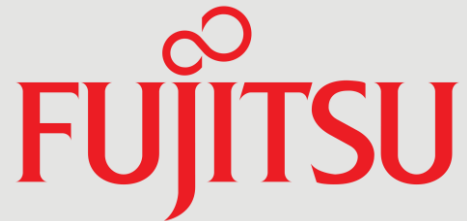




Executive insight paper

Commissioned by



and



Unleashing the full potential of all-flash arrays

The network is part of the system too

Freeform Dynamics, 2016

About this Document

The insights presented in this document are derived from ongoing independent research, coupled with specific briefings from Fujitsu and Brocade on their all-flash storage and network related offerings. While specific technologies and partnership details are used to illustrate how key generic principles translate to practical reality, nothing in this paper should be taken as a validation or endorsement of any product or supplier.

Nobody wants to invest in a new technology only to find it doesn't work properly with their other investments. It's therefore critical to plan in the round, rather than in a piecemeal manner, and fully leverage strategic supplier partnerships.

Management Summary

All-flash opportunities

Enterprise-grade solid state storage based on flash is becoming 'the new normal', for primary storage at least. Much more than just a very fast disk drive, flash can also be more efficient, consistent, robust and manageable. Used carefully, as it is in Fujitsu's self-optimising storage arrays for example, it opens up a number of major opportunities, such as better service management and the ability to support innovative business processes.

The storage network matters

How you move data around is just as important as – and in some ways more important than – how you store it. Otherwise, when you add all-flash storage into your environment you risk simply moving your bottleneck to the network.

The network modernisation imperative

Many storage networks were designed to support point-to-point connections between physical devices and ports. Modern IT is instead a world of virtual servers, virtual storage and yes, virtual networks. Servers and services can come and go much faster, and traffic is no longer relatively hierarchical.

Plan in the round, not piecemeal

Given the dependencies between storage and networking, planning for flash adoption must be based on an end-to-end view. As part of this, it's critical to consider how expansion in one area may result in other component becoming overloaded, or may simply drive up demand for the expanded resource.

Next-generation Fibre Channel

Fibre Channel remains the most common basis for an enterprise storage network. So the advent of Gen 6, which is a next-generation Fibre Channel that both brings new speeds and capabilities, and can be mixed in with existing FC networks, is welcome news. One of the broadest Gen 6 implementations comes from Brocade, and can support smaller switched networks as well as very large fabrics.

Strong partnerships matter too

Nobody wants to invest in a new technology only to find it doesn't work properly with their other investments. Returning to the importance of the holistic system view then, we can see significant advantages in working with companies which not only collaborate deeply to build complete certified solutions, but which also have a similar end-to-end perspective on the challenges.

Music, motorways and fantasy novels

Whether designing a national transport infrastructure or an enterprise IT system, it's critical to consider requirements in relation to speed, volume, throughput and capacity in a holistic manner.

Chris Rea's track "The Road to Hell" struck a chord with many commuters when it was released in 1989. With lines such as "I'm standing by a river but the water doesn't flow" and "This ain't no upwardly mobile freeway", the lyrics of the song were inspired by the misery of sitting in traffic on London's orbital motorway – the infamous M25.

Originally opened in 1986, the M25 was designed with 3 lanes in either direction to deal with up to 88,000 vehicles per day. The idea was to allow plenty of room for growth. This capacity was quickly exceeded, however, and in 1990, shortly after "The Road to Hell" entered the UK music charts, the government announced plans to widen the whole of the motorway to 4 lanes in an effort to deal with already crippling congestion. By 1993, traffic volumes had risen to 200,000 vehicles per day, and further plans were made to widen some of the busiest sections to 6 lanes.

Long term consequences of a bad start

Since those early days, we've seen years of additional unanticipated, hugely expensive and massively disruptive construction work. Along the way, the capacity of the M25 has been an integral part of the discussions around many other civic improvement projects. A topical example here is the potential expansion of airport capacity, the logic being that there's no point in scheduling more aircraft if people can't get to and from the airport quickly and easily enough to use them.

Wind the clock forward to today, and many London residents and visitors will still understand the suggestion that the M25 is "evidence for the hidden hand of Satan in the affairs of Man" - as put forward in the comic novel "Good Omens" by Terry Pratchet and Neil Gaiman. Put simply, after a bad start, things haven't noticeably improved.

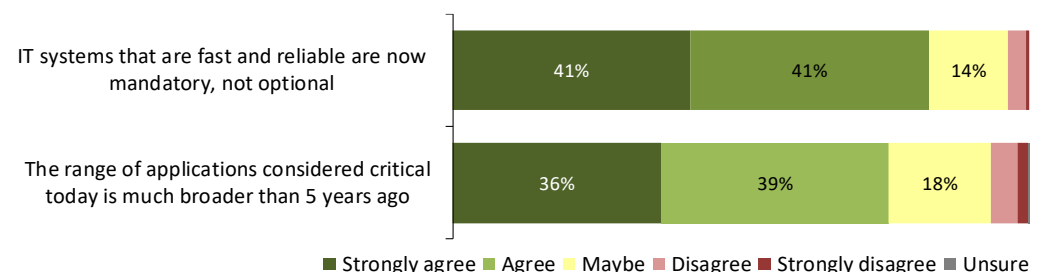
Parallels with storage and networking

The history of the "Road to Hell" provides us with some valuable lessons in relation to IT systems planning and design, and in particular the importance of thinking about speed, volume, throughput and capacity in a holistic manner. If we put this into a modern digital business context, the aim is to build systems that are capable of meeting business expectations for performance and reliability that are already very high, yet are still growing (Figure 1).

The ultimate aim is to build systems that are capable of meeting growing business expectations for performance and reliability that are already very high.

Figure 1
Escalating demands for speed and reliability

Source: Freeform Dynamics
European survey, Summer 2016
401 senior datacentre professionals



In the remainder of this paper, we will consider some of the key principles and practicalities that relate to how we can deliver on the storage and storage-networking elements of these expectations. As we do this, we will explore how recent technology developments can help us to design and implement fast, versatile and future-proof storage networks to deal with rapidly evolving enterprise application needs.

Storage through a network lens

The storage conversation has historically been dominated by the problem of how to manage ‘exploding’ volumes of data.

For the past decade (at least), the storage conversation has been dominated by the problem of how to manage ‘exploding’ [sic] volumes of data. The sheer cost and overhead of housing large data sets as they grow through tens or hundreds of Terabytes, and on up into the Petabyte range, are daunting. Throw into the mix the problems of data protection, compliance, retention, disposal and other information lifecycle considerations, and the focus on managing data volume and diversity in today’s enterprise environment is understandable.

Beyond ‘parking’

Continuing with our earlier analogy, this historical emphasis is akin to focusing on car parking when considering the transport system for a country or city. When you consider the real objective of enabling people to move about quickly and freely, there’s obviously a lot more to be thought about - not least the road system that connects everything together.

And the same is true in an IT context. The need to pay a lot more attention to storage networking becomes abundantly clear when you think of current digital trends. Consider, for example, how the following result in more and different types of data being produced, processed and consumed in new and different ways:

The need to pay a lot more attention to connectivity becomes abundantly clear when you think of current digital trends.

- Digital customer engagement
- Business-to-business automation
- Digitisation of core business processes
- Activity enabled by the ‘Internet of Things’ (IoT)
- Digital transformation in the workplace
- Big data, analytics, and advanced modelling
- Increasing use of AI and machine learning

Success in pretty much all of these areas is directly dependent on how quickly and efficiently data flows within and between the various systems involved.

A new business systems imperative

With the above trends in mind, the speed and reliability with which we can store data and then transport the bits from one place to another has, in fact, become one of the most important aspects of modern system design.

The speed and reliability with which we can transport bits from one place to another has become one of the most important aspects of modern system design.

To take a simple example, website response time is integral to the overall user experience in a digital customer engagement context, and this will often be determined by the slowest link in the bit transport chain. It doesn’t matter whether the delay in getting a product image from the catalogue on disk to the user’s screen is because of slow storage media, inefficient array controllers, limited storage network bandwidth, or congestion at some point in the system. All that counts is the impact on the business, e.g. losing a sale because a customer gets impatient, abandons their transaction, and moves on to your competitor’s website.

From a storage perspective, there are two big areas to consider when looking to address the imperative here in most datacentre environments – the performance of the storage devices, and speed of the storage network. Let’s explore these in more detail, starting out with a look at some important developments in relation to storage devices – namely the continued evolution of all-flash arrays.

The all-flash enterprise opportunity

Things have moved on considerably from the early days of flash media being primarily used for caching purposes or to create a high-performance layer in multi-tiered environments.

1st generation all-flash offerings gave us a glimpse of what could be achieved.

2nd generation systems dramatically extend the potential for all-flash arrays.

Many would argue that flash is already at or close to parity with disk if you take a total cost of ownership (TCO) view of the world.

In our recent paper entitled "Enterprise Flash - The New Normal?", we discussed how the role of flash storage has evolved over time. Things have moved on considerably from the early days of flash media being primarily used for caching purposes or to create a high-performance layer in multi-tiered environments.

All-flash beginnings

As the technology developed, all-flash storage arrays began to appear, though early systems were very expensive and lacked many enterprise features. There were also concerns over the durability of media, given the limited number of reads/writes a flash module could sustain over its lifetime. Even so, these 1st generation offerings gave us a glimpse of what could be achieved when hugely reduced latency and higher throughput were introduced into the storage equation. From a deployment perspective, they found their place supporting particularly demanding applications, and came into their own where the increased performance made a big enough difference to justify the higher costs and functionality compromises.

Taking it to the next level

More recently, we have seen the emergence of what we might call 2nd generation systems that dramatically extend the potential for all-flash arrays in a mainstream IT context. Advancements in both solid-state media manufacturing techniques, and the software trickery used to optimise systems, mean that the latest solutions in this space deliver durability as well as performance at a much lower cost.

The appearance of more-established storage vendors on the all-flash stage, arriving steeped in their enterprise heritage, has then changed the game from a functionality perspective. The abovementioned paper details the full range of enterprise features now often available. Suffice it to say for our purposes here that modern all-flash solutions contain the kind of capabilities you are used to from traditional disk-based systems, such as data protection, high availability (HA), disaster recovery (DR) and comprehensive systems administration.

Economics revisited

From an economic perspective, when you take into account the impact of embedded data compression and de-dupe functions (which can be applied more broadly and effectively in high-performance systems), and the higher utilisation rates achievable with flash (which doesn't slow down as devices fill up), the cost differential between traditional disk and solid-state options becomes relatively small. As time goes on this gap will become even narrower. At some point in the not too distant future, the cost curves may even cross over. Further technology advancements, together with manufacturing economies of scale (as shipment volumes continue to increase), may result in the price per 'usable' terabyte for flash falling below that of disk, at least for online storage.

In the meantime, many would argue that flash is already at or close to parity with disk if you take a total cost of ownership (TCO) view of the world. An all-flash system, for example, will have a much smaller physical footprint in your datacentre, will require much less cooling, and will overall consume significantly less power than the traditional disk alternative.

Inherently high and consistent performance means a lot less tuning and ongoing nurturing.

A modern enterprise class all-flash array has the potential to be used as a general-purpose storage platform.

Fujitsu has a long pedigree of delivering enterprise class storage solutions.

From an IT team resources perspective, inherently high and consistent performance (in terms of IOPS/latency) across an array means a lot less tuning and ongoing nurturing is required to maintain good response times. Put this together with automated quality of service management, allowing performance to be tailored and prioritised by workload, and the administration overhead and skills requirements can be reduced dramatically. With the right solution, your VMware and Microsoft teams don't need to go running to storage specialists in order to fulfil their needs, which has a spin-off benefit of the IT function being generally more responsive to change.

System versatility

If you stand back and consider some of the attributes and capabilities we have been discussing from a different angle, it becomes clear that a modern enterprise class all-flash array has the potential to be used as a general-purpose storage platform. You now have the economics, robustness and manageability necessary to bring high-performance by default to a much greater range of applications and workloads.

This all sounds very attractive, but what shape does a real-life solution actually take?

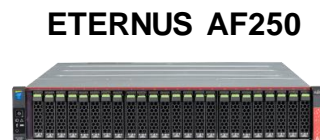
All-flash technology example

To give you an idea of what an enterprise class all-flash storage solution looks like, let's examine how one of the important players in the market, Fujitsu, addresses some of the key requirements. In the interests of full disclosure, we are using Fujitsu as a reference as it was kind enough to co-sponsor this paper. It's not the only vendor of all-flash arrays, however, and its inclusion here should not be construed as Freeform Dynamics endorsing any particular offering. That said, Fujitsu has a long pedigree of delivering enterprise class storage solutions in general. It therefore serves as a good example of what can be achieved when this kind of experience is brought to bear in the all-flash arena – in this case resulting in the ETERNUS AF range (Figure 2).

All-flash technology offerings from Fujitsu

Specifications as at November 2016
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Figure 2
Real-life examples of 2nd generation all-flash solutions from Fujitsu



CPU	6core, 2.0GHz
Memory	32GB/CM, 64GB/system
Max drives	2 - 24
Max capacity	192 TB raw 960 TB effective*
Interface	8x FC 16G / iSCSI 10G

ETERNUS AF650



CPU	10core, 3.0GHz
Memory	128GB/CM, 256GB/system
Max drives	2 - 96
Max capacity	768 TB raw 3840 TB effective*
Interface	32x FC 16G / iSCSI 10G

*Calculated based on a data reduction factor of 5

The first thing you notice when looking at these systems is their extremely small footprint compared to traditional disk-based configurations providing a similar level of

An all-flash array delivering 100Tb of usable storage suitable for a mixed workload environment would typically occupy around a tenth of the rack space.

storage capacity. Fujitsu claims, for example, that an ETERNUS AF650 all-flash array delivering 100TB of usable storage suitable for a mixed workload environment would typically occupy around a tenth of the rack space in your datacentre (52U vs 6U, based on its own portfolio). In addition to almost 10X higher density, Fujitsu further says you should expect 20X faster response times, 4X more IOPS and 8X less maintenance cost from the all-flash alternative. For such larger systems, the power and cooling differential can then be particularly significant, e.g. Fujitsu claims in the order of 95% savings here for the size of solution just mentioned.

Freeform Dynamics cannot vouch for the validity of these numbers, but from discussions with the vendor (and based on feedback from early all-flash adopters), they do sound plausible. Clearly, however, the deltas will vary depending on the size of the system, the type of flash installed, your mix of workloads, and the nature of your data (this governs compression ratios, which in turn affect the level of 'usable' storage).

Even if you take a pessimistic or sceptical view of these claims, however, it is safe to assume that you can expect dramatically more than just incremental improvements; deltas will be measured in multiples or orders of magnitude for most key parameters.

Delta improvements will be measured in multiples or orders of magnitude for most key performance-related parameters.

Enterprise functionality

Beyond the core attributes of all-flash arrays, Fujitsu, as an established storage vendor, has made sure that the kind of enterprise level functionality you have been used to in traditional disk-based systems has been incorporated into its all-flash offerings. Capabilities here include:

Management tool integration

A rich environment for configuring, monitoring and administering the array, with APIs provided for integration with third-party tools.

Data protection and HA/DR capabilities

Full mirroring, replication and transparent failover capabilities are included, and target/secondary systems can be all-flash, disk-based or hybrid.

Selective use of data reduction

An ability to switch in-line deduplication on or off for specific volumes depending on performance and compliance requirements.

Automated quality of service (QoS) management

Policy driven approach allowing priorities, limits, etc to be set by application, ensuring service levels are maintained with little or no manual intervention.

Enterprise-class functionality is particularly important for mixed workload environments.

This kind of enterprise functionality is particularly important for mixed workload environments, which, as we said, will increasingly be a target for deployment of all-flash options as the need for speed broadens and economics continue to become more favourable. You clearly need to be able to deal with differing data protection, data reduction and QoS requirements across the range of applications and workloads if they are operating in the same environment.

But you will only get so far with all-flash if another part of the system, particularly the network, becomes a constraint.

It's worth picking up on the question of QoS specifically in this context. Modern all-flash environments might be inherently fast, but resource contention will still become an issue when systems are driven hard if it's not properly managed. Having said this, the speed and QoS management capabilities of the storage array will only get you so far if another part of the system, particularly the network, then becomes a constraint.

In order to take advantage of the full potential of the 2nd generation all-flash offerings to meet broader needs, you will almost certainly need to modernise your storage network.

Gone are the days when network configuration and access revolved purely around physical devices and ports. We are now in a dynamic virtual world.

The 'always on' digital business increasingly relies on 24 x 7 systems.

The latest so-called 'Gen 6' Fibre Channel networks were designed specifically with the use of all-flash storage in mind.

The network modernisation imperative

The full potential of all-flash arrays cannot be realised if you are relying on a storage network originally designed around the performance characteristics of disk-based technology. It won't be long before the network becomes a bottleneck and starts to throttle and disrupt throughput and response times. To take advantage of the full potential of the 2nd generation all-flash offerings to meet broader needs, you will almost certainly need to modernise your storage network.

So is the answer simply to buy bigger, faster switches? Well partly, but there's a little more to it than that, and this becomes clear if you zoom out for a minute and consider the way in which activity in your datacentre is evolving.

Dealing with modern infrastructure and application needs

Gone are the days when network configuration and access revolved purely around physical devices and ports. We are now in a dynamic virtual world, in which a single physical server, for example, is frequently running many virtual machines (VMs), each hooking into your storage infrastructure through multiple virtual ports and logical connections. The complexity of managing all this has increased significantly as servers have become more powerful with VM's packed onto them more densely.

Furthermore, VMs nowadays tend to get spun up and down and migrated between physical machines much more frequently than in the past. Fast-moving DevOps environments represent one source of constant change here, particularly when release automation tools and automated provisioning systems are used to facilitate continuous delivery. Workload management solutions and private/hybrid cloud platforms designed to optimise resource allocation on a continuous real-time basis are another common source of constant change.

The dynamic nature of the IT infrastructure, and the level of fine grain virtualisation it now has to support, is set to further increase over time as containers and micro services gain popularity. And as the 'always on' digital business increasingly relies on 24 x 7 systems, resilience and availability become even more critical.

Thinking back to the lessons provided by the history of the "Road to Hell", the overriding need is that we must be able to scale capacity and throughput to handle continuously escalating requirements, avoiding huge cost and disruption along the way. Forklift replacement of your whole storage network every time there's an escalation of requirements is simply not feasible.

Enter Gen 6 Fibre Channel

Fortunately, the escalating demand for performance and flexibility, and the rapidly growing role of all-flash storage arrays within this, was anticipated well ahead of time.

As a result, we have seen significant advances in the two main 'flavours' of storage networks – namely Ethernet and Fibre Channel. To illustrate some of the specifics, let's take a closer look at the second one of these. Fibre Channel is still, after all, the most popular option for building an enterprise-class storage 'fabric', i.e. the infrastructure of switches, controllers and other components that connects servers to storage in an enterprise context. The latest so-called 'Gen 6' solutions in this space were designed specifically with the use of all-flash storage in mind.

Gen 6 Fibre Channel solutions are fundamentally engineered for much lower latency.

Gen 6 systems deliver connection speeds at least 4 times greater than most commonly installed networks, and are designed for extreme scalability and high power-efficiency.

You can add Gen 6 components into a previous generation Fibre Channel network and immediately start reaping the benefits.

Monitoring and management tools that provide you with granular visibility and control are key.

Performance and scalability

Gen 6 Fibre Channel solutions are fundamentally engineered (at a silicon/system level) for much lower latency. They also provide 'north/south' connection speeds of 32Gbps at the edge of the fabric to servers and storage devices - twice that of Gen 5, and at least 4 times greater than the speeds of most commonly installed systems today.

In addition, inter-switch 'east/west' speeds of 128Gbps are then possible within the fabric itself. This is important for horizontal load-balancing (to support mixed, dynamic workloads), scale-out performance (to enable efficient capacity growth), and high-bandwidth connections between sites (to support remote replication and DR needs).

To enhance performance even further, Gen 6 Fibre Channel then incorporates a technique known as 'Forward Error Correction' (FEC). This minimises the performance impact of managing data-loss errors at very high network speeds.

And all of this may count for a lot more than you think. Given the critical nature of storage networks, most IT teams take a conservative approach to upgrading them, so your current environment probably contains a mix of earlier generation technologies. This means a move to Gen 6 Fibre Channel wouldn't just represent an incremental improvement; just as with all-flash arrays, performance differences can be dramatic.

Other benefits

But raw performance improvements must be delivered reliably, with mechanisms to minimise and mitigate problems. Brocade's implementation of Gen 6 therefore incorporates an automated diagnostics and management capability called IO Insight. This monitors IO performance non-intrusively, feeding the results to a policy-based monitoring suite that can not only generate alerts when problems occur, but can also apply actions to prevent further degradation.

Other benefits of Gen 6 include lower energy consumption (stemming from protocol efficiencies and throttling power to inactive components), enhanced security (supporting the latest NIST standards) and, not least, backwards compatibility.

Picking up on that last point, from a system upgrade perspective, you can add Gen 6 components into a previous generation Fibre Channel network and immediately start reaping the benefits. The network will detect the superior capabilities of the new components and automatically rebalance traffic flows to optimise performance. Even if your ultimate aim is a complete move to Gen 6 across the board, this means you can migrate incrementally in order to minimise the risk of service disruption.

Beyond core capabilities

While the generic core capabilities delivered by any Gen 6 network are extremely important for capitalising on the all-flash opportunity, just as with storage devices, additional enterprise class functionality is required to enable effective operation.

Particularly key in mixed workload environments are monitoring and management tools that provide you with visibility of what is going on in the network, and an ability to act accordingly. With the previously described dynamic, virtualised landscape generating a complex and ever-changing set of high-speed traffic flows, it's important to be able to track, troubleshoot and control at a very granular level - e.g. down to the activity of individual VMs and storage components.

With this in mind, let's look at our second example of real-life technology.

Brocade has a long history of delivering enterprise solutions, so its Gen 6 portfolio provides us with a useful reference point for what can be achieved.

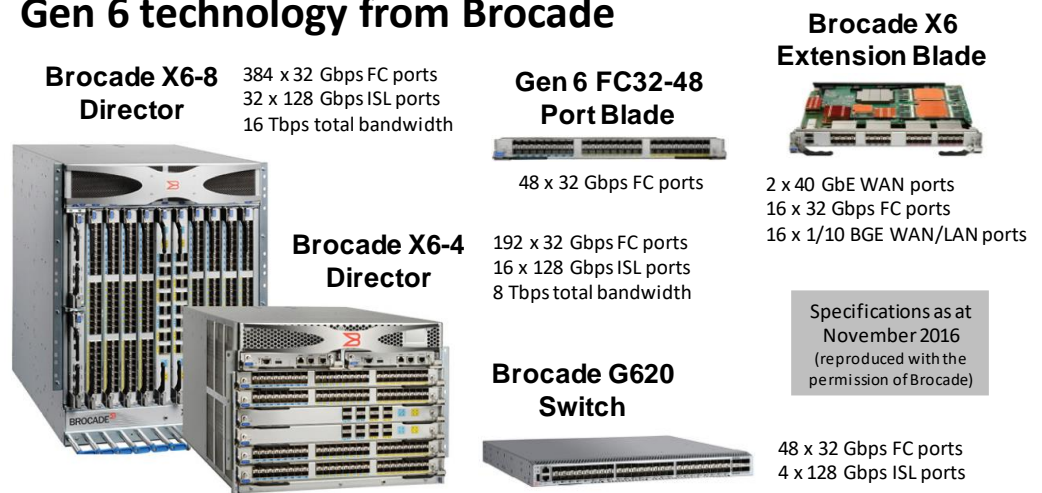
Gen 6 technology example

To give you an idea of what modern Gen 6 Fibre Channel solutions look like, let's again examine how one of the important players in the market addresses some of the key requirements. This time we will look at Brocade, the other co-sponsor of this paper and a close partner with Fujitsu (more on that later). As before, please don't take anything you are about to read as an indication of Freeform Dynamics endorsing any particular offering. Just like Fujitsu, Brocade has a long history of delivering enterprise solutions, so its Gen 6 portfolio provides us with a useful reference point.

The portfolio is unusually broad for Gen 6, starting with a relatively small (in datacentre terms) 64 port switch known as the G620, which is appropriate for more modest or tactical needs. Illustrating the full power and scalability of Gen 6 Fibre Channel, however, we then have the higher-end X6 Directors, designed to be used as a foundation for larger fabrics (Figure 3).

Gen 6 technology from Brocade

Figure 3
Real-life examples of Gen 6 Fibre Channel solutions from Brocade



The X6 Directors are built on blade-based architecture, with blade options such as the ones we have shown being installed into a resilient chassis (with appropriate component redundancy). The size, number and composition of X6 Directors you deploy will clearly depend on your requirements.

Smooth evolution and ultra-scalability

You can combine as many Brocade Directors and switches as you like into a single fabric, and even mix Gen 6 equipment into an existing previous-generation Fibre Channel network.

In line with the Gen 6 spirit, when designing large-scale and/or distributed systems you can combine as many Directors (and indeed G620s) as you like into a single fabric, and even mix Gen 6 equipment into an existing previous-generation Fibre Channel network. If connectivity is required across a WAN, e.g. for remote replication or DR purposes, that's what the Brocade X6 Extension Blade is for.

The overall aim is to allow you to evolve or migrate smoothly from where you are today, and scale freely in the future, no matter how much all-flash storage you add into your infrastructure, and the way in which applications exploit it.

On that note, it is worth mentioning Brocade's commitment to build evolving standards and protocols into its storage network offerings. A good example here is

Brocade has already done the work necessary to ensure that its networks are capable of supporting NVMe based access.

Brocade provides a range of tools under its 'Fabric Vision' brand to address the need for granular monitoring and management in a highly virtualised environment.

Skills, processes, policies and tooling need to be properly coordinated across your IT team(s) so all aspects of your storage environment operate together seamlessly.

When choosing suppliers, it can be helpful to work with companies who are able to take an end-to-end view.

Non-Volatile Memory Express (NVMe), an emerging specification that was originally conceived to provide a standardised mechanism for accessing solid-state storage over a PCI Express bus, e.g. within a server. Brocade has already done the work necessary to ensure that its networks are capable of supporting NVMe based access, commonly referred to in this context as 'NVMe over Fabrics'. It's anticipated that this option will become increasingly popular over the coming years.

In the meantime, there are some operational realities we need to touch on.

Monitoring and management

To address the above-mentioned need for granular monitoring and management, Brocade provides a range of tools under its 'Fabric Vision' brand. Capability here includes the monitoring of host and storage device IO workloads and behaviours, with an ability to quickly and easily identify and isolate the source of device or network performance degradation.

Through a specific tool known as VM Insight, Brocade also enables network administrators to identify, baseline and monitor VM performance end-to-end. As part of this, it's possible to set thresholds for VM flows, and configure alerts so administrators can intervene, troubleshoot and remediate when necessary as part of the service level management process.

Taking the overall system view

The kind of visibility and level of control we have just been discussing is crucial in a fast-moving, mixed workload environment. But what happens if as part of this your network team identifies a problem in the storage array, or indeed, a storage admin uncovers an issue in the network fabric? This question highlights the need to design and operate the storage environment as a single system, taking an end-to-end perspective along the way.

Aligning your internal activities

One requirement that falls out of taking a more holistic view is making sure that traditional lines of demarcation within your IT department don't get in the way of progress. It's not just a case of achieving alignment in terms of the core specifications and growth plans across different aspects of the system. Skills, processes, policies and tooling also need to be properly coordinated to ensure that all aspects of your storage environment operate together seamlessly. Only then will you be able to deliver a coherent and reliable service that meets business expectations while managing continuously escalating demands.

Supplier alignment, and the value of partnerships

When choosing suppliers to help you move forward with your all-flash agenda, it can make sense to work with companies who take a similar end-to-end view. One option here is to rely on a third-party systems integrator that can help you evaluate your requirements, select the right mix of storage and network technologies, then work with you to integrate them into your environment.

Whether you go down the integrator route or not, however, it can make sense to seek out equipment manufacturers who may each be specialists in their area, but work together in partnership to deliver the foundation for a total solution.

Fujitsu and Brocade, combine forces to deliver total solutions which are certified to work end-to-end, and fully supported on that basis.

Fujitsu's ETERNUS AF solutions and Brocade Gen 6 network technology work together not just seamlessly, but in a certified and fully supported manner.

The value of this kind of partnership to customers is particularly significant in a fast-moving area like all-flash storage where 'state-of-the-art' is advancing almost on a month by month basis.

Betting on a Fujitsu/Brocade solution minimises the chances of you waking up one morning and realising that you've been stuck with a dead-end investment.

It's a clear appreciation of this that has led to our two sponsors, Fujitsu and Brocade, combining forces to deliver total solutions which are certified to work end-to-end, and fully supported on that basis.

The all-flash dream team?

Very few days go by in the IT industry without some new kind of partnership being announced. More often than not, these are marketing allegiances designed to get attention and drive some positive PR, generating little or no actual customer benefit.

The partnership between Brocade and Fujitsu is certainly not of this kind. During discussions with the Freeform Dynamics analyst team, it was clear from talking to representatives of each company that the relationship between them is tangible, deep and, in fact, long established and proactive.

Solution-level synergy

Fujitsu and Brocade are both heavily focused on datacentre transformation, and have been working together to serve the needs of larger organisations and mid-sized businesses for many years. They have a history of collaborating on research and development, each dedicating significant time and expertise to ensure that their offerings work together effectively.

As part of this cooperation, relevant elements of each partners' product roadmaps are synchronised to keep pace with evolving technology and customer demands in a highly coordinated manner. Evidence for this is clear from the way in which Fujitsu's ETERNUS AF solutions and Brocade Gen 6 network technology work together not just seamlessly, but in a certified and fully supported manner. The idea is that there should never be more than a few months between one partner making a feature or function available, and the other either supporting or taking advantage of it.

A joint eye on future-proofing

The value of this kind of partnership to customers is particularly significant in a fast-moving area like all-flash storage where 'state-of-the-art' is advancing almost on a month by month basis. And in this respect, the philosophy of both companies to allow customers to move forward smoothly as their needs evolve comes through very strongly when you talk to them.

Whether it's modernisation of the infrastructure or scaling of the overall environment, the joint aim is to avoid costly and disruptive rip and replace scenarios, and allow in-place or even in-flight upgrades and extensions wherever possible. In practical terms, this means you can lay the foundations for your all-flash datacentre today (if that's your ambition) and have a good level of confidence that you will be able to take advantage of new industry developments as they emerge.

Conversely, betting on a Fujitsu/Brocade solution minimises the chances of you waking up one morning and realising that you've been stuck with a dead-end investment. Some early adopters of 1st generation all-flash solutions will be acutely aware of the pain this can cause.

Sales and support

From a commercial perspective, the partnership takes the form of a strategic one-stop purchase and delivery relationship. Put simply, if the customer requires it, Fujitsu can

What Brocade and Fujitsu are doing together is particularly attractive in the context of all-flash arrays given the dynamic and critical nature of this space.

deliver Brocade technology embedded into a fully integrated all-flash solution, specified, delivered and supported on an end-to-end basis to meet current and future needs.

Whether it's pre-contract consulting (e.g. around requirements assessment, system sizing, and so on) or post-sales support (e.g. troubleshooting, remedial work, etc), you deal with a Fujitsu account team or Fujitsu's customer services function. Both of these have privileged access into Brocade's support and engineering teams, with whom they collaborate seamlessly behind-the-scenes.

While this kind of close partnership is not unique, indeed both Brocade and Fujitsu work with other partners in a similar manner, what these companies are doing together is particularly attractive in the context of all-flash arrays given the dynamic and critical nature of this space.

Acting on the all-flash opportunity

As soon as you start putting all-flash arrays in place, you will almost certainly see demands escalate in ways you may never have imagined.

To round off our discussion, let's circle back to where we started - the lessons that can be learned from the "Road to Hell".

The most fundamental mistake made by those who conceived the M25 motorway was to hugely underestimate future capacity requirements. Part of this was failing to consider that it wasn't just the kind of traffic the planners had in mind that would migrate to the new road. As soon as the motorway came into being, drivers that they didn't expect started to re-route their journeys to take advantage of it. At the same time, trips were made that were previously considered prohibitively complex or time-consuming on existing roads. Even local traffic hopped onto the M25 for convenience. The result is what some comedians call "the world's biggest car park".

There is an important takeaway from this as you invest in your storage infrastructure. An analysis of your current application portfolio might initially identify a relatively small subset of applications that really need the performance of solid-state storage technology. As soon as you start putting all-flash arrays in place, however, you will almost certainly see demands escalate in ways you may never have imagined.

Once you are off to a bad start, it's much harder to get things back on track.

It's not just users getting used to fast response times in one application and wanting you to deliver a similar experience more broadly. It's also that it won't take long for developers to discover they can design solutions without having to worry about data access latency, and that this is both easier and results in a better outcome. Pretty soon, whatever your original intentions, the performance characteristics of the new storage environment will become the expected norm. At this point, even if you were initially able to get away with deploying it on your existing storage network, the latter will need expansion. Otherwise, introducing more all-flash capacity into your environment simply shifts the bottleneck. And as the "Road to Hell" experience also tells us, once you are off to a bad start, it's much harder to get things back on track.

The sooner you formulate a robust plan, the better.

Against this background, perhaps the key recommendation we can make is to invest on the assumption that all-flash storage will in one way or another become an increasingly prominent part of your IT infrastructure. Rather than view this trajectory as a challenge that needs to be managed, it's better to be proactive. The sooner you formulate a robust plan around all-flash arrays and Gen 6 style networks, the better.

About Freeform Dynamics

Freeform Dynamics is an IT industry analyst firm. Through our research and insights, we aim to help busy IT and business professionals get up to speed on the latest technology developments, and make better-informed investment decisions.

For more information, please visit www.freeformdynamics.com.

About Fujitsu

Fujitsu is the leading Japanese information and communication technology (ICT) company offering a full range of technology products, solutions and services. Approximately 162,000 Fujitsu people support customers in more than 100 countries. We use our experience and the power of ICT to shape the future of society with our customers.

Business-centric Data Center

Under the theme Business Centric Data Center, Fujitsu provides servers, storage systems, data protection appliances, converged and hyperconverged integrated systems which allow customers to flexibly manage their increasing data volumes at a lower cost of growth, and to benefit from a very reliable architecture and radically simplified operation.

For more information, please see:

<http://business-datacenter.global.fujitsu.com/business-centric-storage#accelerate>

About Brocade

Brocade (NASDAQ: BRCD) networking solutions help the world's leading organizations turn their networks into platforms for business innovation. With solutions spanning public and private data centers to the wireless network edge, Brocade is leading the industry in its transition to the New IP network infrastructures required for today's era of digital business.

For more information, please see: www.brocade.com.

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