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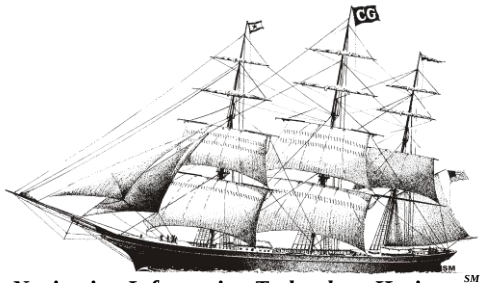

Navigating Information Technology Horizons℠

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When Infrastructure *Really* Matters — A Focus on High-End Storage

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Management Summary

Except for those who rely solely on public transportation or walking, most of us have a vehicle or two (or more) for our (family's) personal use. We all have our strategies about the vehicles that we drive, whether economy, capacity, style, performance, etc. For the authors, and probably for most vehicle owners, a primary requirement for our vehicle is that it be reliable. Having an unreliable vehicle has known and unknown consequences. First, there is the inconvenience of it failing in some way, especially when it needs immediate servicing. The known consequences are those that can be predicted in advance, like not being able to get to work or pick up the kids on time. Time disruptions are a direct consequence of something that is unreliable. Unfortunately, there are even more consequences, which tend to be more indirect yet possibly more consequential. If you were on your way to meet with a client about a critical deal and you are delayed or can't get there, you and your business may lose that deal. Each vehicle owner has a strategy (or "Plan B") for dealing with a suddenly ailing vehicle. Some may not drive a vehicle more than a couple of years old, because unreliability increases with age. Others may have another vehicle on which to rely in an emergency, like one belonging to a spouse or child, but relying on these also has downstream consequences. Some may drive a vehicle with the highest reputation for reliability or do business with a high-end dealer that offers a valet service, thus indicating that they often are quite willing to pay more for the improved quality of service and peace of mind. The old adage "You get what you pay for" hits this on dead center. The same is true for IT infrastructure.

So, why would you be willing to pay more for IT infrastructure? Really, no one wants to pay more than is necessary, especially when IT budgets are tight, which is very common these days. *So, how should you define what is necessary and what solutions are sufficient? How do you know when you are getting good value?*

- **First and foremost, you need infrastructure that can get the job done…under expected circumstances.** You might express this in terms of probability, like, "I want to get through the day without a failure *most of the time*." You also might express this in terms of the "duration of consequence," how long the infrastructure might be down. This presents the minimum situation that needs to be arranged.
- **Second, and related to the first, you need infrastructure that can handle the unexpected**, say when transaction volume is three times what is expected. Handling the unexpected, up to and including a complete, externally caused data center outage, might add significantly to the minimum infrastructure required.
- **Third, you need infrastructure that minimizes the inherent risks that you face** as a business and as a provider of IT services. Since there are many risks, this can be complicated to assess and complicated to mitigate. You need infrastructure that helps to reduce these complexities, because that makes everything easier and more doable.

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This list could be much longer but, for now, let's just say that you need to know your requirements, the inherent risks, and your organization's (and your) tolerance for pain. **The bottom line to all of this is that the infrastructure that you use for critical work *really does matter*.** It is not all the same. Read on to learn more about risks and requirements and how and why your infrastructure really matters.

Focus is on Mission Critical

At this point, we need to narrow the focus of this paper, which is to look at applications and infrastructure that might be labeled as "mission critical". Why the narrowing? There are many reasons, but three are worth mentioning. First, there is more at stake in doing mission-critical work and, almost always, much greater risk when things go wrong. Second, operating at the extreme (whether seen by the business side or the IT side of the equation) presents greater challenges than more mundane needs and solutions. The third is a little more selfish, but mission-critical applications and service delivery is just more interesting (for us, as analysts) and challenging (for those that have the business need or have to deliver the service) than more mundane business requirements and their often "good enough" solutions.

Requirements and Risks

You already may be classifying your business needs into *business requirements categories* like "mission critical", "business critical", "less critical", your risks into *categories of acceptable levels of interruption* like "rarely acceptable", "somewhat acceptable", and "more acceptable", and impacts into *need-to-mitigate risk categories* like "high", "medium", and "low". The labels are less important than the concepts. By categorizing requirements, interruption tolerance, and needs to reduce the effects of risk, you are thinking about the business side of the equation. This is necessary and good, for **it is the business that drives all IT requirements.**[1] **However, the higher the importance to the business, the lower you want the frequency of risk and the greater is your need to mitigate that risk from occurring.** (See Exhibit 1, at the top of this page.) You need to focus on the row in red and that is what we will do herein.

Exhibit 1 — Sorting Out the Priorities

Level of Business Importance	Acceptable Level of Interruption Risk	Need to Mitigate Risk
Mission Critical	***Rarely Acceptable***	***High***
Business Critical	Somewhat Acceptable	Medium
Less Critical	More Acceptable	Low

Source: The Clipper Group

With respect to IT infrastructure, you want the best solution, one that is the best fit to your business requirements (and usually not much more, unless the only way to get what you need is to "buy up" to something that unnecessarily surpasses your minimum requirements). This match of solution to requirements often is measured by its "goodness of fit". You seek goodness of fit to your requirements at the most reasonable cost, often measured as Total Cost of Ownership (TCO).

To determine the goodness of fit, you need to start with your organization's unique list of requirements. Most trace back to your business needs but some may be focused on technology or the status quo[2].

As you can see from Exhibit 2 on the following page, for each business requirement (in the left column), there often is a corresponding IT infrastructure requirement (in the right column). This table represents a way of looking at the confluence of business (user) requirements and IT infrastructure requirements, sort of the yin and yang of these often-separated perspectives. That's important, because now we have a basis to look at the challenges and risks associated with each.

We'll do this in three parts. First, we'll discuss what these requirements mean, at a summary level. Second, we will try to put this into a practical perspective, starting where seemingly most of the IT focus has been put recently (in the name of mission-critical requirements), that is, on high-end servers with server virtualization. Third, we will turn the focus on the need for mission-critical storage, which often becomes the stepchild in the race to deliver mission-critical solutions. We will explain why this frequently appears to be so, discuss the shortcomings of this approach, and then go on to

[1] What this implies is that while focusing on the characteristics of infrastructure components and linkages is good and necessary, often it is not done properly with correlation to business requirements, etc. Thus, it is inappropriate to seek out the "best" solution or components without framing the determination of what business circumstances make it best (i.e., give it the right fit for the requirements).

[2] It is very infrequent that one starts with a clean slate. Usually, we start with "where we are" and try to figure out how to get to "where we want to go". That path and ease of that journey may be a significant determinant to what is decided.

Exhibit 2 — The Two Sides of Mission-Critical Requirements

Business (Application) Requirements	IT Infrastructure (Data Center) Requirements
Sufficiently high quality of service • Application and customer focus • Predictable performance and speedy response time • Conformance to industry standards • Ease of use and access is required	**Sturdy and proven infrastructure** • Application awareness, for performance and troubleshooting • Able to adjust/recover from stress and failures • Conformance to technology standards • Ease of administration and operation is required • Access to special platforms and peripherals
Business solution effectiveness, especially at large scale • Able to handle growth of business volumes, expected and unexpected, without pain	**Infrastructure efficiency, especially at large scale** • Able to adjust rapidly to changing levels of demand for services
Satisfactory mitigation of economic risks • Sufficiently high application and data availability • Sufficiently high security • Sufficiently high process and data integrity	**Satisfactory mitigation of technology risks** • Sufficiently high infrastructure integrity, reliability and availability • Sufficiently high security • Mitigation of vendor/platforms and interoperability risks
Costs in line with business revenues and business risks to mitigate – spend no more than necessary	**Costs in line with business revenues and technology risks to mitigate** • Meaningful tiering of resources to deliver what is needed without overprovisioning or overpaying • Policy-driven automation
Tight integration of business processes and data	**Tight integration of technology components**
Worldwide deployment	**Worldwide support**
Be green, whenever possible	**Be green(er), wherever practical**
Keep it simple	**Mask complexity (as nothing really is simple); keep it doable and manageable**

Source: The Clipper Group

discuss what vendors like IBM offer for a high-end storage solution, especially its recently announced *DS8870*.[3]

Defining the Requirements

Mission critical means just that; it is critically important to the business and, without it, the business will suffer serious repercussions. The "it" could be a business function (like a trading desk in a brokerage firm), or an application (early warning radar), or even a component of an information system (a frequently-updated database of known terrorists). Notice that none of these are focused on a physical piece of IT infrastructure, like servers or storage. **That is because the infrastructure takes on the characteristics of the solutions, i.e., the applications and data that are hosted thereon. If these are mission critical in nature, then the underlying infrastructure becomes mission critical, whether it measures up to the task or not. What this means is that you must have very capable infrastructure to support the mission-critical nature of what is riding on it.**

What you don't want is to have mission-critical work being done on infrastructure that is more likely to come up short or to fail, because there may be large associated costs. While you don't want to be wasteful, it may be reasonable and acceptable to have infrastructure that may be a little better than you require. **What you want to avoid is having less than fully capable infrastructure for your mission critical applications.**

Mission-Critical Servers have been the Focal Point

Two server trends have driven the last ten years of IT deployments. The first is server consolidation and the second is increasing the capabilities of microprocessors significantly (more speed, more cores, more memory, etc.). The virtualization of servers goes hand in hand with both of these trends. **Clearly, the data center staff has been busy trying to get the right workloads on the right servers, both as a task of migration from**

[3] Because of the breadth of its servers and storage product lines, IBM offers a good vehicle to look at the desired characteristics for high-end storage.

previous generations of infrastructure and as a challenge to match server quality-of-service capabilities with what is required for application and data delivery.

No doubt, certain servers come to mind as being more capable of delivering the highest qualities of service for mission-critical applications and business requirements. Historically, the IBM Mainframe (*System z*) and UNIX servers (IBM *Power Systems*, HP *Integrity (Itanium)* servers, and Oracle *SPARC* servers, to name several) have served this role, but many mission-critical applications now run on x86 architectures under *Linux* or *Windows*. As stated earlier, **it is not the infrastructure that makes these mission-critical servers; it is the business applications that run on them that make them critically important.** We assume that you have vetted and chosen these wisely and have spent much time and money trying to strengthen the server underpinnings of your mission-critical workloads. This is important work that must be done. **Once you have selected and implemented your high-end servers, you might want to ask yourself: *Am I done?***

Why You Also Need Mission-Critical Storage

Unfortunately, while many of the data center staff have been busy focusing on servers and server virtualization, some have had less focus on the storage upon which these mission-critical business uses rely. Likely, this has not been intentional. You have not been ignoring storage. No doubt, the increasing growth of storage has been front and center in your battle of the IT budget. However, maybe some have focused too much on the cost of storage and not enough on the qualities and capabilities of what is being deployed in support of mission-critical applications.

Now may be the time to put more emphasis on the storage side of the equation. You might be asking yourself, ***why now?***

- **Because storage is a critical link in the chain of pieces that make up the infrastructure that delivers your mission-critical applications and data.** If you have reinforced your server arsenal many times and in many ways over the last decade, the servers' abilities to deliver very high qualities of service may now exceed that of other components in the chain, especially storage. Again, this mismatch may be the by-product of budgetary pressures to bring down the average costs of storage. While this is a noble goal, it may have lessened your abilities to meet important service level objectives. Whether guilty or not, you might be asking why you need to delineate the requirements for very capable storage.
- **Because even though processing work through your server is ever so important, it is data that is the lifeblood of most businesses.** How you manage your data, especially data used in mission-critical processes, likely is more important than the servers that process data and move it around. This is one of those *garbage in, garbage out* scenarios. If the quality or even the existence of your data is not guaranteed, no amount of superior processing is going to give you the results that you (and your customers and business partners) demand and deserve. Thus, where and how data is kept, shared, and protected is vitally important. What you must ensure is that your storage has not become the weakest link in your mission-critical solution. With as much attention as you paid to selecting the right servers and hypervisors to host your applications and business solutions, you now need to ensure that you have done the same for storage.
- **Because mismatches of server and storage technology may have happened ever so quietly while you were focusing on virtualizing and consolidating the servers**, you need to consider, again, what storage you are using for which purpose. Some of the reasons for a potential mismatch are shown in Exhibit 3, at the top of the next page.

To avoid such mismatches of technology, perhaps it is best to change your point of view and to now consider that your system is not just a high-performance server but a combination of servers plus storage plus their interconnections. In short, **it is important to realize that the "system" is really the entire set of infrastructure components on which it is built. Clearly, the collective set of infrastructure really matters. However, do not forget that every part of the infrastructure is there to satisfy specific application and user requirements, i.e., the *business requirements*, some mission critical, some not.**

The Need to Focus Broadly on IT Infrastructure

Today, executing a single transaction is easy, in the sense that it usually doesn't take much in the way of IT resources to carry out the execution. However, this changes significantly when you need to execute hundreds or thousands (or even many more) transactions per minute (or second). **A slow or moderate rate of transactions may be**

Exhibit 3 — Common Reasons for Needing Better Storage Infrastructure

- Workload priorities may have changed in importance.
- The mix of workloads may have changed, resulting in increased emphasis on real-time results (say driven by business analytics on "big data").
- Workloads may have changed in their sequencing and later mission-critical processes may now depend on them.
- Workloads may have increased demands, requiring heightened performance and/or security objectives.
- Workloads may have changed the location where their data is needed or stored.
- Most importantly, customer expectations quietly may have been elevated precipitously since the last time they were examined thoroughly.

Source: The Clipper Group

deemed mission critical solely by the nature of what the application means to the business. However, needing to execute a high volume of transactions per minute almost always becomes mission critical, because it needs to keep up in real time. When the demands are that high, it usually is very difficult to "catch up" after even a short outage.

Handling large-scale mission-critical requirements, whether transaction processing, business analytics, or other, almost always requires a *high-end server solution*, as you might expect. We think that it is sufficient to say that whatever server solution you are using for your mission-critical applications also sets a high standard for qualities of service and, almost always, costs a lot more than more mundane servers that tend to be incapable of meeting or guaranteeing the needed qualities of service.

So, why do you readily pay more? **The simple answer is that you expect more, or put more strongly, you demand more from your mission critical servers.**[4]

It must be noted here that the data center (and the business) is not so much concerned with a *server outage* as it is with an *application outage*. Storage and networking join with servers to deliver a platform for applications. The platform depends on local data center services (like cooling and emergency power) and external services (like electricity, wide area network connectivity, and remote data centers) to deliver continuity of application and data availability. **Each of these components (and more) also must be up to the challenge, as none is stronger than the weakest link in the system.**

No piece of the system is infallible. As Mr. Murphy would say: "If something can go wrong, it will." Clearly, we are not simply discussing server reliability and availability here. **Today, we want to bring focus on the critical storage that supplies these applications with the data that is needed to drive complex enterprise solutions (reliably, of course).**

Storage, whether disk or tape, has a mechanical foundation.[5] Mechanical components are very susceptible to failure[6], which is why MTBF ratings still are relevant. Many hardware vendors advertise their products' average availability at "Five Nines", which means that the system is operational 99.999% of the time. What does *that* mean? It means that you can expect no more than *5.26 minutes* of downtime every year, using a statistical average. A system with "Six Nines" of reliability, however, statistically may only be out of service for *32.5 seconds* per year, on average.[7] **If your environment cannot withstand five minutes of downtime without experiencing significant penalties, then the enterprise must invest in a**

[4] Before you question the cost of these solutions, let us ask you a question: *What is the cost of a system outage? Do you measure it in thousands of dollars per hour or, perhaps, millions of dollars, or, perhaps, in lives?* When the cost of a system outage exceeds the cost of the system, then that is what we refer to as a "no brainer". The risk-averse CEO, CFO, or CIO usually is willing to invest whatever it takes to ensure, in every humanly possible way, business continuity.

[5] A notable and relatively recent exception to this is solid-state (flash) storage, typically solid-state disks or SSDs. Because they have no moving components, they are faster than rotating disks or tapes and far less prone to failure. If your application can justify investing in an all-SSD solution (because of the speed requirement or because of the reduced MTBF rating), then you might have an all-SSD solution for some of your applications. However, given that storage costs tend to be growing, even without SSDs and due to the increases in data being stored, cost matters. So, for many, an all-SSD solution is a luxury that they cannot afford broadly. Much more common is a mix of SSDs and rotating disks, with SSDs being used as an accelerant for the most frequently used data.

[6] It is important to remember how the mathematics of probabilities works. The total systems probability of remaining up and functional is determined by multiplying each component's uptime probability, thus illustrating why the weakest link in the chain of components is so important. But, in the end, it is the availability of the total system that you worry about because, without it, works slows down significantly or stops.

[7] Remember that statistical averages represent a broad range of occurrences and should only be used as a point of reference and not as a hard operational objective.

system that mitigates the risk of failure and ensures an availability level that meets its needs.

When it comes right down to it, the data center must focus on the applications, their clients, and maintaining their data. Access to that data is the key, no matter the nature of the application's infrastructure. The most valuable resource that an enterprise has is its data. Most businesses get their competitive edge from constant analysis of that information. To lose data or access to data, even for five minutes, could lead to missed opportunities. In order to be a smarter enterprise, every enterprise must maintain access to a smarter storage infrastructure. To do this, the data center staff must protect critical data, while preparing for the next new challenge.

In addition to performance, reliability, and availability, the mission-critical storage platform should be integrated tightly with the server(s) that are running the applications, so that the mission-critical applications can take advantage of every feature provided in that storage, whether contributing to performance, reliability, data integrity, or other important characteristics. In selecting an appropriate mission-critical storage solution, the data center staff must understand exactly what features are needed, so that the storage system adequately will complement the mission-critical servers on which the business success is so dependent. The data center must mitigate against both economic and technology risks to ensure business continuity, high capacity, easy scalability, a secure environment (possibly very secure, depending on the application and data), ease of administration, data integrity, and energy efficiency.

All of these requirements rank high in the minds of most C-level executives – when explained adequately. Please keep in mind, however, that different departments view the system with different eyes. **What is important to the business executives who own the applications may be different from the key features that the IT department depends upon, which also may be different from what the individuals responsible for data resources or networking design. A sufficient storage solution is one that meets all of their needs.**

Focus on IBM DS8000 Series Storage, especially the new DS8870

The *DS8000* series of storage servers is the flagship of IBM storage. Its newly announced *DS8870* (shown in Exhibit 4, above) represents the ultimate in high-end storage and, because it is the latest and greatest, the DS8870 offers an ideal platform to use as a template for seeing how IBM satisfies the most complex mission-critical requirements.

Exhibit 4 – IBM DS8870

Source: IBM

First, let's compare the DS8870 with its three predecessors, the DS8800, the DS8700, and the DS8300.[8] Using Exhibit 5 (on the next page) as your hardware guide, you can see the performance has been enhanced significantly with the new DS8870. This is achieved by moving to more performant and more numerous *POWER7* processor cores (upgraded from *POWER6+* in the DS8800), by almost tripling the maximum amount of memory in the cache, and by significantly increasing the maximum bandwidth.

Clearly, the DS8870 is the turbocharged newest member of the DS8000 series.[9] If you need more throughput performance for your mission-critical workloads, especially those running on IBM servers, the DS8870 is for you.

The DS8870 comes in seven performance configurations, which are sized by the amount of processor memory, according to the table in Exhibit 6, below. These configurations can be upgraded non-disruptively. As with the DS8800, the DS8870 offers an entry-level Business Class configuration option. This option enables more drives to be

[8] For several years, IBM has been delivering DS8000 improvements largely in alternating cycles of new hardware and new software. The DS8870 primarily is an upgrade to the hardware, with only a modest introduction of new software functionality (some partial VMware VAAI support). With that exception, the software on the DS8870 is the same as the software on the DS8800.

[9] With an SPC-1 rating in excess of 450,000 IOPS, the DS8870 is the top rated scale-up array and, according to IBM, is 173% faster than the DS8800. Also, with a performance rating of 15,424 MBps, the DS8870 is at the top of the SPC-2 results (and 59% faster than the DS8800, according to IBM).

Exhibit 5 — Comparison of Latest Four Generations of DS8000 Series

	DS8870	DS8800	DS8700	DS8300
Processor	P7 3.55Ghz 2,4,8,16-core	P6+ 5.0GHz 2 or 4-core	P6 4.7Ghz 2 or 4-core	P5+ 2.2GHz 4-core
Processor Memory	16 - 1,000GB	16 - 384GB	32 - 384GB	32 - 256GB
Drive Count	16-1,536	16-1,536	16-1,024	16-1,024
Enterprise Drive Options	SAS2 - 146, 300, 600, 900 GB	SAS2 - 146, 300, 450, 600, 900 GB	FC – 300, 450, 600 GB	FC – 73, 146, 300, 450 GB
SSD Drive Options	400 GB	300, 400 GB	600 GB	73, 146 GB
Nearline Drive Options	3 TB	3 TB	2 TB	1 TB
Drive Enclosure	High-density, high-efficiency Gigpack	High-density, high-efficiency Gigapack	Megapack	Megapack
Max Physical Capacity	2,304 TB	2,304 TB	2,048 TB	1,024
Rack Space for SSD Ultra Drawer	Yes	No	No	No
RAID Options	RAID 5, 6, 10	RAID 5, 6, 10	RAID 5, 6, 10	RAID 5, 6, 10
Internal Fabric	PCI-E	PCI-E	PCI-E	RIO-G
Max Number of LUNs / CKD volumes	64K total	64K total	64K total	64K total
Max LUN Size	16 TB	16 TB	16 TB	2 TB
Host Adapters	8 Gb FC x 4 or 8 ports per adapter	8 Gb FC x 4 or 8 ports per adapter	4 Gb FC x 4 ports 8 Gb FC x 4 ports	ESCON x 2 ports 4 Gb FC x 4 ports
Host Adapter Slots	16	16	32	32
Max Host Adapter Ports	128	128	128	128
Drive Interface	6Gbps SAS-2	6Gbps SAS-2	2Gbps FC-AL	2Gbps FC-AL
Device Adapter Slots	16	16	16	16
Cabinet Design	Front-to-back	Front-to-back	Top Exhaust	Top Exhaust
Power Supply	DC-UPS	Bulk	Bulk	Bulk

Source: IBM

packed into the base frame and restricts some other functions, but it keeps costs lower.

Energy efficiency is on everyone's mind. The DS8000 series has a long history of energy efficiency improvements over the generations. For a fully configured storage server at maximum capacity, the DS8870 specs show a 21% absolute reduction from the DS8700 (see the row highlighted in light blue in Exhibit 7, at the top of the next page). While that is very impressive, it isn't a complete metric. What you really want to consider is the energy consumption per terabyte of storage. This shows a 29% improvement from the DS8700 to the DS8870 (as shown in the yellow highlighted row in Exhibit 7). That savings per terabyte is significant, especially when you consider all of the additional processors and memory that reside in a fully configured DS8870 (i.e., potentially many more than in the DS8700). **So, if you need to go faster and want to consume less energy, go with the DS8870.**

However, there is more. In Exhibit 8, on the next page, you can see how IBM satisfies mission-critical requirements via its DS8000 series. Notice that the template from Exhibit 2 has been overlaid with IBM's vehicles for meeting these needs.

Exhibit 6 — Range of DS8870 Configurations

Amount of Processor Memory	Number of POWER7 Cores
16 GB	2*
32 GB	2*
64 GB	4
128 GB	8
256 GB	8
512 GB	16
1024 GB	16

* Business Class configuration only

Source: IBM

Exhibit 7 — Energy Comparison of the Latest Three Generations of DS8000

Energy Consumed Per Hour and % Saved	DS8870	DS8800	DS8700
kW (maximum configuration)	23.2	26.3	29.2
KW delta compared to DS8870	n/a	3.1	6
KW % delta reduced compared to DS8870	**n/a**	**12%**	**21%**
Max TBs (maximum configuration)	2304	2304	2048
kW/TB	0.0101	0.0114	0.0143
kW/TB delta compared to DS8870	n/a	0.0013	0.0042
kW/TB % delta reduced compared to DS8870	**n/a**	**12%**	**29%**
Note: Measurements taken on 100% read miss workload			

Source: IBM; with computations by Clipper

Tight Integration with IBM Servers

Tight integration is what you would expect from any vendor offering both high-end servers and storage. All models in the DS8000 series have been integrated tightly with IBM's high-end servers, including *System z* mainframe (for all operating systems, but the most advanced features are available on *z/OS*) and *Power Systems* (supporting *AIX*, IBM's *i5* OS, and *Linux*).

The DS8000 series provides optimized, bullet-proof reliability, balanced performance, outstanding scalability, superior availability and business continuity, and more, especially for (but not limited to) these IBM server platforms. The DS8000 series enables the data center staff to take control of their storage to enable the enterprise to gain valuable insight from their data. It enables the data center staff to remove complexity and replace it with simplicity – by supporting a mix of random and sequential workloads, as well as both interactive and batch applications. In addition, the DS8000 also works well with any of today's popular distributed systems, whether UNIX servers from HP or Oracle, or x86 systems typically running Linux or Windows in a virtualized environment. The DS8000 provides the redundancy and flexibility required by the enterprise data center.

Especially for System z

As you would expect, the System z provides the mission-critical enterprise application with the maximum performance, availability, consolidation, security, and scalability to support those critical applications. It also provides more specialized storage functions to support these objectives than any other operating system. However, these specialized mainframe functions will work only if the disk storage systems (arrays) are designed to support them.

The DS8000 series is part of a shared architecture among servers and storage designers at IBM. Servers and storage are designed, developed, and tested together to provide the best integrated solutions for delivering mission critical applications. Competitors lack access to this pre-release collaboration and integration testing, especially when new features are released simultaneously on servers and storage.[10] This places IBM in the best position for earliest delivery of many new features from the server.

An example of this is the DS8000 *List Prefetch* Optimizer for High Performance FICON, which improves query performance by a factor of eight times. Since most of the cost for this innovative R&D effort has been borne by POWER development budgets, IBM has been able to keep the cost for the DS8000 within the reach of almost all enterprise budgets. The DS8000 also has enjoyed the luxury of being able to adopt other innovative functionality that originally was developed elsewhere within the IBM family of storage products. The DS8000 also supports System z *Discovery and Auto-Configuration* to simplify configuration, in addition to many other System z capabilities.[11]

The DS8000 Series – A Long, Innovative Enterprise-Class Tradition

Generation after generation, the functionality of the DS8000 continues to improve. The net result is a very rich suite of onboard and related advanced function storage software, for provisioning, managing, and optimizing storage, with an emphasis on policy-driven automation and ease of use. See Exhibit 9 (on the next page) for a list of many of the capabilities that are so important to your mission-critical applications and data.

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[10] IBM offers to license the specification of its storage architecture and components to interested parties on a feature by feature basis. Understand that IBM is not licensing the code but the specification (often the interfaces and protocols) needed to design a compatible solution and then to write and test the code. This takes interest (economic motivation for being compatible with IBM and for making a large up-front investment) and time (to design and develop a compatible solution). Some of IBM's advanced storage features have been developed and now are offered by other storage vendors. Compatibility is limited to select features and often is delivered a long time (often measured in years) after IBM first delivers the solution via its storage products.

[11] For more information on the DS8000's rich functionality for the IBM mainframe, see *The Mainframe and Its Storage - The Search for Optimized Infrastructure*, in **The Clipper Group Navigator** dated March 4, 2010, which is available at http://www.clipper.com/research/TCG2010007.pdf.

Exhibit 8 — How IBM Satisfies Mission-Critical Storage Requirements with its DS8000 Series

Business (Application) Requirements	IT Infrastructure (Data Center) Requirements
Sufficiently high quality of service • Bullet-proof reliability (redundancy, no SPoF, failover, call home) • Improved application performance due to POWER7 innovation • Integrates Easy Tier to optimize SSDs and take advantage of changing value of data over time	**Sturdy and proven infrastructure** • Tight integration with server/applications • Redundancy, Metro/Global replication • Meets technology standards • Automated administration and recovery • Integration with primary and secondary storage (Tape and Virtual Tape)
Business solution effectiveness, especially at large scale • Dynamic scalability for both accelerated growth and seasonal/end of month peaks	**Infrastructure efficiency, especially at large scale** • Provides easy migration of data between multiple tiers of HDDs and SSDs • Provides on-demand scalability
Satisfactory mitigation of economic risks • Adherence to standards for investment protection • Provides full disk encryption with easy to use key manager to minimize risk of data theft • Uses existing technology (from IBM) to maintain lowest possible TCO	**Satisfactory mitigation of technology risks** • Provides redundancy and failover in case of a failure • Provides full disk encryption with easy-to-use key manager • Provides end-to-end data integrity through ANSI T10 DIF • Provides over six 9s of availability when combined with GDPS/PPRC HyperSwap
Costs in line with business revenues and business risks to mitigate – spend no more than necessary • Multiple tiers of backup/recovery available to match budget to RTO	**Costs in line with business revenues and technology risks** • Policy-driven automation to match value of data to speed of storage • Multiple tiers of drives control cost
Tight integration of business processes and data • Fast access to data supports business analytics and big data initiatives	**Tight integration of technology components** • All components (server, storage, networking) designed, developed, and tested by IBM
Worldwide deployment • Sales and installation support from IBM wherever you are	**Worldwide support** • Maintenance support from IBM wherever you are
Be green, whenever possible • Supports consolidation to minimize application administration	**Be green(er), wherever practical** • Reduced energy consumption to prolong life of data center; *ENERGY STAR* ready • Denser deployment to minimize floor space
Keep it simple • Automation deployed wherever available	**Mask complexity (as nothing really is simple); keep it doable and manageable** • On demand scalability and automated data migration to improve ease of use

Source: Specifications from IBM with mapping by The Clipper Group

Conclusion

Mission critical applications deserve a mission critical infrastructure from top to bottom. For the storage elements of the infrastructure, this means that your platform selection must be ranked against the three major criteria that define what it means to be mission critical.

- **Will your mission-critical storage infrastructure get the job done under expected circumstances?**
- **Will your mission-critical storage infrastructure handle the unexpected in terms of transaction volume as well as manmade and natural disasters**

Exhibit 9 — The Software Side of DS8870 and DS8800

As stated earlier, the DS8870 is mostly a hardware upgrade over the prior generation DS8800. Both can run the latest DS8000 software, including or supporting the following important capabilities. (This list does not include all of the DS8000 family's features, functions, and capabilities.)

- ***Redundant active-active dual server complexes***, to ensure high availability.
- ***RAID 5, 6, and 10***, for the right combination of protection and performance.
- ***Supports full-disk*** 256-bit encryption to protect clients concerned about the growing threat of security breaches for data at rest, protecting sensitive information from both internal and external threats.
- ***Point-in-time copies and local and remote data replication*** for business continuity.
- ***Metro Mirror and Global Mirror to*** enable business continuity when seconds really matter.
- ***Easy Tier*** for automated management of storage tiers.
- ***Storage Tier Advisor,*** for determining which volumes are candidates for optimization by analyzing the performance of actual application workloads.
- ***Online administrative control*** over the logical configuration.
- ***Proactive and reactive call home features***, to alert the administrators of soon-to-fail, failing, and failed components.
- ***Faster replication of data via Metro and Global Mirror,*** both local and remote, with advanced mirroring capabilities.
- Support for System z's ***Load Balancing Algorithm***.
- ***List Prefetch Optimizer***, for High Performance FICON, which improves query performance by up to eight times on System z.
- ***Support for GDPS (Geographically Dispersed Parallel Sysplex***), for the highest availability across multiple data centers, also for System z.
- ***I/O Priority Manager*** for advanced QoS management, to enable more effective storage consolidation and application service manage, by assigning system resources to separate workloads
- ***Scalable performance and management for IBM i*** environments, including SSD tools and automation.
- ***Tivoli Storage FlashCopy Manager***, for application-aware taking of snapshots.
- ***Tivoli Key Lifecycle Manager***, for easy-to-use key management.
- ***ANSI 110 Data Integrity Field (DIF) standard*** is supported, for end-to-end data protection.
- ***Partial support of VMware's VAAI***.
- ***Works with IBM's TS7700*** (virtual tape appliance), used for backups and archiving, which provide the lowest TCO per TB for backup and archiving.
- ***Supports IBM deduplication technology***, to increase capacity and improve backup performance.

Source: IBM

possibly causing data center outages?

- **Does your mission-critical storage infrastructure minimize the inherent risks that you face, as a business and as a provider of IT services?**

You need a solution that answers "Yes" to all three. **For your mission-critical needs, IT infrastructure – including each piece of it – really does matter!**

The IBM DS8870 can meet these needs. If you need more from your storage, especially more performance to support your mission-critical applications and data, take a closer look at IBM's new flagship storage system, the DS8870.

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The Clipper Group, Inc., now in its twentieth year, is an independent publishing and consulting firm specializing in acquisition decisions and strategic advice regarding complex, enterprise-class information technologies. Our team of industry professionals averages more than 25 years of real-world experience. A team of staff consultants augments our capabilities, with significant experience across a broad spectrum of applications and environments.

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