The Future of the Data Center Is Software Defined.

A software-defined data center (SDDC) provides an easy-to-automate infrastructure foundation for delivering IT at the pace of business innovation.

Executive summary

Business leaders are constantly asking IT departments how the public cloud can provide services that are so much faster, cheaper and more flexible than in-house solutions. The answer is simple: automation. Future-ready data centers that leverage a software-defined foundation have high levels of automation that control and coordinate every facet of the environment, enabling service delivery that will meet business requirements today and tomorrow. A software-defined data center (SDDC) provides an easy-to-automate infrastructure foundation for delivering IT at the pace of business innovation.

At the heart of the SDDC is the idea of abstracting the hardware and enabling its functionality in software. Hardware today is so fast that it's no longer necessary to run everything in firmware. It's possible instead to use a generic platform with specialized software that enables the core functionality, whether for a network switch or a storage controller. Firewalls, for example, were once specialized hardware appliances; today, they look like — and in fact are — general-purpose servers with specialized software.

Virtualization has revolutionized computing and allowed unprecedented flexibility and speed of deployment. In a modern ecosystem, virtualization enables both portability of entire virtual servers to far-off data centers for disaster recovery and local virtual server replication for high availability. What used to require specialized hardware and complex cluster configuration can now be handled through a simple check box.

By applying the principles behind virtualization of compute to other areas such as storage, networking, firewalls and security, we reap its benefits throughout the data center. And it's not just virtual servers: entire network configurations can be transported to distant public or private data centers to provide full architecture replication. Storage can be provisioned automatically in seconds and perfectly matched to the application that needs it. Firewalls are now part of the individual workload architecture, not of the entire data center, and this granularity against threats inside and out, yielding unprecedented security.

But what does it all mean? Is the SDDC some high-tech fad or invention? Absolutely not. The SDDC is the inevitable result of the evolution of the data center over the last decade.

The evolution of the data center

This evolution has happened quickly, and it is worth discussing how it unfolded. Virtualization was born in the mainframe, and its application to the x86 server proved vital. Critical IT services were no longer tied to individual physical servers, and applications gained dramatic improvements in density, scalability and portability. Today, the growth of big data and analytics and the emergence of the Internet of Things (IoT) have created more storage, networking and security complexity. This complexity is expensive, not only because of the capital expense of hardware, the ongoing operational expense of managing it and the lack of visibility and reporting, but also because of the lack of agility and flexibility of traditional data centers.

To administer the increasingly complex infrastructure, functional management silos of compute, storage and networking have evolved over time, each silo requiring specialized management skills. Additionally, the individual silos have grown independently to address their specific concerns, often without a broader perspective of the entire environment. This is problematic for today's businesses because it makes it difficult to manage change, address incidents or innovate.

Ironically, the very data center architectures that powered business improvement and innovation have now become an impediment to continued growth.

Thankfully, virtualization can once again address the increasing demands on IT infrastructure. Extending the concept of virtualization to the entire data center makes it possible to abstract, pool and automate all areas of the data center and achieve IT as a Service.

A history of the data center

1940s
Early mainframe computers emerge.

1960s
Mainframes go mainstream. Compute functions are partitioned (virtualized) to improve utilization.

1970s
ARCNET and ARPANET are early precursors of the Internet.

1980s
The personal computer arrives. Early virtualization technologies are abandoned as multitasking moves out of the data center.

1984
Dell Inc. is founded in a dorm room at the University of Texas.

1990s
Client-server computing begins. Affordable x86-based computing moves to the data center.

Late 1990s
The emergence of the Internet creates an explosion in demand for data centers with advanced capabilities.

1998
VMware is founded in Palo Alto, California, bringing virtualization to the x86 world.

Early 2000s
Internet demands catch up with the data center, creating massive power and efficiency challenges.

Mid 2000s
x86 server virtualization arrives to help improve the efficiency and utilization of the Internet-era data center.

Late 2000s
Software as a Service (SaaS) and cloud arrive — and multi-tasking functions begin to move back into the data center.

Late 2000s
Modular data centers appear and advanced virtualization opens the door for "the cloud."

Early 2010s
Virtualization extends to storage and networking.

Today
Cloud technologies are increasingly automated and hybrid in nature.

Tomorrow
Welcome to the world of software-defined everything.

The SDDC: a service-first strategy

IT has become a strategic asset and in order to stay competitive, modern businesses must include technology-based services, and do so quickly. But achieving speed and efficiency in a siloed data center can be a real challenge.

> "Management is moving closer to compute, and what started with virtualization (software-defined compute) has expanded to include software-defined storage and software-defined networking. What's more, convergence is breaking down management barriers, changing the way data centers are deployed and simplifying management functions. All of these core technologies combine to create the software-defined data center. "
>
> — Luke Mahon
> Dell Enterprise Solutions Group

The building blocks of the SDDC are straightforward. The primary goal is to be able to manipulate each of these components in a standardized way through software. Orchestration, automation and policy enablement can be accomplished via management software to enable a more efficient and integrated architecture.

Compute virtualization: Also referred to as server virtualization, compute virtualization is an essential building block for the SDDC. Pioneered by VMware in the x86 server space, it allows multiple physical servers to be shared (via a hypervisor) by multiple encapsulated virtual machines. The workload or service (i. e., the specific application or business functionality) thus becomes decoupled from the underlying hardware.

Software-defined storage (SDS): In a data-intensive world, SDS helps ensure that the pools of storage needed for various applications and services remain available and accessible. Storage virtualization can be very powerful by coupling the data to the workload. It can do this because it knows about the workload, not just the storage pool, as in traditional implementations. As the scale and type of data change, zettabyte-scale data lakes become prohibitively expensive and the business needs solutions that will scale with the data requirements. SDS can help build massive scale with commodity hardware at a fraction of the cost of traditional enterprise storage.

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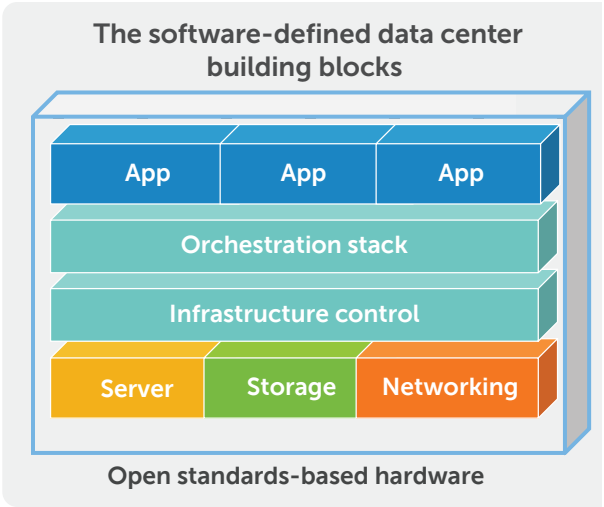


Software-defined networking (SDN): SDN evolved because the old practice of manually connecting has become unsustainable in today's complex data center. SDN only requires the physical connection of cables to happen once, after which software can be used to manage, control and alter the flow of information as needs change. This allows for architectures in which workloads live on their own network, completely isolated and firewalled from the rest of the data center, and in which networks can be created for application testing and then instantly decommissioned after the testing. This is possible because the network is tightly coupled to the workload or application.

Management: The SDDC depends on software to manage all of the infrastructure resources in the data center. In a traditional data center, each silo is managed within its own domain. The SDDC management software bridges the silos so that all of the necessary resources can be viewed and managed together. Properly implemented, the SDDC will dramatically reduce the number of tools and resources needed to build and manage the infrastructure.

Security: The management software extends beyond the data center components of server, network and storage to the application layer. This is how the SDDC approach couples the infrastructure resources to the unique needs of a particular application, service or workload. When security principles are applied to the entire ecosystem of an application, security can be based on specific requirements. For example, the network topology is not based on or limited to a coarse construct such as a VLAN or a network location but instead on the application's unique connectivity requirements. As a result, individual workloads can run in their own microsegmented space with each microsegment having its own unique policy-based security.

Choosing the right approach to the SDDC

In determining how to approach SDDC implementation, keep in mind that the SDDC is an infrastructure-architecture approach, not necessarily a destination. Therefore, you don't have to "software-define" your entire infrastructure all at once. Keep in mind, too, that the SDDC is an extension of technologies that your business has probably already adopted, so you don't have to start over.

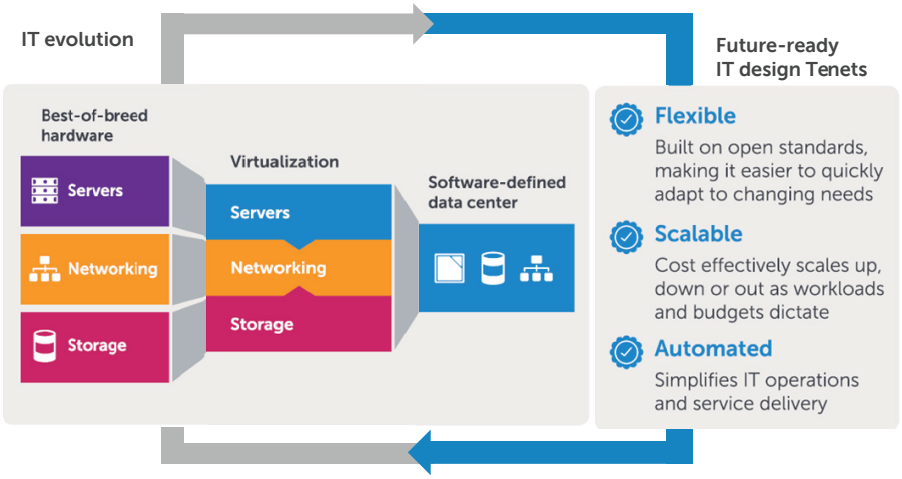
The SDDC approach allows IT to focus on a core set of outcomes that delivers significant business benefits. These outcomes include:

Accelerating innovation

- Application and infrastructure automation with services delivered in minutes rather than days or weeks
- Streamlined and automated data center operations
- Increased choice, flexibility and extensibility

Improving security and control

- Micro-segmentation of workloads to prevent the spread of threats by encapsulating workloads (which are comprised of networks, virtual machines and applications) with security policies like firewalls to provide fine-grained security control
- Automating availability and recovery to enable policy-based application and service continuity across the IT infrastructure (both on-site and in the cloud) to ensure that workloads are available and backed up at all times



You can, and should, take advantage of existing investments. What we're really talking about is a fundamental shift in philosophy. The SDDC reflects a change in how you manage resources, not a change in the resources themselves, and in how you align IT services to business needs. Most Dell customers have already taken the first step with compute virtualization and many are adopting SDN and SDS.

At Dell, we see three approaches to SDDC adoption:

1. Bimodal: The first approach is to adopt Gartner's Bimodal IT concept and run traditional IT alongside an SDDC infrastructure. As you acquire new hardware to support a specific workload, you can take an SDDC approach to ease into this new world. Many vendors have reference architectures as well as fully engineered, prepackaged and validated solutions that can save countless hours of hardware assembly and configuration. Adopting such a "cloud in a box" architecture is an expeditious way to enable a bimodal approach.

2. Fully software defined: The second and somewhat bolder approach is to implement a fully software-defined environment. This typically only happens during a major restructuring event such as a divestiture or a greenfield cloud implementation. Such deployments offer the most latitude for implementing a fully software-defined environment since they are not constrained by legacy considerations. However, with no existing fabric, they also require significant planning to ensure that every aspect of a modern data center is taken into account. One exciting attribute of a brand-new data center could be modern facility management software that provides APIs that communicate with the SDDC management software, so that workload placement is informed by the physical attributes of the data center. This enables the workloads to be informed of not only the base compute, network and storage, but also the physical environment in which it will be launched.

3. Evolutionary: The third and final approach is evolutionary. As systems reach end of life, you replace them with modern systems capable of supporting an SDDC architecture, and you upgrade network or storage functionality in keeping with the SDDC vision for the data center. Converged appliances replace distributed systems to allow rapid compute deployments and upgrades. And as the hardware evolves, you migrate its management to the SDDC management platform.

During the early days of compute virtualization, deployments showed the value of the technology and gave the organization the experience and skills needed to support the virtual infrastructure as it grew. This remains true with the deployment of SDDC.

SDDC offers numerous benefits, but think through your implementation:

- The SDDC approach, like server virtualization, can result in added complexity. Don't rush in without a roadmap.
- Beware of vendors who are trying to sell a monolithic product rather than a holistic integrated solution based on standardized APIs. Some vendors will try to sell you a proprietary approach to SDDC, which can result in trading one set of silos for another.
- Automation makes everything easier — including breaking things. Make sure you test and look for problems before you roll out your solutions.
- SDDC is a fundamental shift that requires both business and IT to be on board and in sync. Some groups, especially IT, will have to rethink their processes and organization. Be aware of political pressure or turf wars within your own organization.

The SDDC paves the way for your journey to hybrid cloud

Dell believes the future of the data center is going to be hybrid — spanning hardware that you own and cloud-based infrastructure that you use on demand from others. Public-cloud providers are already fully software defined, and mirroring that architecture in your data center will make hybrid integration much simpler. However, this path to hybrid cloud delivery is not without turns and bumps. You certainly don't want to head out in the wrong direction or to have your route dictated by a single vendor's vision of SDDC.

The ultimate goal is to have your internal SDDC infrastructure closely mirror the public cloud, with your workloads modernized and architected to take full advantage of this approach. Your infrastructure will then be ready to deliver IT as a Service with the same agility and flexibility that your workforce has come to expect. This allows for a seamless transition between the on-premise and public cloud to enable your hybrid cloud, something that would be difficult with a traditional environment.

Dell solutions are designed from the beginning to be future-ready. They're based on open standards, with the modularity and scalability to give your organization the agility it needs to capitalize on every opportunity — even the ones that don't exist yet. Our end-to-end solutions provide the ideal foundation for the SDDC approach, whether you're just starting out or adding to what you've already built.

If you aren't sure where to begin, our consultants can help you assess your current environment, then design and implement a plan for an efficient, future-ready data center. Dell offers consulting workshops to help identify the best place to start on your journey. Find out more by visiting www.dell.com/itconsulting.

A long-term partnership that drives the SDDC

There are many choices to make in your SDDC journey. One of the most significant decisions you face is in your choice of technology partners. Dell and VMware are ideally suited to help you achieve your SDDC goals and vision. The two companies have a long history of joint development of tightly integrated solutions. Dell is the largest reseller of VMware in the world and was recognized as VMware's Global Strategic Alliance Partner of the Year in 2016.

Ten steps to success:

Planning your software-defined data center

Make a plan:

1. Identify business priorities and needs over the next three to five years and align IT to those initiatives.
2. Ensure your SDDC foundation supports your corporate cloud strategy.
3. Document legacy manual processes, especially those that slow down service delivery.
4. Understand the limitations of existing technology, such as the absence of automation or a lack of open APIs.
5. Ensure any new investments can integrate into the existing environment to avoid extensive custom integration.
6. Document requirements and ensure any new technology investments will be fully leveraged. Don't just go for the new shiny features without assessing their value to your implementation.
7. Recognize that a new culture and supporting organizational structure will be necessary.
8. Develop metrics that show business value to enable investment.
9. Understand which services are better suited to an external provider.
10. Pick a pilot area and start small to demonstrate quick wins.

Look for partners and vendors with:

- A deep history of partnership and joint development
- A comprehensive approach and vision for the future of the SDDC
- A commitment to standards-based technologies
- A strong track record and deep experience in delivering virtualized solutions