A **laboratory information management system** (**LIMS**), sometimes referred to as a **laboratory information system** (**LIS**) or **laboratory management system** (**LMS**), is a software-based laboratory and information management system with features that support a modern laboratory's operations. Key features include—but are not limited to—workflow and data tracking support, flexible architecture, and data exchange interfaces, which fully "support its use in regulated environments". The features and uses of a LIMS have evolved over the years from simple sample tracking to an enterprise resource planning tool that manages multiple aspects of laboratory informatics.

The definition of a LIMS is somewhat controversial: LIMSs are dynamic because the laboratory's requirements are rapidly evolving and different labs often have different needs. Therefore, a working definition of a LIMS ultimately depends on the interpretation by the individuals or groups involved.[1]

Historically the LIMS, LIS, and process development execution system (PDES) have all performed similar functions. The term "LIMS" has tended to refer to informatics systems targeted for environmental, research, or commercial analysis such as pharmaceutical or petrochemical work. "LIS" has tended to refer to laboratory informatics systems in the forensics and clinical markets, which often required special case management tools. "PDES" has generally applied to a wider scope, including, for example, virtual manufacturing techniques, while not necessarily integrating with laboratory equipment.

In recent times LIMS functionality has spread even farther beyond its original purpose of sample management. assay data management, data mining, data analysis, and electronic laboratory notebook (ELN) integration have been added to many LIMS, enabling the realization of translational medicine completely within a single software solution. Additionally, the distinction between LIMS and LIS has blurred, as many LIMS now also fully support comprehensive case- centric clinical data.

The LIMS is an evolving concept, with new features and functionality being added often. As laboratory demands change and technological progress continues, the functions of a LIMS will likely also change. Despite these changes, a LIMS tends to have a base set of functionality that defines it. That functionality can roughly be divided into five laboratory processing phases, with numerous software functions falling under each:[3] (1) the reception and log in of a sample and its associated customer data, (2) the assignment, scheduling, and tracking of the sample and the associated analytical workload, (3) the processing and quality control associated with the sample and the utilized equipment and inventory, (4) the storage of data associated with the sample analysis, (5) the inspection, approval, and compilation of the sample data for reporting and/or further analysis

# Cloning Virtual Machines through Network Isolation

Virtual lab management is an emerging area in software development lifecycles. Visual Studio Lab Management is a product in Visual Studio that brings virtual lab management to developers and testers. By using Visual Studio Lab Management, development teams can leverage virtualization technology in their development and test labs to compose complex multi-tier environments from virtual machines. They can then deploy application builds and run tests on those environments.

One of the motivations for using virtualization in development and test labs is that you can create identical copies, or *clones*, of deployed virtual machines by copying just a few files.

Cloning is useful in many scenarios. For example, a developer who needs a copy of a tester's environment to reproduce an issue can create a clone of that environment. In a test team, each individual tester can clone a copy of an environment and then coordinate his or her testing efforts with the rest of the team. Cloning saves time for both developers and testers because they do not have to repeatedly install the operating systems and other software in each environment that they create.

The first example describes the various forms of conflicts that can occur between clones in the absence of network isolation. Subsequent examples examine multiple solutions to prevent conflicts by using Visual Studio Lab Management.

## Network Conflicts

The figure shows the computer names, IP addresses, and MAC addresses of the two virtual machines in the original environment.

Original environment

The Figure 2 shows a cloned environment in addition to the original. After cloning, when both the environments are started, the following types of network conflicts could occur:

1. Computer name conflicts
2. IP address conflicts
3. MAC address conflicts

Original and cloned environments on a common network

### 1. Computer name conflicts

A computer name is a friendly name assigned by a user to identify a machine in a network.

Two protocols are typically used to resolve a computer name to its IP address: NetBIOS and Domain Name Server (DNS). When two machines that have the same computer name are started on the same network segment, NetBIOS detects the name conflict and warns the user. Normally, NetBIOS can detect conflicts only if the machines are on the same network segment. If the machines are not on the same network segment or if the warnings are ignored, the next level of conflicts occurs in DNS. DNS is a central repository for machines to register their names. When two machines that have the same computer name attempt to register in DNS, the second machine might override the entry created by the first computer.

In this case, the first machine that starts is not reachable through name resolution.

2. IP address conflicts

An Internet Protocol (IP) address is used for machines to communicate with each other over

a TCP network. IP addresses are assigned either statically or dynamically by a DHCP server on the network. Each connected network interface in a machine has an IP address. If a virtual machine that is configured with a static IP address is cloned and then placed on the same network as the original virtual machine, then there is an IP address conflict, in addition to a computer name conflict. You can manually fix this conflict by changing the IP address of one of the clones. Once again, the impact of changing the IP address depends on how the static IP address is used by the applications that are installed on virtual machines.

3. MAC address conflicts

A Media Access Control (MAC) address is an address that is assigned to each network interface in a machine. In the case of physical machines, it is assigned to each network interface by the card's manufacturer. In the case of virtual machines, there are two ways to assign MAC addresses: static or dynamic MAC. You can specify a specific MAC address to use for a network interface of a virtual machine. This is called static MAC. Or, you can let the hypervisor assign a MAC address dynamically. This is called dynamic MAC.

Dynamic MAC addresses are assigned by Hyper-V from a pool of MAC addresses every time a virtual machine is started. Each host has a scheme to generate MAC addresses so that they do not conflict with the virtual machines on another host.

## Network isolation in Visual Studio Lab Management

Visual Studio Lab Management implements network isolation for SCVMM environments by introducing two network interfaces in each virtual machine. One of these network interfaces is a private interface connected to a private network, and the other is a public interface connected to the public network.

The Lab Management software, together with an agent installed on each virtual machine, ensures that the original environment and cloned environment can coexist without conflicts.

## workstation (WS)

A workstation (WS) is a computer dedicated to a user or group of users engaged in business or professional work. It includes one or more high resolution displays and a faster processor than a personal computer (PC). A workstation also has greater multitasking capability because of additional random access memory (RAM), drives and drive capacity. A workstation may also have a higher-speed graphics adapters and more connected peripherals.

Workstations usually are built with an optimized design for complex data manipulation and visualization. Examples include image rendering and editing, computer-aided design (CAD), animations and mathematical plots. Workstations were the first industry segment to market collaboration tools and advanced accessories and enhancements. These include 3D mice, multiple displays and high performance/capacity data storage devices.

## server

A server is a computer, a device or a program that is dedicated to managing network resources. Servers are often referred to as dedicated because they carry out hardly any other tasks apart from their server tasks.

There are a number of categories of servers, including print servers, file servers, network servers and database servers.

Nearly all personal computers are capable of serving as network servers. However, usually software/hardware system dedicated computers have features and configurations just for this task. For example, dedicated servers may have high-performance RAM, a faster processor and several high-capacity hard drives. In addition, dedicated servers may be connected to redundant power supplies, several networks and other servers. Such connection features and configurations are necessary as many client machines and client programs may depend on them to function efficiently, correctly and reliably.

In order to operate in the unique network environment where many computers and hardware/software systems are dependent on just one or several server computers, a server often has special characteristics and capabilities, including:

- The ability to update hardware and software without a restart or reboot.
- Advanced backup capability for frequent backup of critical data.
- Advanced networking performance.
- Automatic (invisible to the user) data transfer between devices.
- High security for resources, data and memory protection.

# DATA CENTER MANAGEMENT

About 80 percent of the unplanned downtime is caused by process or people issues, and 20 percent is caused by product issues. Solid processes must be in place throughout the IT infrastructure to avoid process-, people-, or product related outages. Planned or scheduled downtime is one of the biggest contributors (30 percent). It is also the easiest to reduce. It includes events that are preplanned by IT (system, database, and network) administrators and usually done at night. It could be just a proactive reboot. Other planned tasks that lead to host or application outage are scheduled activities such as application or operating system upgrades, adding patches, hardware changes, and so forth.

In terms of equipment, a data center administrator handles network switches, storage arrays and servers, and is either directly in charge of installation or supports a team and/or contractors with deployments. Administrators troubleshoot and offer hands-on support to make sure the data center keeps a high uptime.

A data center administrator should have experience with data center infrastructure management and other software tools, and be able to make recommendations for equipment and procedure changes to decrease costs and increase efficiency. They create and keep documentation and processes up to date so successful server and system deployments are repeatable. The job also entails capacity planning to ensure that the facility meets current and expected power demand and cooling requirements of the IT equipment.

A data center administrator may obtain certifications from industry organizations and vendors to advance their understanding of the technologies under their oversight. Certification and/or experience is required on server and storage hardware, network architecture, virtualization, security and monitoring tools, backup, capacity planning and power management, remote support and site planning.

## Three Layer Approach

Data center management requires three layers. First, monitor and visualize the details and activities across all systems and locations. Next, analyze how to utilize the data center more efficiently to save energy and space or increase the utilization of existing equipment. Finally, automate the action layer, which allows for synchronized management across the silos of facility, IT hardware, networks, and applications.

The same three-layer approach has to be expanded also across multiple data centers, a likely scenario in any organization with a need for multi-site redundancy. At this level, broader coordination with network providers and power utilities that serve and connect each data center must be integrated with the management of each data center. If a power or network outage impacts one particular site or application stack, it behooves the data center manager to be able to switch that stack seamlessly to another data center or even across multiple data centers. An integrated, holistic data center management framework enables this kind of agility.

Data center management refers to a small number of employees who have been designated and hired to manage large data sets and hardware systems that are usually part of a large distributed network. The data center is responsible for the management of significant amounts of data and the hardware required to store it and distribute it to users.

Data center management plays a crucial role in protecting data and keeping it secure so as to avoid data security breaches. The hosted computer environment within a data center must be explicitly managed, but most of the management is conducted in an automated fashion, thus saving hiring and energy costs. Data centers can be managed remotely and may not even house actual employees.

Functions of data center management include upgrading hardware and software/operating systems, managing data distribution and storage, backup regimes, emergency planning and some technical support.

## Advantages

Data center management can also come into play in the telecommunications arena. Customer service representatives can work on-site in various offices across the country, the world, or from the employees' own homes. Meanwhile, consumer orders are processed and managed in one large data center located elsewhere.

The advantages of data center management include cost savings, especially when the data centers are green. Within all data management centers, fewer employees are needed as a result of automation, allowing agencies and businesses to experience growth without having to allocate space for their servers or operating systems.

# HIGH PERFORMANCE COMPUTING

High-performance computing (HPC) is the use of parallel processing for running advanced application programs efficiently, reliably and quickly. The term applies especially to systems that function above a teraflop or $10^{12}$ floating-point operations per second. The term HPC is occasionally used as a synonym for supercomputing, although technically a supercomputer is a system that performs at or near the currently highest operational rate for computers. Some supercomputers work at more than a petaflop or $10^{15}$ floating-point operations per second.

The most common users of HPC systems are scientific researchers, engineers, and academic institutions. Some government agencies, particularly the military, also rely on HPC for complex applications. High-performance systems often use custom-made components in addition to so-called commodity components. As demand for processing power and speed grows, HPC will likely interest businesses of all sizes, particularly for transaction processing and data warehouses. An occasional techno-fiends might use an HPC system to satisfy an exceptional desire for advanced technology.

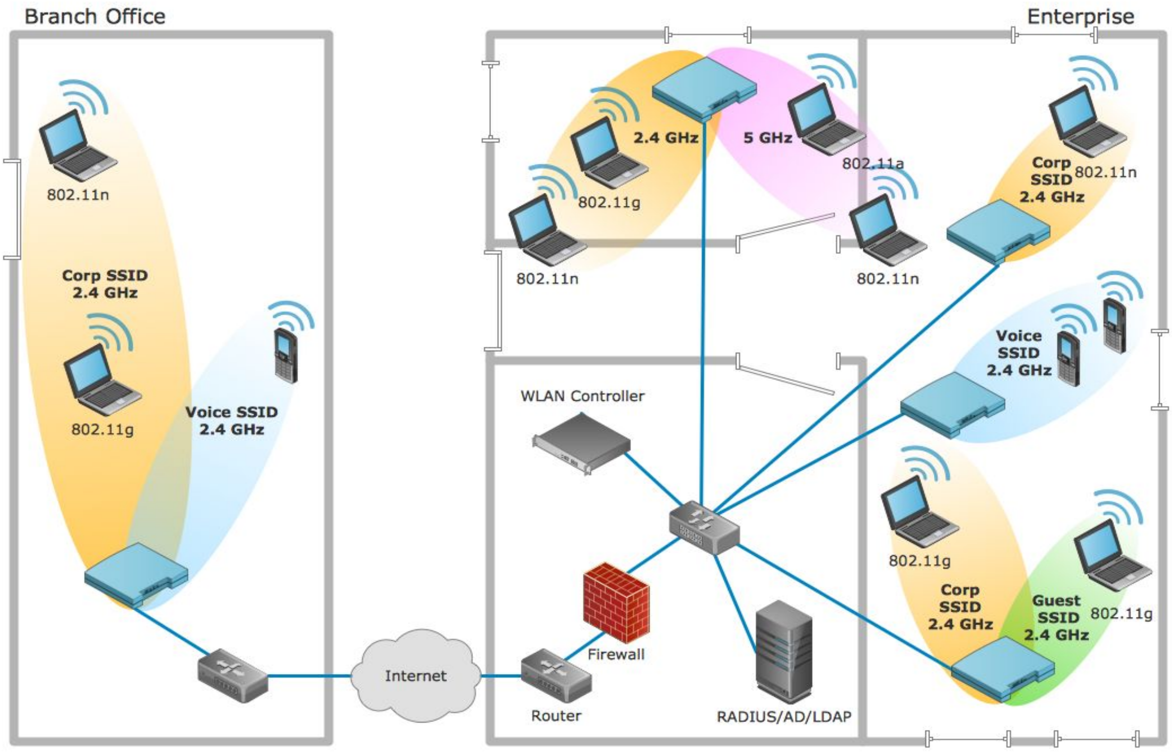
High-performance computing (HPC) is the use of supercomputers and parallel processing techniques for solving complex computational problems. HPC technology focuses on developing parallel processing algorithms and systems by incorporating both administration and parallel computational techniques.

High-performance computing is typically used for solving advanced problems and performing research activities through computer modeling, simulation, and analysis. HPC systems have the ability to deliver sustained performance through the concurrent use of computing resources.

High-performance computing (HPC) evolved due to meet increasing demands for processing speed. HPC brings together several technologies such as computer architecture, algorithms, programs and electronics, and system software under a single canopy to solve advanced problems effectively and quickly. A highly efficient HPC system requires a high-bandwidth, low-latency network to connect multiple nodes and clusters.

HPC technology is implemented in multidisciplinary areas including:

- Biosciences
- Geographical data
- Oil and gas industry modeling
- Electronic design automation
- Climate modeling
- Media and entertainment

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## VIRTUALISATION AND CLOUD

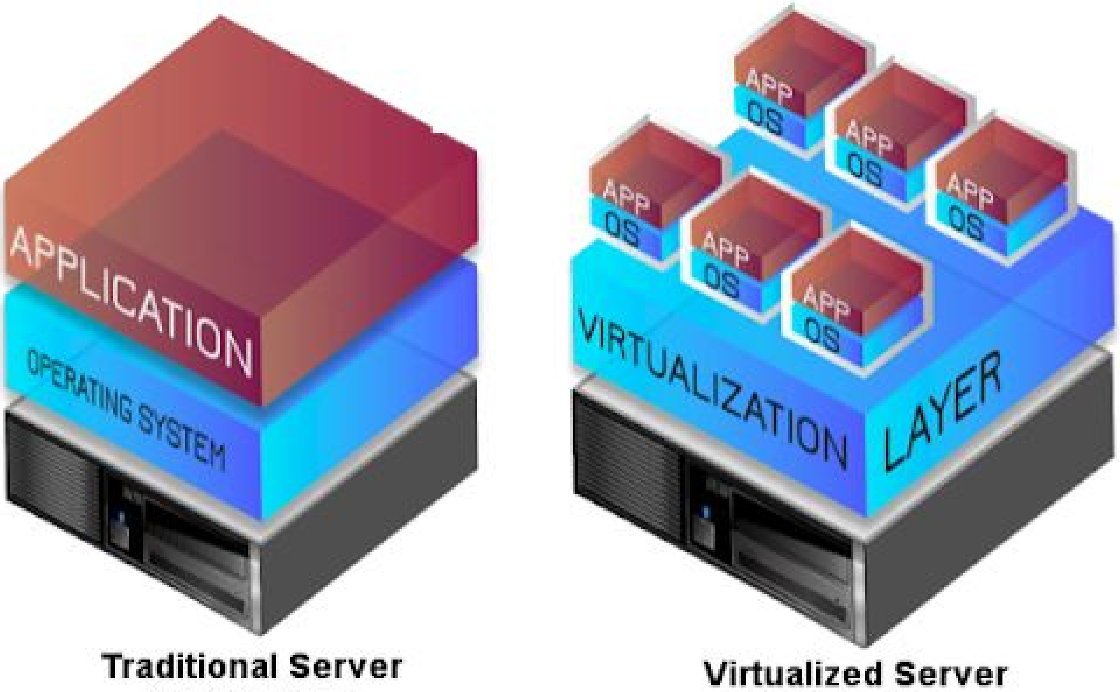
### WHAT IS VIRTUALISATION ?

In a nutshell, virtualization is software that separates physical infrastructures to create various dedicated resources. It is the fundamental technology that powers cloud computing.

Virtualization software makes it possible to run multiple operating systems and multiple applications on the same server at the same time. It enables businesses to reduce IT costs while increasing the efficiency, utilization and flexibility of their existing computer hardware.

The technology behind virtualization is known as a virtual machine monitor (VMM) or virtual manager, which separates compute environments from the actual physical infrastructure.

Virtualization makes servers, workstations, storage and other systems independent of the physical hardware layer. This is done by installing a Hypervisor on top of the hardware layer, where the systems are then installed.




**Traditional Server Architecture** **Virtualized Server Architecture**

### HOW IS VIRTUALISATION DIFFERENT FROM CLOUD COMPUTING ?

Essentially, virtualization differs from cloud computing because virtualization is software that manipulates hardware, while cloud computing refers to a service that results from that manipulation.

### WHAT IS CLOUD COMPUTING?

Cloud computing is an information technology (IT) paradigm, a model for enabling ubiquitous access to shared pools of configurable resources (such as computer networks, servers, storage, applications

# Types of virtualization:

There are six types of virtualization techniques which can be described as follows :

1. **Network virtualization** is a method of combining the available resources in a network by splitting up the available bandwidth into channels each of which is independent from the others and can be assigned –or reassigned –to a particular server or device in real time. The idea is that virtualization disguises the true complexity of the network by separating it into manageable parts, much like your partitioned hard drive makes it easier to manageable your files.

**2. Storage virtualization** is the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console. Storage virtualization is commonly used in storage area networks.

**3. Server virtualization** is the masking of server resources -- including the number and identity of individual physical servers, processors and operating systems -- from server users. The intention is to spare the user from having to understand and manage complicated details of server resources while increasing resource sharing and utilization and maintaining the capacity to expand later.

**4. Data virtualization** is abstracting the traditional technical details of data and data management, such as location, performance or format, in favor of broader access and more resiliency tied to business needs.

**5. Desktop virtualization** is virtualizing a workstation load rather than a server. This allows the user to access the desktop remotely, typically using a thin client at the desk. Since the workstation is essentially running in a data center server, access to it can be both more secure and portable. The operating system license does still need to be accounted for as well as the infrastructure.

**6. Application virtualization** is abstracting the application layer away from the operating system. This way the application can run in an encapsulated form without being depended upon on the operating system underneath. This can allow a Windows application to run on Linux and vice versa, in addition to adding a level of isolation.

## CLOUD COMPUTING:

**Cloud computing** is an information technology (IT) paradigm, a model for enabling ubiquitous access to shared pools of configurable resources (such as computer networks, servers, storage, applications and services), which can be rapidly provisioned with minimal management effort, often over the Internet. Cloud computing allows users and enterprises with various computing capabilities to store and process data either in a privately-owned cloud, or on a third-party server located in a data center, thus making data-accessing mechanisms more efficient and reliable.

## Types of cloud services: IaaS, PaaS, SaaS

Most cloud computing services fall into three broad categories:

1. infrastructure as a service (IaaS),
2. platform as a service (PaaS) and
3. software as a service (Saas).

These are sometimes called the cloud computing stack, because they build on top of one another.

## Infrastructure-as-a-service (IaaS)

The most basic category of cloud computing services. With IaaS, you rent IT infrastructure—servers and virtual machines (VMs), storage, networks, operating systems—from a cloud provider on a pay-as-you-go basis.

## Platform as a service (PaaS)

Platform-as-a-service (PaaS) refers to cloud computing services that supply an on-demand environment for developing, testing, delivering and managing software applications. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.

## Software as a service (SaaS)

Software-as-a-service (SaaS) is a method for delivering software applications over the Internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle any maintenance, like software upgrades and security patching. Users connect to the application over the Internet, usually with a web browser on their phone, tablet or PC.

**CHARACTERISTICS OF CLOUD COMPUTING**

Cloud computing exhibits the following key characteristics:

**Agility** for organizations may be improved, as cloud computing may increase users' flexibility with re-provisioning, adding, or expanding technological infrastructure resources.

**Device and location independence** enable users to access systems using a web browser regardless of their location or what device they use (e.g., PC, mobile phone). As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect to it from anywhere.

**Maintenance** of cloud computing applications is easier, because they do not need to be installed on each user's computer and can be accessed from different places (e.g., different work locations, while travelling, etc.).

**Multitenancy** enables sharing of resources and costs across a large pool of users thus allowing for centralization of infrastructure in locations with lower costs (such as real estate, electricity, etc.) peak-load capacity increases utilisation and efficiency improvements for systems that are often only 10–20% utilised.

**Performance** is monitored by IT experts from the service provider, and consistent and loosely coupled architectures are constructed using web services as the system interface.

**Resource pooling** is the provider's computing resources are commingle to serve multiple consumers using a multi-tenant model with different physical and virtual resources dynamically assigned and reassigned according to user demand. There is a sense of location independence in that the consumer generally have no control or knowledge over the exact location of the provided resource.
**Productivity** may be increased when multiple users can work on the same data simultaneously, rather than waiting for it to be saved and emailed. Time may be saved as information does not need to be re-entered when fields are matched, nor do users need to install application software upgrades to their computer.

**Reliability** improves with the use of multiple redundant sites, which makes well-designed cloud computing suitable for business continuity and disaster recovery.

**Security** can improve due to centralization of data, increased security-focused resources, etc., but concerns can persist about loss of control over certain sensitive data, and the lack of security for stored kernels. Security is often as good as or better than other traditional systems, in part because service providers are able to devote resources to solving security issues that many customers cannot afford to tackle or which they lack the technical skills to address.

**On-demand self-service**. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

**Broad network access.** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

**Resource pooling**. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

**Rapid elasticity**. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear unlimited and can be appropriated in any quantity at any time.