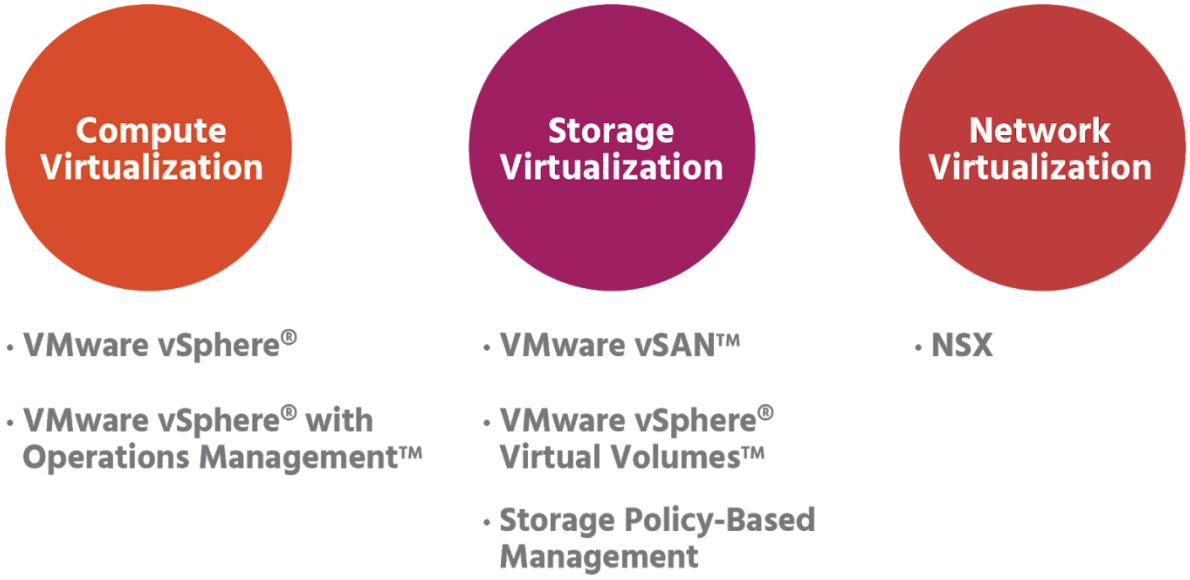
Module 3: The Software-Defined Data Center

The Software-Defined Data Center (SDDC)

With 2.5 billion bytes of data currently being produced around the world every single day and the amount of data stored around the world doubling every two years, it's easy to see why data centres are growing in importance. It's also clear why increasing efficiency(in terms of systems and manpower) and safeguarding uptime (the number of systems that are running smoothly and available) are two of their highest priorities

Data centres have traditionally been 'hardware-centric" - focused and reliant on physical equipment. And this hardware has very often been made by vendors who charge a lot for the initial purchase(especially if the hardware has been custom-made), for maintenance and for the upgrades. This has not only been financially expensive but has also come at the cost of flexibility and agility in a rapidly-changing business landscape.



Thankfully all major services services in a data center can be virtualized. Pioneered by VMware, the **Software-Defined Data Center**(*SDDC*) extends virtualization beyond compute(i.e, servers) to network and storage as well. All data centre resources and services become software-defined.

Expensive vendor- specific hardware is replaced with affordable *off-the-shelf* industry-standard hardware. Because virtualized systems can be copied and saved, they can be easily be reproduced in the event of a system failure. And with automation, this reproduction can be almost immediate, meaning less downtime

In the software-defined data centre, the hypervisor is the controller. It pools together hardware resources which can be allocated precisely when and where they're most needed.

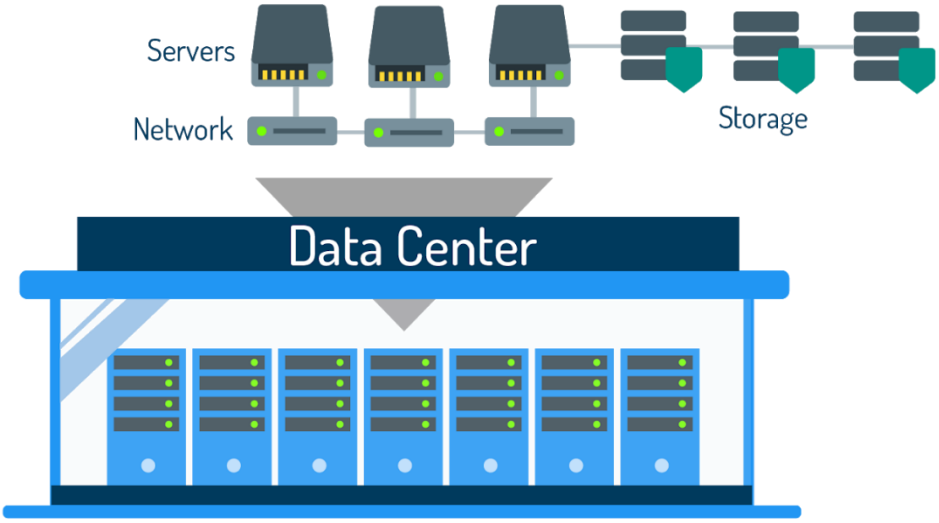
Management software that uses pre-defined policies vastly simplifies SDDC operations. All applications - wherever they're located - can be centrally monitored and managed. Different kinds of workloads (VMs or containers, for example) can be set up, run, and managed in different kinds of environment - physical, virtual, or cloud - using the same management software. And with automation, far fewer people are needed to do this.

Physical Data Centres

Every bit of information that you access on a device is the result of a transfer of data between where the information is processed and stored, and the device to which the data is sent. Whether you're searching for a good restaurant or the best price on a textbook, the information you find comes from a website that hosts its content in a data centre. Today, most people rely on the internet to get the majority of their information about the world around them, and most companies rely on it to reach a good proportion of their customers. This is why efficiency and agility in data centres are so vital.

Data centres are often presumed to be large warehouse-sized structures owned by a large corporation or a government, but they can also be set up on-site by small businesses and companies themselves. These data centres house computer systems, called servers, that are used to share or compute data for clients such as a smartphone user or a business website faster than a regular computer could.

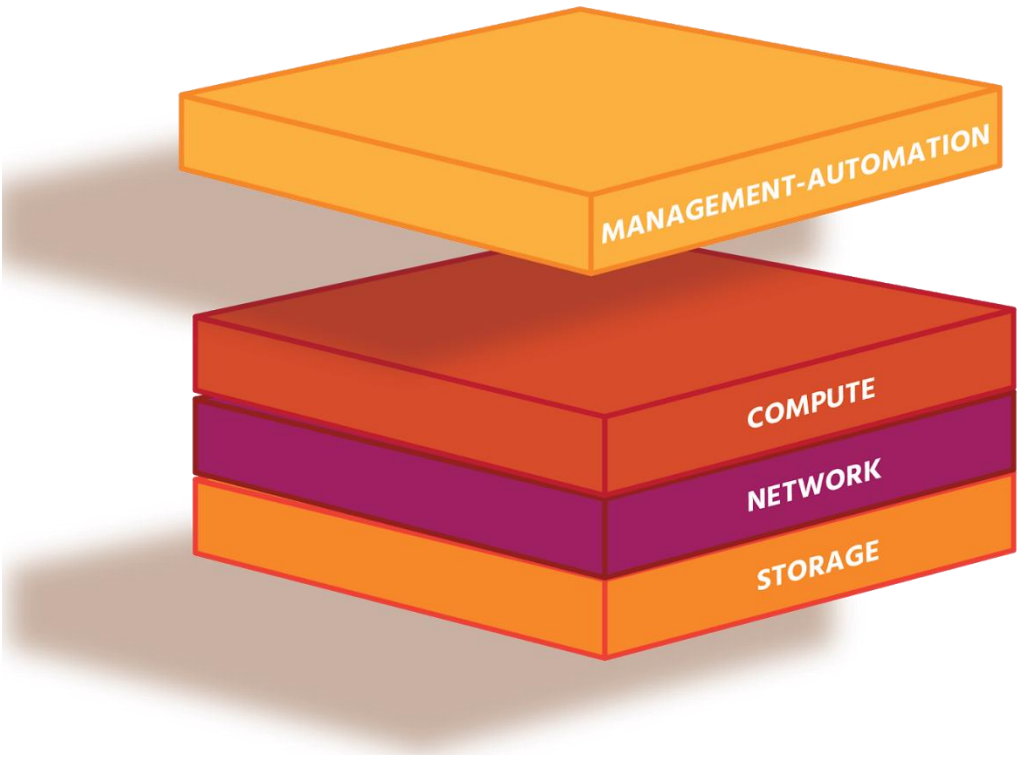
Data centre infrastructure consists of three main components: compute systems (a server or host), storage devices, and networks. In a physical data centre, this will all be hardware, and massive amounts of it are needed for all the data currently in circulation. It was estimated in 2016, for example, that Google had 2.5 million servers at the time.



Effective management means monitoring data availability, capacity, and performance, and providing robust data security (as well as power management, effective cooling systems, and security measures).

As mentioned in the last section, physical data centres are inflexible. They're also costly to maintain with multiple manual processes and disconnected operations. Even with compute and storage virtualization, applications are still linked to the physical network infrastructure. Without network virtualization, data centre operations will remain very manual, and therefore slow and expensive.

Virtualized Data Centres



Software-defined data centres solve the problems of cost, complexity, inefficiency, and inflexibility posed by physical data centres. A fully-virtualized SDDC will encompass compute, storage, networking infrastructure and cloud management, making data centre services as inexpensive and as easy to configure and manage as virtual machines. Not only does the move away from vendor-specific hardware reduce purchasing and maintenance bills, but it also removes the need for costly training on how to use this highly-specialized and often custom-made hardware.

The main benefit of virtualization in the SDDC is the ability to gather physical resources such as CPU, memory, storage, and network I/O (data transfer from one device into another) into logical (i.e., non-physical) pools, which can then be allocated to individual VMs or containers (workloads).

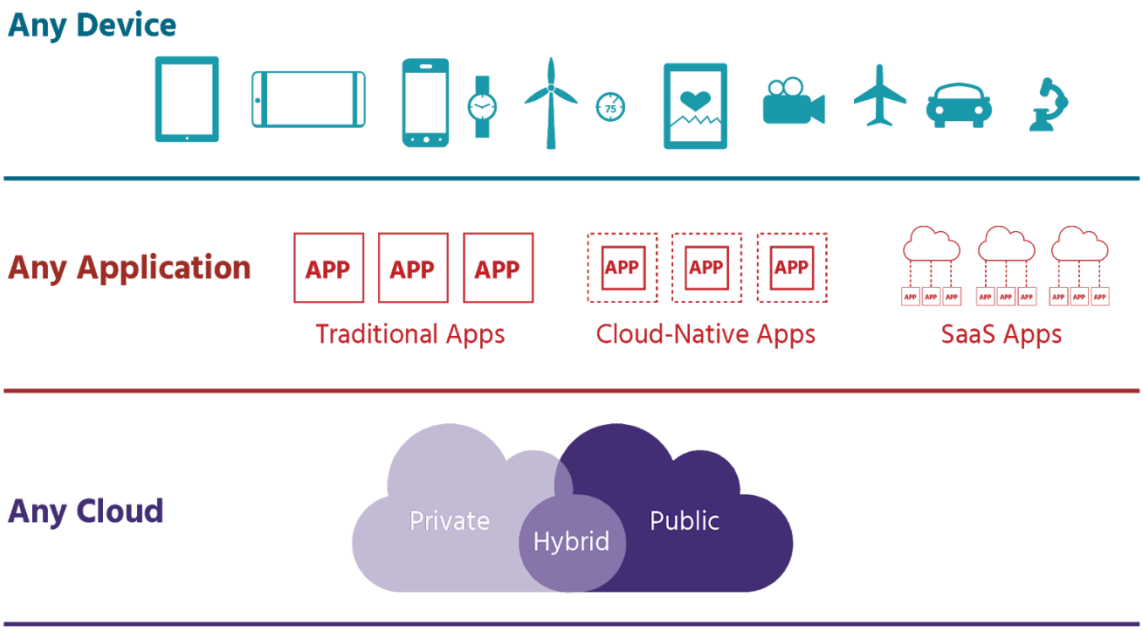
The use of management and automation software means that these virtualized resources can be quickly provided when needed and adjusted as needs change. The use of policies (pre-defined rules) means that this can be done with consistency and precision. Automation has the further benefit of releasing highly-skilled staff from repetitive tasks into more productive, value-adding activities.

Information can be collected from the data centre environment (using, for example, *VMware's vRealize Operations Manager*, which provides automated operations management for physical, virtual, and cloud infrastructures) and used to plan future capacity more accurately.

Network virtualization separates switches, routers, and network services from the underlying physical network. The network virtualization platform of VMware is *NSX*. It bridges the gap between physical networks and

applications, reduces hardware complexity and costs, improves application availability (uptime) and speeds up system recovery.

VMware's SDDC Approach



Software powers the growth and development of networks and data centre infrastructure. VMware is the creator of software-defined agility, with instant provisioning from the data centre to devices. Its technologies provide advanced security that is built into (or *native to*) applications, devices, and infrastructure, and seamlessly unify private and public clouds. Using the SDDC approach, organizations can meet their business demands efficiently and flexibly, while making long-term cost savings. VMware's vSphere for server virtualization, vSAN for storage virtualization, and NSX for network virtualization are just some of the products that help their more than half-a-million customers achieve these benefits. (We'll look at the *NSX Data Centre* in detail in section 5).

More and more organizations are choosing to mix and match their clouds to maximize the effectiveness of their spending and resourcing. Blending on-premises private clouds with public clouds is the most common mix, and the term used to describe this 'best of both worlds' approach is *hybrid clouds*. A hybrid cloud strategy is integral to VMware's vision to help their customers use any cloud to deliver any application to any device. In addition, as the majority of businesses have yet to fully-virtualize their compute, storage, and network infrastructures, VMware technologies can be brought together in natively-integrated software sets (SDDC in-a-box). Sets (or *stacks* as they're known) such as *VMware Cloud FoundationTM*, in turn, make deploying hybrid clouds much simpler. *Cloud FoundationTM* and *Cross-CloudTM* services (together

known as *VMware's Cross-Cloud Architecture*) support VMware's hybrid cloud strategy.

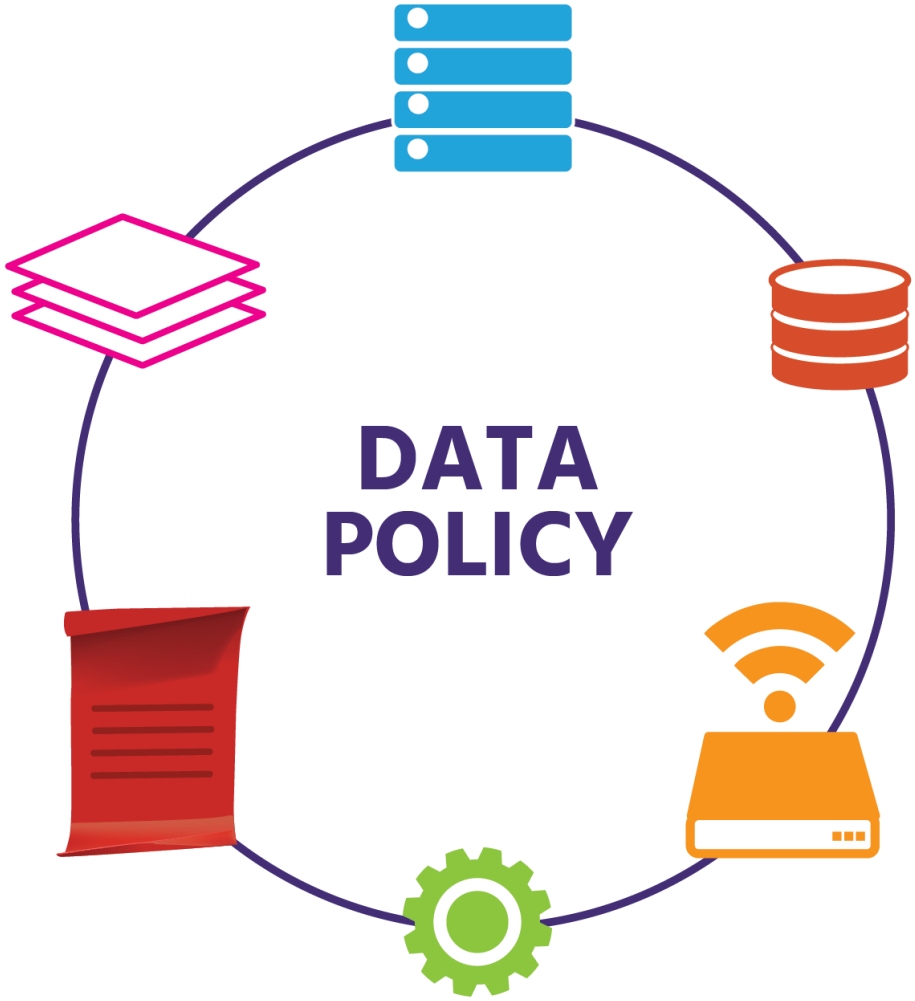
VMware has partnered with *Amazon Web Services* (AWS) to offer *VMware Cloud on AWS* (SDDC as a Service), in which a single set of software tools can be used to manage both on-premises private clouds and public clouds. This approach combines both VMware's and AWS's extensive compute, storage, networking, and security capabilities in one flexible and easy-to-use service.

In a nutshell, here is why VMware thinks its SDDC offers what no-one else can:

- SDDC technology means more of an organization's infrastructure can be used more of the time, in turn making their staff more productive, and greatly reducing spending on physical equipment (known as *capital expenditure* or CapEx) and on operating costs (OpEx).
- SDDC enables the deployment of applications in minutes or even seconds with policy-driven provisioning that matches resources to continually-changing workloads and business demands.
- SDDC makes possible the right availability, security, and compliance for every application.
- SDDC supports private, public, and hybrid clouds. In each case, the infrastructure is fully abstracted from applications so they can run on multiple sets of hardware, hypervisors, and clouds.

The result of a fully-virtualized SDDC is unprecedented IT agility and efficiency, with the flexibility to support today's and tomorrow's hardware and applications.

Data Centre Building Blocks



With all the components, no two data centres will be the same. However, some of the key components that an enterprise (i.e., large-scale) data centre will include are applications, servers, storage, networking infrastructure, management, and automation

As the role of virtualization in data centres increases, these key building blocks may look different. Currently, we'd expect a *fully-virtualized* data centre to:

- be software-defined: automated and managed by a single set of policy-based software tools that allow you to centrally monitor and administer all applications across different environments (physical, virtual, and cloud) and infrastructure types
- have built-in security

- be very easy to adjust in size – either *scaling out/in* by adding/removing devices, or by *scaling up/down* by adding/removing resources such as CPUs or storage to a single device
- support the latest developments in application technology, such as containers and apps specifically designed for the cloud
- support *infrastructure* as a code - i.e., support the writing of code that takes care of configuration and automates provisioning.

These building blocks will change as the SDDC grows and develops. Since the emergence of virtualization in the 1960s, with the likes of the Burroughs Corporation's B5000 computer and IBM mainframe computers, it has changed the world. Servers have probably gone through the most innovation, with the tangible benefits including reduced physical complexity, increased operational efficiency, and simplified repurposing (i.e., virtualizing) of underlying physical resources. Today the vast majority of servers are virtualized and, in terms of networking, there are now more virtual ports being used globally than physical ones.

With an already-large range of products in data centre management and automation (*vSphere*, *vRealize*, and *NSX*, to name just three), VMware continues to innovate for its current and future customers.