Supercomputer

A supercomputer is a computer with a high level of performance compared to a general-purpose computer. Performance of a supercomputer is measured in floating-point operations per second (FLOPS) instead of million instructions per second (MIPS). Supercomputers contain tens of thousands of processors and can perform billions and trillions of calculations or computations per second. Some supercomputers can perform up to a hundred quadrillion FLOPS. Since information moves quickly between processors in a supercomputer (compared to distributed computing systems) they are ideal for [real-time](https://susedefines.suse.com/definition/real-time/) applications.

Supercomputers are used for data-intensive and computation-heavy scientific and engineering purposes such as quantum mechanics, weather forecasting, oil and gas exploration, molecular modeling, physical simulations, aerodynamics, nuclear fusion research and cryptoanalysis. Early operating systems were custom made for each supercomputer to increase its speed. In recent years, supercomputer architecture has moved away from proprietary, in-house operating systems to [Linux](https://susedefines.suse.com/definition/linux/). Although most supercomputers use a Linux-based operating system, each manufacturer optimizes its own Linux derivative for peak hardware performance. In 2017, half of the world’s [top 50 supercomputers](https://www.suse.com/c/isc-suse-top500/) used SUSE [Enterprise Linux Server](https://www.suse.com/products/server/).

The largest, most powerful supercomputers are actually multiple computers that perform parallel processing. Today, many academic and scientific research firms, engineering companies and large enterprises that require massive processing power are using cloud computing instead of supercomputers. [High performance computing](https://susedefines.suse.com/definition/high-performance-computing/) (HPC) via the cloud is more affordable, [scalable](https://susedefines.suse.com/definition/scalability/) and faster to upgrade than on-premises supercomputers. Cloud-based HPC architectures can expand, adapt and shrink as business needs demand. SUSE [Linux Enterprise High Performance Computing](https://www.suse.com/products/server/hpc/) allows organizations to leverage their existing hardware for HPC computations and data-intensive operations.

# Linux Cluster

A Linux cluster is a connected array of [Linux](https://susedefines.suse.com/definition/linux/) computers or nodes that work together and can be viewed and managed as a single system. Nodes are usually connected by fast local area networks, with each node running its own instance of Linux. Nodes may be physical or virtual machines, and they may be separated geographically. Each node includes storage capacity, processing power and I/O (input/output) bandwidth. Multiple redundant nodes of [Linux servers](https://susedefines.suse.com/definition/linux-server-2/) may be connected as a cluster for [high availability](https://susedefines.suse.com/definition/high-availability/) (HA) in a network or [data center](https://susedefines.suse.com/definition/data-center/), where each node is capable of failure detection and recovery.

IT organizations use Linux clusters to reduce downtime and deliver high availability of IT services and mission-critical workloads. The redundancy of cluster components eliminates single points of failure. Linux clusters may be connected nodes of servers, storage devices or virtualized containers. A [server cluster is a group of linked servers that work together](https://susedefines.suse.com/definition/computer-cluster/) to improve system performance, load balancing and service availability. If a server fails, other servers in the cluster can take over the functions and workloads of the failed server.

Compared to a single computer, a Linux cluster can provide faster processing speed, larger storage capacity, better data integrity, greater reliability and wider availability of resources. Clusters are usually dedicated to specific functions, such as load balancing, high availability, high performance, storage or large-scale processing. Compared to a [mainframe computer](https://susedefines.suse.com/definition/mainframe/), the amount of power and processing speed produced by a Linux cluster is more cost effective. The networked nodes in a cluster also create an efficient, distributed infrastructure that prevents bottlenecks, thus improving performance. SUSE [Linux High Availability Extension](https://www.suse.com/products/highavailability/) provides open source HA clustering that can be deployed in physical or virtual environments.

**xCAT** (**Extreme Cloud Administration Toolkit**) is [open-source](https://en.wikipedia.org/wiki/Open-source_software) [distributed computing](https://en.wikipedia.org/wiki/Distributed_computing) management software developed by [IBM](https://en.wikipedia.org/wiki/IBM), used for the [deployment](https://en.wikipedia.org/wiki/System_deployment) and [administration](https://en.wikipedia.org/wiki/Computer_administration) of [Linux](https://en.wikipedia.org/wiki/Linux) or [AIX](https://en.wikipedia.org/wiki/AIX) based [clusters](https://en.wikipedia.org/wiki/Computer_clusters).

xCAT can:

* Create and manage [diskless](https://en.wikipedia.org/wiki/Diskless_node) clusters
* Install and manage many [Linux](https://en.wikipedia.org/wiki/Linux) cluster machines (physical or virtual) in parallel
* Set up a high-performance computing software stack, including software for [batch job](https://en.wikipedia.org/wiki/Batch_job) submission, parallel libraries, and other software that is useful on a cluster
* [Cloning](https://en.wikipedia.org/wiki/Disk_cloning) and [imaging](https://en.wikipedia.org/wiki/Disk_image) Linux and Windows machines

xCAT has specific features designed to take advantage of [IBM](https://en.wikipedia.org/wiki/IBM) hardware including:

* Remote Power Control
* Remote [POST](https://en.wikipedia.org/wiki/Power-on_self-test)/[BIOS](https://en.wikipedia.org/wiki/BIOS) console
* Serial over LAN functions
* Hardware alerts and vitals provided via [SNMP](https://en.wikipedia.org/wiki/Simple_Network_Management_Protocol) and [email](https://en.wikipedia.org/wiki/Email)
* Inventory and hardware management

xCAT achieved recognition in June 2008 for having been used with the [IBM Roadrunner](https://en.wikipedia.org/wiki/IBM_Roadrunner), which set a [computing speed](https://en.wikipedia.org/wiki/Instructions_per_second) record at that time.[[2]](https://en.wikipedia.org/wiki/XCAT#cite_note-2)[[3]](https://en.wikipedia.org/wiki/XCAT#cite_note-3)

xCAT is the default systems management tool of the [IBM Intelligent Cluster](https://en.wikipedia.org/wiki/IBM_System_Cluster_1350) solution.

xCAT is used by [Lenovo](https://en.wikipedia.org/wiki/Lenovo).