that are, in many cases, less expensive to manufacture and are certainly less expensive for customers in terms of the floor space needed to house them.



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Just as AMD's introduction of 64-bit processors (and then dual-core processors) shocked Intel into a flurry of innovation, the advent of Linux as a viable operating environment has done the same thing for (or to) Microsoft – and, by extension, the entire x86 enterprise computing market. Back in the early 90s, x86 systems were, at best, edge systems (or 'toys', according to Unix/mainframe folks). Things have changed considerably in the intervening years. The competition between Microsoft and Linux has advanced the technical quality of both products considerably – to the point where almost every enterprise software package of note is available on both platforms. In fact, many major ISVs do their development work on Linux platforms and then port the code over to Windows and then to various Unix flavors.

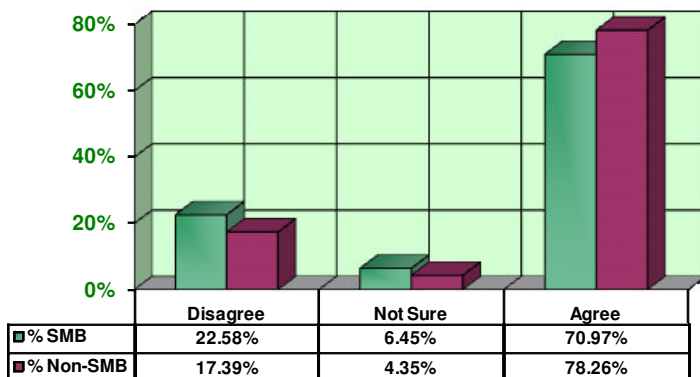
Trend #2: The Virtualization Revolution

The advent of virtualization is also having an enormous impact on the industry as a whole. Virtualization has long been used in the mainframe and proprietary large system world as a safe and reliable method of improving IT efficiency. The big news now is that x86 server virtualization technology is ready for prime time, and the benefits of implementing it are profound – particularly in the x86 Windows/Linux world.

In the traditional x86 usage model, still in use in many data centers, the vast majority of x86 servers run only a single workload. Adding a single new application spawns the need for several more servers: one for production, another for testing, another for failover, and maybe still another for development. If you need to scale the applications to handle more demand, you either purchase a bigger system (to scale vertically), or several small systems (to scale horizontally). The systems are relatively inexpensive, compared to their Unix-based cousins, so it's not a big deal to just buy more of them....which works to a point. However, the traditional model falls apart when you realize that the utilization rate of an average x86 server is only about 6%. In other words, 94% of the time, the average x86 server is just idling – taking up floor space, using electricity, and needing the same amount of attention (read: money) for maintenance, administration, and security as any other system.

This outdated and hideously expensive scenario represented a huge opportunity for any company that could change the economics of the x86 server game. VMware was the first company to offer truly sophisticated x86 virtualization, giving customers the ability to run multiple Windows and Linux workloads on single servers without compromising availability or security. They were one of the first to enter the market and are still the undisputed leader in terms of product range, sophistication and market share – despite well-publicized competition from a host of other vendors.

"We are virtualizing our x86 servers"

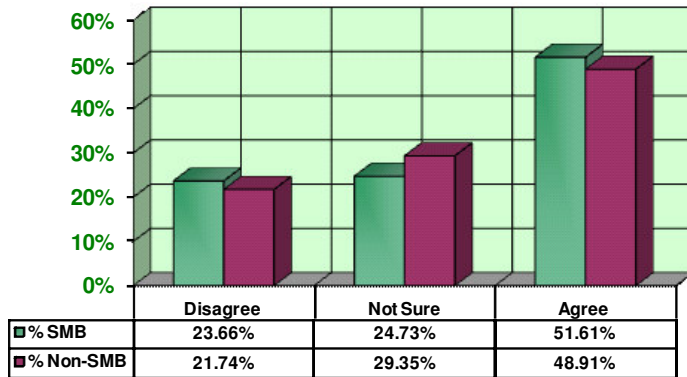


But is virtualization technology something that makes sense for an SMB? More to the point, are SMBs actually using virtualization? Conventional wisdom is that virtualization is mainly taking place in larger enterprise data centers. In one of our recent data center surveys, we asked a number of questions covering virtualization and then analyzed the results by organization size. As can be seen on the chart, fully 70% of SMB

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respondents are implementing x86 virtualization to at least some extent. This compares very favorably to the 80% of enterprise customers who said the same thing. It's interesting to look at the negatives on this question; only 23% of SMBs have no virtualization plans, compared with 17% of larger enterprise respondents.

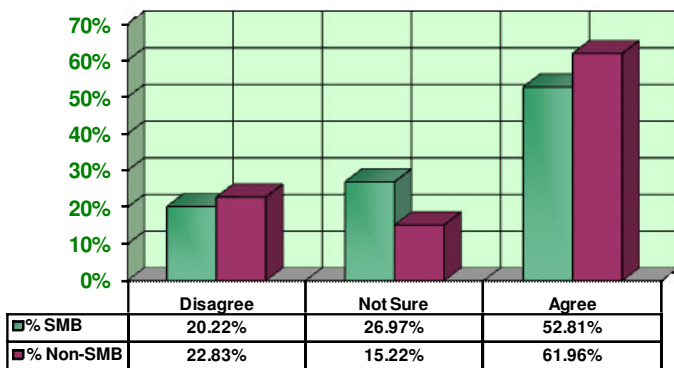
"Virtualized x86 will become the dominant x86 usage model in our organization..."



respondents believe that x86 virtualization won't be their corporate standard. It is obvious to us that virtualization is firmly entrenched in data centers large and small, and that the trend will only grow from here – particularly in the SMB IT shop.

Perhaps the most interesting point along these lines is to look at how SMBs and enterprise IT personnel view the future of x86 virtualization in their organizations. We asked exactly that question in our survey and weren't surprised to see that about half of the respondents believe that virtualization will be the dominant usage model in their organization. The surprise came when we compared organization sizes; SMBs are in the forefront of customers who see virtualization becoming their standard operating procedure. It is also interesting to note that only about 20% of our survey

"x86 Virtualization saves us money..."



Customers are embracing x86 virtualization for many reasons, some of which we've already touched on in this report. We have data showing that customers using virtualization find it easier to do capacity planning and hit service level requirements.

But the real driver behind virtualization adoption, in our mind at least, is the impact on costs. As can be seen on the chart at left, the majority of customers we surveyed believe that virtualization is saving them significant money. Only a small minority (~20%) see virtualization

as having no beneficial impact on the bottom line. This is impressive when you consider that virtualization for x86 systems is still relatively new to most organizations.

The fundamental benefit from VMware's virtualization products is the ability they give customers to consolidate 5, 10, or 50 workloads onto a single server, depending on the applications and usage characteristics. They can easily push server utilization rates from mid-single digits to 50% or more, resulting in a huge savings on hardware purchases alone. Rolling out new applications is also a much quicker process using virtualization. A new virtual machine can be fully provisioned in minutes, while the alternative – purchasing, installing, and provisioning a new physical server – can take days or weeks.

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VMware makes it easy to assign system resources to a particular workload to ensure it has enough capacity to handle business needs. It can reassign resources to handle workload spikes, giving a particular application more processors or I/O on a temporary basis to cover higher usage – without operator intervention or interrupting other workloads on the physical system. VMware ESX with VMotion can even move entire running applications from one physical server to another – again, without human intervention or inconvenient reboots. This feature is most commonly used to take workloads off of a system so it can be taken down for maintenance purposes, or to move applications that need more hardware resource to larger systems.

Virtualization can also help increase application and system availability – a vital concern to any SMB contemplating a move to a modern infrastructure. VMware has enhanced VMotion to give customers true fault tolerance – a capability that simply wasn't available to the average SMB customer before now, unless they wanted to part with a large chunk of money. Briefly, VMware Site Recovery Manager uses VMotion to keep two systems exactly in synch; if one fails, then the other system automatically picks up the load. This is much like traditional clustering, but significantly less expensive to implement and far easier to manage and configure.

More and more customers are using VMware Infrastructure software with VMotion to minimize the power and cooling load in their data centers. Even at idle, systems use as much as 40% of their total potential energy draw. It takes a lot of power to make the fans and disk drives spin, fire up the power supply, and run volts through all of the memory, processors, and interconnects. When systems run more applications, the power needed for each app is quite a bit lower than what would be needed if the workloads were all on separate systems.

With VMware's Distributed Power Manager, customers can have workloads sitting on lightly used systems dynamically relocated to more fully load up other systems or racks. The process only takes seconds to execute and is fully scriptable; the unneeded systems are then powered down completely. When user demand rises again, the process can be reversed to ensure that Service Level Agreements are met.

In our view, virtualization is the first step a customer should take to reduce their IT facility demands. When we talk to clients about 'greening' up their data centers, our advice is that implementing virtualization is the quickest and easiest way to increase energy efficiency; it provides a much higher ROI than any other alternative. The benefits in terms of real estate usage are much more obvious – reducing server count by a factor of five or ten frees up considerable floor space.

As we mentioned above, VMware is the king of the hill in terms of x86 virtualization with somewhere around 75% market share. This isn't necessarily because they were the first to introduce a commercial product, and it certainly isn't because their products are the cheapest. We believe that they've maintained – and increased – their lead by continuing to push the boundaries of virtualization technology. VMware has added more capabilities and made their products more technically sophisticated, yet at the same time made them easier to implement and manage.

Trend #3: Blade Servers

None of the advances in system, software, and virtualization technology do SMBs any good if the hardware that offers solid performance, reasonable scale, and enterprise-level availability is priced out of reach. Mainframes, for example, provide high levels of performance and

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availability plus great virtualization – but their high purchase price and hefty software costs, along with the specialized expertise necessary for operating these complex systems, make them non-starters for the vast majority of SMB customers.

Blade servers are a different approach to the problems faced by SMBs. Since their introduction in the early 2000s, blades have sparked a competition between the major server vendors to increase sophistication, reduce complexity, and provide performance, availability, and scale at a price that is affordable for small and large enterprises alike.

While each vendor has a different blade implementation, here are the basics. There are two parts to a blade system: the chassis and the blade servers themselves. The chassis is the enclosure that provides the infrastructure needed for the blade servers. The chassis contains the power supply/supplies and fans for cooling; most include an interconnect that gives each blade connectivity with chassis resources and other blade servers. Individual blade servers can be configured as single, dual, or in some cases, even 4-socket systems with memory, local disk, and a wide variety of storage and network options.

The efficiency advantages of the blade approach are fairly obvious. With the predecessor rack-mount systems ('pizza box servers'), each system is self-contained with its own power supply (or redundant power supplies), cooling equipment, storage, and network I/O cards. With blades, all of these components are contained in the chassis and used by all blades. This makes the cost of individual blades less expensive than a comparable rack-mount system, although the balance swings back in favor of rack-mount systems when the cost of the blade chassis is included in the analysis. However, when a customer looks at purchasing two or three blades (including a new chassis), the blade system is often less expensive than the equivalent number of rack-mount systems and commensurate surrounding components.

Blade systems can free SMBs from the typical hodgepodge mix of systems, each with its own idiosyncrasies, management tools, and configuration issues. A great example of a blade system that has been designed from the ground up to meet SMB requirements is IBM's BladeCenter S.

It's a fully integrated system – meaning that it contains servers, storage, and networking infrastructure – all in a standard chassis that can run on standard office current (single phase 110v). For the SMB, the BladeCenter S is an entire IT infrastructure in a single, pre-integrated box.

The innovation begins at the chassis. While some vendors have integrated blade storage by offering individual storage blades, IBM went a different, and probably better, route. With BladeCenter S, the storage array is integrated into the chassis, offering, in a RAID configuration, up to 3.6 TB of usable SAS storage in a SAN (Storage Area Network) supporting VMotion, or 12 TB of SATA capacity. Because the storage is integrated into the chassis, each blade has fast access – a full 3 Gb/sec – to the storage array. Also, the SAN gives customers the ability to use the full suite of VMware VMotion and virtualization management capabilities – something that customers using direct attached storage can't take advantage of.

The BladeCenter S chassis has many of the same availability innovations that are found on much more expensive systems. Redundancy is the name of the game: the chassis is able to hold four power supplies, which means that even if two go down, the system will continue to operate. Extra fan packs can also be installed to ensure that the system is adequately cooled at all times.

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The chassis has redundant storage controllers, ensuring that the system will still operate (although with degraded performance) in the event of a failure. The chassis also provides redundant network paths, so a network adapter failure won't result in downtime.

BladeCenter S: Storage Advantage

Using SAS storage, it provides 3x faster throughput when compared to competitive systems that rely on iSCSI disk.

3.6 TB total raw capacity SAN (12 x 300GB) is much larger than the 876 GB (6 x 146GB) offered by competitive systems.

BladeCenter S provides considerable configuration flexibility. First, any x86 blade that IBM offers will fit into the S chassis. This means that customers can mix and match blades featuring the latest Intel or AMD dual- or quad-core processors. IBM's blade menu offers single, dual, or even quad-socket flavors. One of the advantages to the blade concept, particularly as implemented by IBM, is that it is future-proof. IBM has a long track record of maintaining a single blade standard, meaning that past, current, and future blades all fit into IBM's BladeCenter chassis. Other vendors have changed their blade chassis design (some more than once), negating much of the value of the blade form factor and significant customer investments at the same time.

Customers can pack quite a bit of performance into this small package. With the fastest quad-core processors, six blades could provide 12 total processors (48 cores) running at 3.33GHz, with 576GB of system memory. This configuration is with IBM's HS22 blade, a new blade option that provides more memory than its predecessor. While the HS22 delivers in terms of processing capacity, most customers hit the wall on memory well before they hit CPU constraints, making this new blade a welcome addition to the IBM product line. Virtualized systems are memory hungry – the more memory on a system, the more virtual machines that can be supported. As a general rule of thumb, most applications will need 1-2 GB of memory for each partition. Customers often find that their virtualization options – and benefits as well – are limited by systems that can't be configured with enough memory to handle the load.

With the HS22 blade, customers have plenty of headroom and the ability to run a large number of virtual machines. How many, of course, depends on the actual applications and usage characteristics. However, conservatively estimating that each virtual machine needs 3GB of memory leads to the conclusion that the BladeCenter S could support somewhere around 30 applications per blade – or 150 workloads on a moderately configured 5-blade system. For most SMBs, two or three virtualized blades would probably accommodate most of their existing workloads. The extra capacity that can be gained by adding up to six blades total should be enough headroom for even the fastest growing small business.

IBM's system is priced to fit the SMB budget. The list price for the chassis starts at around \$2,500 and rises according to how it is configured with I/O (switches, adapters, etc.), storage, and power supplies. Prices for individual blades start at less than \$1,000. The list price of the HS22 runs from around \$2,100 to \$4,900, depending on the number and speed of each processor and the memory configuration. While it's hard to do direct comparisons – list prices don't mean all that much in this industry – we find that the crossover point between BladeCenter S and traditional rack-mounted servers is somewhere around three blades, or half the total capacity of the BladeCenter S. At first glance, rack-mounted systems look to be much less expensive, and they don't require the purchase of a chassis component. But this is deceptive.

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Rack-mount servers require quite a few additional components – including, for example, an entire SAN RAID array with redundant controllers – to give them the same storage, connectivity, availability, and performance capabilities of a BladeCenter S system. When you configure in these supplementary but necessary components, the price tag increases very quickly.

Implementing & Managing the Virtual SMB

One of the big challenges for the small data center – whether it's on a raised floor, in an empty office, or tucked away in a closet – is handling the ever-increasing complexity of modern IT. Small organizations have the same information technology needs as larger firms but fewer resources for getting the job done. IT staffing is a major hurdle for most SMBs. They don't have the headcount budget to hire specialists; thus their technical folks tend to wear a lot of different hats, ranging from desktop support and administration to, in many cases, acting as the defacto CIO. Given the demands on their time and their generalist nature, it's often difficult for them to evaluate and document the business value arising from new solutions such as the 'data center in a box' concept we're discussing in this research report. While this move looks good on paper, every organization is unique, and the ROI will vary considerably from firm to firm. So it's important for companies to evaluate the potential move to blades and virtualization carefully in order to ensure that the cost savings and operational benefits are high enough to justify the investment – a task that many thinly-staffed SMBs are ill-prepared to do on their own.

But there's plenty of help out there. Both IBM and VMware, for instance, offer TCO (Total Cost of Ownership) evaluation tools that will help organizations understand how virtualizing on blade servers will impact overall costs, including hardware and software outlays, along with data center facilities cost savings achieved by eliminating a large portion of the existing base of physical servers. These tools also attempt to quantify the value of additional IT flexibility – the ability to easily add new virtual systems without having to add physical assets.

A 'background' note – IBM and VMware have a long-standing partnership dating back to early 2002. The companies jointly collaborate on innovation, development, and solution delivery activities. It is an interesting combination. IBM has been doing virtualization since the 1960s on their mainframe products, while VMware is the acknowledged expert on virtualizing x86 operating systems and applications. Together, they represent the widest and deepest source not only for virtualization technology, but also for the necessary system, application, and enterprise management solutions that enable customers to get the most out of the virtualized system usage model.

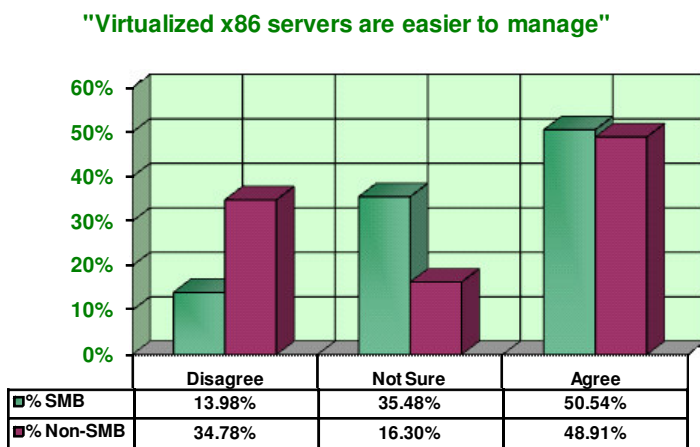
The two companies, with assistance from Intel, have also developed a set of virtualization sizing guides that help customers solve the sometimes tricky task of selecting what to consolidate, where to put it, and how to configure their systems. IBM is also offering innovative financing programs that allow customers to tailor a custom package to fit their unique needs.

On the implementation side, both IBM and VMware have made it much easier to get the new systems up and running. Every BladeCenter S system includes IBM's Start Now Advisor, a DVD that walks customers through all of the tasks necessary to set up the system. It's very comprehensive, beginning with instructions on how to unpack and cable the system, and then advancing through more complex topics. When the system is powered up, Start Now will automatically discover the system configuration, set up network and storage paths, and even

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lead customers through the process of setting up administrative accounts and passwords. Because the BladeCenter S is a completely integrated system, Start Now Advisor has the ability to automate a far greater number of set-up tasks than, for example, a traditional rack-mount or tower server.

Once the system is configured and running, it's time to begin the virtualization process. While VMware offers a dizzying array of tools and packages geared to virtualize and manage almost any size environment, they have assembled a special suite of products that are specifically designed for the SMB customer. Every package includes the basics necessary to move workloads running on discrete physical servers over to virtual machine partitions running on single systems. The process is quick and painless in the vast majority of cases – often to the surprise of administrators anticipating a tension-filled migration.



Managing the resulting virtualized infrastructure is also highly automated. In our recent IT personnel surveys, a solid majority of SMB administrators said that virtualized systems are easier to manage. They also said that virtualization makes it easier for them to hit their service level goals – mainly due to the way the management tools monitor system usage and alert administrators to capacity problems well before they become critical. VMware's vCenter management suite includes tools that monitor and manage virtual machine

instances on multiple physical servers. In addition to the basics of launching, configuring, and provisioning new virtual systems, it also includes centralized backup management, patch management, and capacity planning.

The main difference between the various VMware packages, aside from the price, is the inclusion of VMotion and Storage VMotion. There is a considerable price premium for these features – one that might prompt sticker shock in some SMB organizations. However, we believe that customers should take a hard look at these features before making a decision to utilize the lower-end packages. If the goal is to truly have an enterprise-class IT infrastructure, then the VMotion features (and the associated accessories) become critically important.

It is these mechanisms that allow administrators to move running applications between physical systems without user interruption or system reboots. This will radically reduce both planned and unplanned downtime and provide the ability to configure true fault tolerance for the most important applications. Being able to quickly and easily move applications between systems also gives administrators much more flexibility in terms of where they can host particular applications; this will result in higher overall consolidation ratios. As one data center manager said to us, "VMware without VMotion got us moving in the right direction, but adding VMotion is what really made the difference in terms of overall value. It was kind of difficult initially to justify the price, but after trying it on one system, we quickly found that it more than paid its way."

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Enterprise IT Capability @ SMB Prices

When taken together, the combination of VMware virtualization and IBM's BladeCenter S gives SMB customers an IT infrastructure that begins to look a lot like an enterprise data center. They have the ability to quickly deploy, manage, and monitor large numbers of workloads with VMware. These workloads are hosted on a highly sophisticated platform that is fully integrated – containing server hardware, a SAN storage array, and network infrastructure in a single, very small footprint. With virtualization, a large system can host hundreds of applications simultaneously, facilitated by a highly automated system and application management suite that uses a common set of tools to manage workloads on multiple physical systems.

The entire package has high availability baked in, beginning with redundant hardware components such as power supplies, storage controllers, and network interfaces. VMware builds on the story by providing high availability at the application level; customers have the ability to move active workloads between physical systems to facilitate maintenance and avoid unplanned outages.

It's important to keep the above capabilities in mind when evaluating the overall package. Most SMBs buy their IT in small chunks, a single server at a time, with each transaction a relatively small expenditure. The price tag for a full-on, enterprise-class BladeCenter S and VMware solution might prompt concern on the part of some SMB buyers. But the difference in terms of performance, features, availability, and capacity between a virtualized BladeCenter solution and the normal patchwork collection of servers currently owned by most SMBs is stark. It becomes even more profound when considering that a relatively modest configuration will be able to easily replace twenty or thirty non-virtualized standalone servers, while providing superior availability as well as system and application management. Customers who do their homework and weigh both the tangible and intangible benefits will find that the combination of IBM BladeCenter S and VMware is a compelling argument against the status quo.

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