White Paper
Flash Forward – a guide to find the right path to your storage solution

Content

Digitization increases data traffic 2
Starting point: Choosing the scalability approach 3
Architectures for independent storage scalability 4
All-flash or hybrid – which way to go? 5
What happens if even all-flash storage is not fast enough for your? 6
When is Software-defined Storage (SDS) the right way? 7
From ETERNUS to converged infrastructures 8
When to move into hyper-converged IT 9
Fujitsu puts you on the right track 10
Digitization has a big impact on storage. More data sources create more data, which needs to be gathered, transmitted, processed and stored. Experts predict a growth in data volumes by a factor of 10 in the next three years. This will lead to higher storage demands in terms of response time as well as faster and greater scalability. In order to keep the costs of this explosive growth under control, the costs per terabyte of data need to be reduced significantly. Since storage systems have to host larger data volumes, customers require longer life cycles because the migration of hundreds of terabytes or even petabytes of data is a complex task.

Not all of these new requirements can be solved with one single storage architecture. This is the reason for the emergence of new and innovative storage designs – such as all-flash systems, software-defined and hyper-scale architectures, plus hyper-converged solutions. They add to the classical controller-based hybrid storage designs which host hard disk drives (HDD) and solid state drives (SSD). What’s more, many storage categories partially overlap, making it difficult for enterprises to find just the right technology for their requirements. The information in the following sections of this white paper provides guidance when choosing the storage approach that is best for you.
Starting point: Choosing the scalability approach

When selecting the right storage for a particular use case, the starting point involves thinking about which overall scalability approach should be deployed with the new storage solution. A key question is whether the demand for additional storage capacity also requires a linear growth of compute power, or whether these growth paths are only loosely coupled.

In a classical architecture there are discrete server, storage and network entities – this is why they are also called ‘3-tier architectures.’ This is an ideal architecture for general purpose scenarios intended to consolidate as many workloads as possible in one central data center infrastructure. It also provides high flexibility when selecting storage, server and networking equipment. The purchase cycles of all three can be decoupled to a certain extent. Currently most mission-critical business applications run on this type of architecture.

Another approach is to merge storage, computing and networking functionalities in one hyper-converged infrastructure (HCI). In this hyper-converged system, computing and storage functions are not separated in different hardware elements, but are instead provided from one “building block” with one embedded management system. Scalability is achieved by adding more blocks. The growth rates of HCI are amazing. Various analysts predict high double-digit growth rates over the next few years. Despite the steep growth of HCI, it is a safe assumption that both scalability models will coexist.

If you are thinking in terms of classical architectures, the next question is what the core application requirements will be in relation to the storage system. Applications like server or desktop virtualization, databases or transactional applications, classical CRM, ERP and SCM, plus several types of analytical applications, require short response times from storage systems. Even more important are reliable response times in order to prevent application time-outs. Of course, there are also huge amounts of unstructured data which are seldom accessed and do not require high storage performance. Due to the sheer amount of data, the key requirement in this case is to achieve the lowest cost per capacity possible. Scenarios to consider are online archive/content depots, 2nd tier cloud storage, gathering historical data for analytical tasks, and media streaming.
Architectures for independent storage scalability

Whenever high and reliable performance is needed, all-flash storage arrays are probably the ideal storage solution. All storage media are non-mechanical and deliver the lowest latency. Scalability is achieved by adding additional shelves (scale up), and fast internal high-speed connections avoid bottlenecks. The system software is optimized for the use of SSDs. The adoption of all-flash storage is rising at a very fast pace because the price – in comparison with fast-spinning hard disks – is eroding dramatically, and data reduction technologies are further reducing capacity costs. This is also supported by many operational benefits like heavily reduced power consumption, less space and less administration effort (e.g. no performance tuning, no replacement of disks). “By 2021, 50% of data centers will use solid state arrays for latency-sensitive workloads, up from less than 30% today.” (Gartner, “2018 Strategic Roadmap for Storage” P3, 12 March 2018)

On the other end of the scale, the best architecture for hosting huge volumes of rapidly growing data is scale-out, software-defined storage (SDS). Essentially the storage software transforms the disks of connected servers into a storage pool. The software ensures high availability by automatically placing multiple copies of the data on different nodes. This also supports adding or replacing hardware nodes on the fly for easy scalability and easy maintenance. Another advantage is the fact that the life cycle can be extended by many years, thus reducing migration efforts. As such architectures typically require a couple of nodes as a minimum configuration, efficiencies of SDS start in the range of 200 to 300 terabytes. Some can scale in extreme petabyte ranges – so there are practically no limits.

In larger environments the combination of all-flash as a performance tier and scale-out, disk-based SDS as a capacity tier may be an ideal combination, providing that the data volume is big enough.

There are a lot of scenarios where it may be necessary to host data for performance-hungry applications like virtualization, databases or OLTP alongside unstructured data, online archives and other “lukewarm” data in a single system. This is where hybrid storage systems, using SSDs and large capacity disks, are still the ideal solution. They are true all-rounders in IT environments and allow you to balance speed, capacity and costs in one single storage system.

---

**ETERNUS AF**
**ALL-FLASH STORAGE**
- Fastest response time
- Lowest operational costs (power, space, maintenance, admin)

**ETERNUS DX**
**HYBRID DISK AND FLASH STORAGE**
- All-in-one
- Balancing capacity, speed and costs in one system

**ETERNUS CD10000**
**SOFTWARE-DEFINED, HYPERSCALE STORAGE**
- Extreme scalability
- Lowest costs (open source)
- Object and OpenStack storage

---

**Reliable performance**
[Image of storage systems]

**Lowest cost of capacity**
[Image of storage systems]
All-flash or hybrid – which way to go?

If your current storage systems are mainly equipped with fast-spinning disks, you should definitely consider an all-flash array as your next storage platform. The price per capacity for SSDs is still four times higher than fast-spinning disks – but this price gap will probably disappear in the next two years. Thus any additional SSD capacity which is added during the second half of your investment cycle will be on the same cost level. Short-term data reduction technologies like deduplication and compression will also significantly close the price gap. Since the effect of these two technologies depends on the data type, make sure that you invest in systems that can use these data reduction technologies in very flexible ways – and definitely avoid architectures in which you cannot switch them off.

All-flash arrays are unbeatable from an operational perspective. SSDs are ten times faster and six times more reliable than hard disks. Furthermore, all-flash arrays require 95% less power and 95% less space for the same raw capacity. The operational workload is further reduced because there is no need for performance optimization or tuning. Overall you can expect 40% less operational effort – the same IT team can manage more data or more processes. In addition, up to 30% fewer servers are needed, which results in lower license costs.

If your objective is to consolidate all your data tiers in one or very few systems, then hybrid systems are the best all-in-one solution. By combining fast SSDs with cost-effective low-spinning disks, they allow you to balance speed, capacity and costs in one single storage system. In contrast to all-flash arrays, however, you may encounter higher operational efforts. But if you use modern automation tools, you can compensate for a fair share of the administration workload. Look for storage systems that let you redefine response times for data volumes. In some systems all internal adjustments like bandwidth allocation or storage tiering are made automatically. Fujitsu offers such technologies.

If you are thinking about whether your next storage replacement should be an all-flash system, or whether it is better to again use a hybrid system for the next couple of years, here are some simple recommendations – assuming that your usage scenario is similar.

- **GO HYBRID** if you plan to consolidate structured and unstructured data in one system.
- **GO ALL-FLASH** when you mainly use fast disks.
- **HYBRID** if you are thinking about whether your next storage replacement should be an all-flash system, or whether it is better to again use a hybrid system for the next couple of years, here are some simple recommendations – assuming that your usage scenario is similar.
What happens if even all-flash storage is not fast enough for you?

Flash storage is unbeatable, but hasn't reached its full potential yet – because the SAS interconnection is still being used. This is very efficient for hard disk connectivity (for which it has been created), but it cannot exploit the full performance potential of SSDs. The next evolutionary step for all-flash arrays will be what Fujitsu calls “Express Flash,” which is based on all-flash arrays using internal PCIe connectivity and the non-volatile memory Express (NVMe) protocol.

In current all flash systems the internal SAS connectivity can queue about 256 commands in a single queue. When using new age technologies like artificial intelligence, big data, analytics or the Internet of Things, this can quickly lead to bottlenecks. This is where NVMe comes in. NVMe deploys flash storage on a PCIe bus directly connected to the CPU and offers up to 64,000 parallel data streams, thus overcoming serial limitations in storage I/O processing. The protocol capitalizes on the multiple parallel, low latency paths to flash storage to offer faster storage response times and higher throughput for faster application performance. It also requires much less overhead when moving data. However, to have a real impact on performance at infrastructure level, it requires an end-to-end view and the elimination of bottlenecks at the application, server and network level. Right now the implementation of an end-to-end NVMe solution stack can be a very demanding task, so early adopters should start with standard SAN having at least 16 Gbps, or even better 32. Finally, upgrades are required for the host bus adapters on the storage and server side, and this in turn will result in driver upgrades. The applications should also be written in a way that allows for parallel data streams.

Fujitsu will introduce NVMe-based Express Flash arrays in the near future. The new product line will expand the overall Fujitsu storage portfolio, giving customers more opportunities to balance speed, costs and capacity. And we can expect a longer time frame of coexistence, with all-flash storage providing best price-performance and with express flash delivering relentless performance.

Mature SAS/SCSI-based all-flash arrays offer an optimal price/performance ratio and more than enough performance for most applications. This also applies in many cases when new applications are to be provided alongside traditional applications. However, you should check in advance how much more parallel data streams need to be processed. Considering the demands NVMe places on the entire IT infrastructure, investing in an all-flash array is still the best choice in many scenarios. Fujitsu ETERNUS AF has the highest ranking in the SPC-1 price and performance benchmark.
When is Software-defined Storage (SDS) the right way?

In terms of performance, the use of high capacity disks, the synchronization of multiple data copies and the networking of storage nodes add a lot of latency, making SDS suitable for applications which do not require low latency. Thus SDS today is mainly used as a 2nd tier storage environment for unstructured data. This may change over time with the emergence of all-flash, scale-out SDS systems, so eventually SDS will find more application areas.

The adoption of SDS is gaining momentum because the architecture promises a robust and secure system with easy and efficient scalability of capacity and performance. Cloud native applications and analytics which require efficient, scalable solutions that help you get more out of your data are the main driver. There is considerable saving potential for overall costs because industry-standard server hardware is used, and various software-defined storage platforms are available as open source products. Probably the most mature and scalable SDS open source platform is Ceph, an open source, software-defined storage platform designed for object, block and file storage from a distributed x86 server cluster. Ceph supports scalable clusters up to the Exabyte level.

A complete SDS setup consists of many components. Servers, a network which connects the servers and a storage software suite which takes care of the storage and data management functions. This involves a lot of integration work and requires substantial testing and evaluation in order to build a flawless and balanced system. Network performance management and incident root cause analysis can be very challenging, not to mention keeping software and hardware updates in sync – a task which is done by the vendor when it comes to traditional storage. The complexity requires expertise going beyond the skills of a storage administrator, and this is keeping IT organizations from adopting SDS.

In order to facilitate deployment and operation, Fujitsu offers the reference architecture ETERNUS CD10000 which provides right-sized components based on best practices. The system is based on open standards throughout, plus optimized Ceph Open Source Software from the Red Hat and Suse alliance.
From ETERNUS to converged infrastructures

ETERNUS Hybrid, All-Flash and Express-Flash storage systems deliver the performance headroom necessary for future data growth. They minimize TCO by automating storage operations, optimizing quality of service management and promoting comprehensive consolidation. When seamlessly integrated into converged infrastructures, customers can leverage these solutions to drive end-to-end data center innovation quickly and efficiently.

More than ever before, today’s IT organizations are faced with the challenge of operating existing applications more efficiently and with more user orientation, while at the same time driving innovation forward with more flexibility. In addition, many business applications will continue to require independent scalability of server and storage resources. Converged Infrastructures (CIs) provide the architecture needed to manage this balancing act. Basically, CIs simplify data center consolidation and innovation, including hybrid IT scenarios, for three reasons:

- CIs save time and money because they are pre-configured and pre-tested: Time savings of 50% or more are possible. Thus IT organizations can innovate faster and reduce the burden on their own IT team.
- CIs simplify scalability by making it easy to independently scale computing, network and storage capacity as needed.
- CIs reduce TCO by simplifying the environment and drastically minimizing the number of devices required, not to mention the associated space, power and administrative overhead.

Ideally CIs should have a virtualization layer and a flexible hardware concept, along with integrated and centralized management. If this is the case, then CIs are almost as easy to operate as their hyper-convergent counterparts.

VMware vSphere is by far the first choice for virtualization in data centers. Building on comprehensive best practices from a long-standing strategic partnership with VMware, Fujitsu has integrated the virtualization platform in PRIMEFLEX for VMware vSphere. This fully virtualized infrastructure provides the complete solution stack required for virtual environments and is supported as one complete solution. Flexible scalability at component level, HA and DR as well as easy functional expandability, e.g. through integration of backup, all guarantee the agility and efficiency necessary in an increasingly dynamic business environment.
When to move into hyper-converged IT

Today HCI has become more than just a niche solution. But Gartner estimates that “by 2020, 20% of business critical applications currently deployed on 3-tier infrastructures will have transitioned to HCIS, up from 5% today (Gartner “2018 Strategic Roadmap for Storage” P3, 12 March 2018). Various kinds of external service providers are the biggest early adopters. Even if HCIs replace some traditional systems, it is quite probable that they will coexist with classical storage systems.

In most cases HCI is based on x86 servers that function both as server and storage systems. As servers play a dual role by providing storage functionality and serving as an application platform as well, this can dramatically reduce the diversity of system hardware. Storage capacity and compute power scale hand in hand. And since everything is virtualized and distributed, it is easy to expand the IT infrastructure and perform hardware refreshes – without downtime and without any migration. What’s more, server administrators usually have or can quickly acquire expertise based on their experience in server virtualization.

HCIs are less suitable for scenarios that need high scalability in terms of data volume, but do not require much computing power to move data. To ensure expected response times, the sizing and configuration of HCIs must take into account the server resources required for storage functions. Since an HCI is typically a distributed environment, the network and the ongoing data copy transactions between servers add latency. In larger configurations this may require complex tuning and optimization at the operational level, not to mention adapting server and network configurations. Finally, HCIs could also result in an additional storage silo in the data center, and that would have a negative impact on operational efficiency. In fact, it could even mean adding another platform with its own provisioning, management, backup and disaster recovery, plus capacity planning tools.

Microsoft and VMware are the leading commercial vendors of integrated virtualization stacks for HCI. The advantage of HCI software provided by these vendors is that HCI can be run on any suitable hardware. Thus hardware and software support – as well as management – will be separate. This means that the challenges of implementation, operation and maintenance could increase operational effort, costs and risks.

That is why Fujitsu offers complete hyper-converged solutions comprised of the right hardware, software stacks from VMware and Microsoft. These solutions are fully supported and maintained, allowing you to fully benefit from new agile IT concepts without any pitfalls after purchase.
Fujitsu puts you on the right track

There are many new ways to handle storage. All have their particular advantages for individual application scenarios. As a vendor of storage, servers and hyper-converged solutions, we support you in finding the right storage approach to your requirements.

We offer ETERNUS AF all-flash today in the near future also Express Flash storage with leading-edge performance and the highest levels of operational efficiency. They support the flexible use of modern data reduction technologies and have the richest options for implementing cost-effective disaster recovery configurations.

With ETERNUS DX hybrid storage we enable you to achieve a maximum of storage consolidation for structured and unstructured data by balancing speed, capacity and cost in one system. The latest automation technologies allow you to manage more data without additional IT personnel.

ETERNUS CD10000 is an extremely scalable SDS platform ideal for cost-effective storage of huge volumes of 2nd tier and unstructured data. The combination of the right hardware with the most advanced open source storage software allows you to implement SDS in a fast way.

Our PRIMEFLEX converged and hyper-converged solutions for VMware, Microsoft and other vendors deliver all the benefits of new and agile approaches for data center innovation.

When planning your next storage project, be sure to contact Fujitsu! https://www.fujitsu.com/emeia/products/computing/storage/