Next generation datacentre infrastructure

Convergence and hyper convergence are shaping the IT infrastructure of tomorrow

Definition

Converged infrastructure involves multiple IT components being linked together to form a single, optimised computer system. Servers, data storage devices, network equipment and software for operational support of IT infrastructure are all components that may be included in a converged infrastructure.

Hyper converged infrastructure solutions natively collapse core storage, computing, and storage networking functions into a single software solution or appliance.
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Background

In the world of IT, convergence means linking together multiple components in a datacentre to form an integrated system which is supplied more or less ready to operate. Servers, storage and networks used to be managed individually.

Convergence is currently a strong trend which has increasingly come to characterise both the product selection on the market and how IT infrastructure is built in practice. The next step in development involves hyper convergence, a term used for systems in which integration has been taken even further. Solutions and products now exist where a complete IT infrastructure is accommodated in a single unit.

There are a number of driving forces behind convergence, and most of them relate fundamentally to finance. It is a way of countering increased complexity in the IT environment, getting away from the traditional “silom mentality” where systems are divided according to function – servers, storage, backup and network – and where specialists were required for installation, operation and support in each field. The hardware was linked directly to the relevant function, and as a rule a number of suppliers were involved.

With hyper converged the functions are by definition all made in software and build a scale out architecture based on commodity hardware. This is a key trend in the datacentre and is described as a software defined datacentre.
Convergence and virtualisation

Datacentre structure has altered a lot since the turn of the millennium. Virtualisation has been the great novelty; the option of managing servers, storage and even the user environment as logical units instead of linking every function to a physical machine. Convergence can be said to be a natural consequence of virtualisation – although a virtualised environment does not have to be converged.

The degree of virtualisation varies among various converged infrastructure options, but essentially server virtualisation is always present. Nowadays, the trend is moving towards a fully virtualised environment in which even storage and networks are controlled by means of software. New terms have been introduced to describe this development: SDS (Software-Defined Storage), SDN (Software-Defined Networking) and SDDC (Software-Defined Datacentre), for instance. Hyper converged systems developed by one manufacturer from the ground up are often described as fully virtualised and given the SDD label.

Converged IT infrastructure is also supplied with the promise that the component parts are all tested and optimised to work together. Time is saved as a result on account of faster deployment and greater reliability thanks to the fact that there are fewer potential error sources. And even if products from various manufacturers are included in the systems, only one supplier is needed to work with the customer.

Efficiency and cost savings during continuous operation are another significant argument. Convergence means that operational support and monitoring can be implemented using fewer tools – ideal from a single monitor. It also means less complexity so there are clear saving although the CAPEX cost is most cases on the same level as buying individual components.

Converged systems are available in a number of set configurations in which the component parts and their capacity cannot be selected freely, as when a datacentre is constructed in the traditional way. The degree of flexibility and the element of freedom as regards the selection of the component parts varies among the different options on the market.

What are known as the reference architectures for converged infrastructure provide the opportunity to combine equipment of different makes and offer enormous scope in terms of capacity and performance, as well as several options in terms of manufacturer and product.
From convergence to hyper convergence

Hyper convergence is a further development of the concepts and architectures that have emerged for converged IT infrastructure. This involves complete products in which servers, storage and network functions are accommodated in a single unit – a kind of “all-in-one” solution. A hyper converged infrastructure can replace a number of different separate products: servers, storage devices for various levels (disk, SSD, backup), control devices for storage networks (SAN), load balancers, WAN optimisation, etc.

Certainly, all-in-one solutions have occurred in various IT contexts previously, but hyper converged infrastructure is a new concept on the IT market and the field is currently developing at a great pace. This major interest can be explained by the fact that it involves technology which promises to dramatically simplify matters and reduce the cost of running a datacentre. And regardless of manufacturers’ typical promises of cost savings – a figure of 50 per cent is commonly cited – it is entirely logical that a system with strongly integrated components and functions, a more compact format and a shared power supply will also be cheaper. Hyper converged solutions generally have a more fixed architecture and are also more limited in terms of capacity compared with converged solutions. If there is an increased need for storage, for example, it is not always possible to add extra storage in the same way as with an independent storage system without expanding or upgrading the entire solution at the same time.

Hyper converged technical background

Hyper converged is a term that can be described as an infrastructure in a box since server, storage network and server are combined in a single chassis. The chassis is a standard PC server with built in storage of different flavours. All functionality is built in a software layer that covers not only storage and data management functionality but can also run the virtual server instance. It does in many cases make sense to combine the virtualized storage with the virtual server instance to create a virtualized infrastructure on a single chassis – an hyper converged solution.

In many cases the solution are packaged as appliances but there are also software only solution available. An important distinction in the architecture is that the storage network is not needed but to scale out between several chassis a standard 10gBit ip network is needed.

The market is still in its infancy but the projections for the future is quite aggressive. The Wikibon projection below is of course somewhat qualified guessing but it has shaken up the storage and server vendors and most all of the have solution.

![Graph showing projections for Traditional Enterprise Storage, Hyperscale Server SAN & Enterprise Server SAN](source:image)

What is called Server san is the innovative software technologies that is the foundation of every Hyper converged solution apart from the actual hypervisor and integration with the hypervisor management frameworks. This is the magic sauce in hyper converge solutions so let’s dig into a bit more.

The current Networked Storage SAN/NAS model was a reaction to the inefficiencies of the direct attached (DAS) model of the late 20th century. Centralizing storage onto storage arrays attached to multiple servers created significant improvements in storage utilization. Moving applications to different servers is much easier - seconds/minutes vs. hours or days. Over time, functionality previously in the server migrated out to the storage array, e.g., synchronous and asynchronous replication. Switched network capabilities improved, and a complete ecosystem was born around the storage array. The arrays adapted to new technologies such as flash, embraced automatic tiering technologies, and helped address the overheads of virtualization with complex APIs between the hypervisor and the storage arrays.

The performance of arrays has always centered on caching IO in the storage array controllers. Reads are cached in storage controller DRAM, and writes are cached in small amounts of battery or capacitance protected DRAM. Storage arrays work best with applications that have small working set sizes, have good locality of reference and are "well behaved" in terms of IO request rates. Application design and operational processes and procedures have adapted to the storage array technologies and topologies. The choice of storage vendor brought with it a strong incentive to buy the storage management software from the same vendor. Operational procedures are baked into the specific array software. The cost of migration from one vendor to another is high.

Virtualization and flash technologies have also highlighted the disadvantages of the fibre networked storage model. When IO latency is measured in 10s of milliseconds, and the number of IOs to a disk drive is limited to 100 IOs/second, the overheads of a fibre network are not important. As flash allows orders of magnitude more IO, and potential IO latencies are reduced by a 1,000 times, the protocol overheads of IO and fibre networks become a bottleneck for new applications.
The management of storage in storage arrays is complex to set up and monitor, and even the language of storage (LUNs, ports, RAID, etc.) has resisted simplification and this is a challenge where one is not able to have dedicate storage admins.

So the hyper converged world take advantage of the improvements in ever more powerful CPUs, flash drive, ultra-fast LANs and the fact that a key admin point has become the hypervisor management tool and adopted to these changes.

Converged and Hyper converged Architecture overview
To explain hyper converged we will compare it to the converged solutions we have seen in the market for several years.
The converged solutions are built by discrete components (server, switch and storage) each have their own package of hardware and software. Every component is managed and scaled independently which have both its pros and cons. It’s powerful and flexible but requires a lot of competence to manage all bits and pieces.

A converged will not only support virtualized infrastructure but have the ability to run application on physical hardware.
The hyper converged consist of a number of standard PC server with a software layer installed on top to aggregate the combined storage resources for all the chassis. This is a scale out design where one can start with a few PC:s and grow as you need to a large number of chassis over time.
On the same PC the hypervisor and its management tool is normally installed – in some cases preinstalled. Most of the solution have a separate management tool to handle the storage and data management part of the solution but most if not all functions are tightly integrated into the Hypervisor management tool (i.e. Vcenter) for a single point of administration – one of the key differentiators.
Virtualisation, convergence and the cloud

The development of datacentre virtualisation and convergence is taking place in parallel with the rapid growth of cloud services. There are links between these trends. Virtualisation is a fundamental prerequisite for cloud services, these always go together. At the same time, virtualisation is facilitated by convergence. One way of looking at it is to consider the fact that converged systems have been built with virtualisation and the cloud in mind.

Most suppliers of converged infrastructure provide the option of choosing from various hypervisors, the central software which allows virtualisation to take place.

Common hypervisors on the market at present include VMware vSphere ESX and ESXi, as well as Microsoft Hyper-V. These are commercial products, but a number of hypervisors have also been developed as Open Source code, including Xen, KVM (Kernel Based Virtual Machine) and Open VZ. Both Xen and KVM have in turn been adopted by commercial stakeholders who have created their own versions; Citrix XenServer, Oracle VM and Red Hat KVM, to name but a few.

Hypervisor software used to focus fully on server virtualisation, but these products have also been expanded to include new functions so as to extend virtualisation to more levels. For instance, VMware VSphere has been supplemented with Virtual SAN (VSAN), which adds virtualised storage (Software-Defined Storage, SDS).

Advantages of convergence

- Easy installation and deployment. Customers do not have to test or optimise the system, this job is already done.
- Clear distribution of responsibilities. As a customer, you have only one company to deal with for support issues even if you choose a converged solution involving components from a number of suppliers.
- Certification provides a “guarantee of reliability” – different manufacturers are unable to blame problems on one another.
- Simplified regular maintenance. Consistent administration of all IT processes.
- Greater opportunities for datacentre automation.
- Energy savings. Reduced power consumption for operation and cooling.
Value of a hyperconverged solution

The key differentiator pioneered, and still viable, by converged infrastructure is to be able to deploy a service efficiently, with limited risk and technical issues. Hyper converged build on this by simplifying the deployment even further. Added upon this is the ability to start small and grow in small increments. Expect the actual CAPEX of a specific configuration be about the same as for a converged solution. The potential savings are in more granular expansions and a more simple way of managing the solution. This is especially true where we don’t have the ability to hire or train sysadmin that focus on managing the storage layer. Here we can manage the whole solution using hypervisor tools and competencies.

Potential use cases for hyperconverged

It is early days for Hyper converged solutions and if you take away the hype we have seen success in point use cases like VDI, Remote office and 2nd/3rd Tier applications.

Where these solutions goes in the future is certainly decided by initial success (or not) but of course how these technologies mature and develop.

- The expansion of workloads, and continued growth within VDI environments, helped drive total 2014 hyperconverged systems sales (hardware and software) up 162.3% to $373.2 million.

- Prior to 2015, the vast majority of hyperconverged systems were sold by limited number of start-ups and their partners. With a striking number of top-tier OEM infrastructure suppliers now rolling out their own offerings, global market awareness and product availability are expected to increase considerably over the billion-dollar mark sometime during 2016.

- In 2015, hyperconverged systems sales (including hardware and software) are expected to increase 116.2% over the previous year to $806.8 million in value. The market is expected to experience a 59.7% compound annual growth rate (CAGR) from 2014 to 2019, with it will generate more than $3.9 billion in total sales.

The “use cases” 2014-2019

Source: IDC
Converged IT infrastructure

The Path to Hyperconvergence

All the major datacentre system suppliers offer converged infrastructure products and concepts.

- VCE has developed the reference architecture Vblock, where complete converged infrastructure “stacks” are built up with storage from EMC, servers and network functions from Cisco and a hypervisor from VMware.
- FlexPod is a reference architecture for converged systems, with hardware from Cisco and NetApp. This includes components such as Cisco UCS servers, Cisco Nexus switches and virtualised storage systems from NetApp FAS or E-Series. Support for VMware vSphere, Microsoft Hyper-V, RedHat KVM and Citrix XenServer is available for server virtualisation.
- EMC has the reference architecture VSPEX for converged infrastructure. VSPEX forms the foundation for pretested and validated systems aimed at small and medium-sized organisations.

As an independent integrator, Proact evaluates the market regularly in order to offer its customers the best converged and hyper converged solutions with the partners that have made the most progress in the field. This white paper contains a list of the market-leading solutions which Proact feels are best suited to the Swedish market.
Reference architectures

Collective initiatives, where suppliers have joined forces and created what are known as reference architectures for converged infrastructure, are an important factor on the market. Solutions in which products of various makes can be combined have resulted from these partnerships. These include FlexPod and Express-Pod, which are supported by Cisco and NetApp, VCE/Vblock (EMC, Cisco) and VSPEX (EMC, Intel, Microsoft, VMware, Cisco).

For hyper converged systems, there are also a number of small, new companies specialising in such products. Nutanix and Simplivity are two suppliers in this category. We also see traditional vendors like EMC and NetApp catching up with EVOrail based solutions – a version of VMware VSAN technology.
Vblock (EMC-Cisco)

VCE (Virtual Computing Environment Company) started off in 2009 as a company co-owned by EMC and Cisco, with the support of EMC subsidiary VMware and Intel. EMC has been the sole owner of VCE since 2014, and it now belongs to the same part of the company which develops EMC’s reference architecture VSPEX (see below).

VCE has developed the reference architecture Vblock, where complete converged infrastructure “stacks” are built up with storage from EMC, servers and network functions from Cisco and a hypervisor from VMware.

Vblock is available through fixed and pretested configurations, currently divided into five levels according to capacity, from the smallest Vblock 100 up to Vblock 700.

Vblock is a stricter reference architecture, with fewer options to choose from compared with a more open architecture such as VSPEX. However, Vblock offers good scalability within the scope of each configuration, allowing both server and storage capacity — among other things — to be adapted to suit individual requirements. There are also special variants of Vblock, systems built especially for various applications, including VDI (desktop virtualisation), advanced relational databases and the memory database SAP Hana.

VCE offers its own complement to tools from Cisco, EMC and VMware for management of Vblock systems. This is known as VCE Vision and offers an open API which makes it possible to integrate the various manufacturers’ support systems, as well as other existing system administration tools.
NetApp FlexPod

FlexPod is a reference architecture for converged systems, with hardware from Cisco and NetApp. This includes components such as Cisco UCS servers, Cisco Nexus switches and virtualised storage systems from NetApp FAS or E-Series. Support for VMware vSphere, Microsoft Hyper-V, RedHat KVM and Citrix XenServer is available for server virtualisation.

Three basic FlexPod variants are available:

- **FlexPod Express** is suitable for small and medium-sized enterprises wishing to consolidate and virtualise their IT infrastructures.
- **FlexPod Datacenter** is aimed at companies and suppliers of cloud services with large-scale IT environments. Fully flash-based storage can be selected. Packages are available for applications from VMware, Microsoft, Oracle, SAP and Citrix.
- **FlexPod Select** is for dedicated environments with specific and sometimes extreme performance and data volume demands where having a separate converged infrastructure is applicable.

Special configurations are available for users with Oracle databases and Hadoop, a popular framework for Big Data applications.

FlexPod solutions offer good opportunities to choose between different components and plenty of flexibility for expansion. Some minimum configuration requirements, including switch duplication, are defined in order to guarantee high uptime.

FlexPod solutions are managed via suppliers’ administration tools, NetApp OnCommand and Cisco UCS Manager, but also with full automation and orchestration with tools such as Cisco UCS Director, vRealize and Azure.

FlexPod is now undergoing further development in order to support software-defined networks (SDN). FlexPod will support Cisco’s SDN technology, Application Centric Infrastructure. Openstack and Cloudstack environments are another field offering plenty of development for FlexPod customers.
EMC VSPEX

Besides Vblock, EMC also has the reference architecture VSPEX for converged infrastructure. VSPEX forms the foundation for pretested and validated systems aimed at small and medium-sized organisations. VSPEX focuses on cloud-based environments, with users wishing to switch to private clouds or hybrid clouds, while Vblock is often produced as a more general architecture.

VSPEX also differs from Vblock and other reference architectures on account of greater flexibility, with more alternative products and suppliers and greater upward and downward scalability. For data storage, however, only EMC products are included in VSPEX, but the company’s broad range nevertheless offers plenty of choice thanks to the VNX and VNXe product ranges and others.

Cisco UCS or Intel-based servers can be used with VSPEX, which supports network devices from Cisco and Brocade. VMware, Microsoft Hyper-V and Citrix XenServer can all be selected as VSPEX hypervisors.

VSPEX-based systems are available in three variants which correspond to different environment types and capacity requirements:

- VSPEX End User Computing. Desktop virtualisation (VDI) solutions aimed at small and medium-sized companies and organisations.
- VSPEX for Private Cloud. Infrastructure for medium-sized companies and organisations.
- VSPEX for Enterprise Hybrid Cloud – Infrastructure for larger organisations, with options for integration between private and public cloud services.

VSPEX-based systems are also offered through various packages of common applications: Microsoft Exchange, Microsoft SharePoint, Microsoft SQL Server, Microsoft Collaboration Suite and Oracle.
Other converged infrastructure solutions

**Hitachi Data Systems UCP**

Hitachi Data Systems (HDS) has collated its converged infrastructure offering in its Unified Compute Platform (UCP) product range. This includes both fully integrated, ready-to-operate systems for standard applications and general systems based on Hitachi’s own reference architecture. The first category includes custom solutions for Oracle databases, SAP Hana and Microsoft SQL Server.

Hitachi Compute Blade or Cisco UCS blade servers, switches from Brocade or Cisco, and various storage systems from HDS are components available for selection. The virtualisation software is either VMware vSphere or Microsoft Hyper-V.

The HDS administration tool UCP Director is a general framework for the entire converged infrastructure. In turn, this can be integrated with existing support systems via a special interface.
Hyperconverged IT infrastructure – suppliers

VMware Evo:Rail

Evo:Rail was launched in the autumn of 2014 as the first VMware product for hyperconverged infrastructure. Evo:Rail is used to virtualise and implement software control for all components in the IT infrastructure: servers, storage and networks. VMware VSAN and other solutions are used for virtualised storage.

Evo:Rail is not available to purchase from VMware as separate software, it can only be purchased in combination with hardware from a partner company. This ties in with the idea of offering optimised, ready-to-operate systems requiring minimal preparation for deployment. Of the major systems suppliers, Dell, EMC, HP, Fujitsu and NetApp have all launched products based on Evo:Rail.

NetApp supplies a solution based on Evo:Rail in which hyperconverged Evo:Rail solutions are combined with Clustered Data ONTAP and integrated in collective automation and administration. This creates new options for using enterprise functionality for efficiency and data protection, and for combining with private or public cloud solutions offering the same options.

EMC’s Evo:Rail-based product is known as VSPEX Blue Hyper Converged Infrastructure Appliance. It comes with additional built-in software from EMC for handling functions such as systems administration, disaster recovery and data protection.

Nutanix

Nutanix is a young company which began with strong financial support from venture capital firms. Nutanix was early to market with a complete product for hyperconverged datacentre infrastructure.

Nutanix Virtual Computing Platform is a distributed system made up of standardised modules known as nodes. The solution offers easy deployment and good scalability through clustering, allowing multiple nodes to be linked together and new nodes to be added quickly when requirements grow.

A hypervisor for virtualisation (Nutanix supports VMware, Hyper-V and KVM) is run in every node, along with the supplier’s Nutanix Operating System (NOS) software. These notes have Intel-based servers and storage, and both flash memory and standard hard disks are available as options.

Nutanix supplies complete hardware and software systems through its NX-3000 product range. Alongside its general NX-3000 solution, Nutanix also offers application packages for functions such as desktop virtualisation (VDI) through Citrix XenDesktop.
Simplivity

Simplivity is a new supplier focusing entirely on hyperconverged solutions. The company was formed in 2009 with strong venture capital backing. Simplivity launched its first product, OmniCube, in late 2012, making a name for the company in the field of datacentres.

The term Software-Defined Datacentre is close at hand for describing Simplivity’s ambitions for OmniCube. OmniCube is a closely integrated system with servers, storage (both flash-based and conventional disk), networks and advanced software for controlling all components, including storage and networks. Three product models are available which meet different requirements in terms of processor power (up to 24 CPU cores) and storage capacity.

OmniCube is currently supplied with just one hypervisor, VMware, for server virtualisation, but Simplivity has plans to support Microsoft Hyper-V as well.

The OmniCube hardware is based on technology from Dell, with Intel Xeon processors as the most important component. The associated software, OmniStack, includes virtualised storage functions, with compression and deduplication when data is saved, as well as for backup and replication. The user interface is integrated with VMware’s administration tool.

Simplivity also offers a product known as OmniStack Integrated Solution where the company’s software and storage controller (Accelerator Card) are combined with hardware from Cisco (rack-mounted Cisco UCS C-servers) in order to create a complete hyperconverged infrastructure.
EMC ScaleIO

Alongside EMC's storage products included in various reference architectures (VSPEX and Vblock) is EMC ScaleIO, a fully software-based product for converged, network-based storage (SAN). ScaleIO collates storage and server resources into a uniform, shared system and can utilise relatively simple hardware, standard servers with directly connected storage. Both capacity and performance can be scaled up linearly, so ScaleIO offers the option of growing from individual servers to thousands. ScaleIO can shared the same physical PC as the hypervisor thus making it a hyperconverged solution.

ScaleIO was initially developed as an independent product by a small company which was bought out by EMC in 2013. This background means that ScaleIO is not dependent on other EMC and VMware products, but works with more or less all types of disk-based and flash-based storage.

Comparisons are sometimes drawn between ScaleIO and VMware Virtual SAN (VSAN), another virtualised storage solution. However, these products have very different starting points. VSAN is an integral part of VMware vSphere and offers very high performance in environments in which server virtualisation has already been implemented, and is managed easily together with other VMware tool functions. ScaleIO makes it possible to build a very scalable storage system on a less uniform platform which may include several hypervisors and different types of physical server, for example. ScaleIO is installed and managed as a separate system, which requires special expertise.
Take the next step with Proact

Reference architectures – complete systems involving components from a number of manufacturers which are supplied fully tested and optimised – are available to facilitate the introduction of a converged IT infrastructure.

Proact can assist with planning, designing and implementing an integrated and converged or hyper converged infrastructure based on your requirements, demands and targets. To facilitate a transition, we can analyse the existing IT environment first and recommend how to build on it, while also taking into account investments already made.

Visit our website at www.proact.eu or our contact our local offices.
Proact is Europe's leading independent integrator in the field of integrated systems (data storage, servers and networks) and private cloud services. Proact supplies business benefits by helping companies and authorities the world over to reduce risk and costs, and above all to supply flexible, accessible and secure IT services.

Proact solutions cover all data centre elements, including storage, servers, security and network functions. In addition, Proact’s cloud service operations manage 70 petabytes of information. Proact has completed more than 3,500 successful projects all over the world to date.

The Proact Group has more than 660 employees and conducts business in Belgium, the Czech Republic, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, the Netherlands, Norway, Slovakia, Spain, Sweden, the United Kingdom and the USA. Proact was founded in 1994, and its parent company Proact IT Group AB (publ) has been listed on Nasdaq Stockholm under the symbol PACT since 1999.

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