

Mainframe hardware course: Mainframe's physical environment

IBM. z/OS Basic Skills: The mainframe's physical environment

Mainframe environment

This hardware course introduces you to one model of IBM® mainframe computer, the IBM System z9™ Enterprise Class, to help you learn about the physical environment that is typical for mainframes, and to introduce you to some of the many peripheral devices used in the mainframe environment.

Time to complete: 10 - 15 minutes

- Mainframe terms
- The data center or raised floor
- The mainframe's footprint
- Other mainframes on the raised floor
- Other hardware on the raised floor



Mainframe terms

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Mainframe environment > The term mainframe

Early computer systems were housed in large metal boxes or frames, which is how the term *mainframe* originated. To create a complete system, customers needed many frames, and so could easily fill an entire room. Those first large machines also became known as *Big Iron*.

Over time, however, the size of mainframes gradually has decreased; its size is now more closely aligned with other types of commercial-use computers.



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Mainframe environment > The term server

As the mainframe's physical size has decreased, its capacity has steadily—even exponentially—increased over the years.

The IBM System z9 Enterprise Class (z9 EC) is a state-of-the-art computer that can support thousands of applications and input/output devices to simultaneously serve thousands of users.

Today, computer manufacturers often use the term *server* to refer to any commercial-use computer (large or small) but industry professionals continue to use the term *mainframe* to distinguish modern Big Iron machines from other servers.



The data center or raised floor

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Mainframe environment > The data center or raised floor

Although the mainframe's physical size has changed since the early days, its physical environment still looks much the same.

Just as in the 1960s, a typical customer site today has a large area of building space that is specially designed for data processing equipment. This area, often called the *data center* or the *raised floor*, is devoted to housing not only mainframes such as the z9 EC, but also peripheral devices for storage, networking, and other computing functions, as well as support equipment such as electrical panels and cooling equipment.

A command center, with panels and screens for monitoring the computing and support equipment, is also part of the data center.

Because of the critical work this equipment performs, companies usually secure the data center and tightly control access to it.

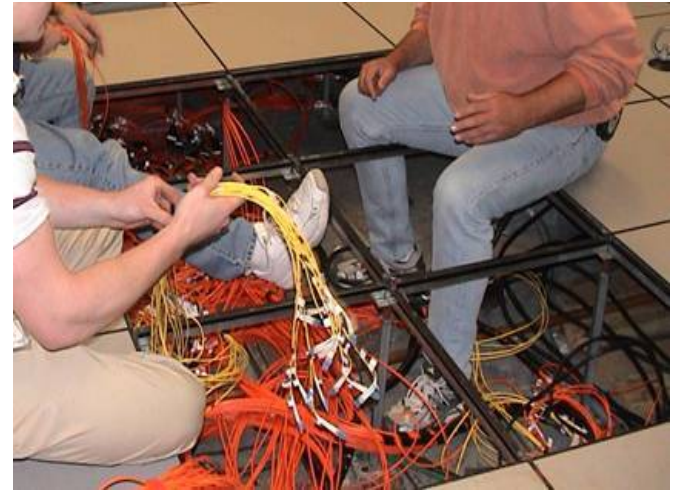


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Mainframe environment > Under the raised floor

People often use the term *raised floor* for the data center because this space actually has two floors: A lower floor, which is usually made of concrete, and an upper floor, constructed several feet above the other, which consists of large removable tiles.

Having a lower and upper, or raised, floor creates a crawl space between the floors, to hold network cables, electrical wiring and outlets, and other maintenance or support equipment. The crawl space ranges from 1.5 feet to 6 feet deep, or 0.5 to 1.8 meters; a 2-foot, or 0.6-meter, depth is the industry standard. In this photo, technicians work with cables in the crawl space.



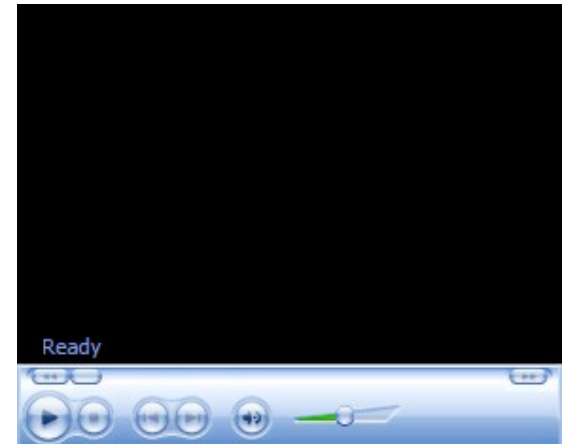
Having a crawl space allows networking cables, electric wiring, and water pipes to be placed under the equipment they support for more efficient connectivity, power or cooling. Because all of the cables, wires and pipes are out of the way, using the crawl space also eliminates safety hazards on the raised floor itself.

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Mainframe environment > Raised floor size and sounds

Raised floors vary in size, depending on the amount of building space required to house the company's computing equipment. Some raised floors are very large—the size of several football fields (soccer or American).

IBM's raised floor in Poughkeepsie, New York (where mainframes are designed, manufactured and tested) contains 100 mainframes and supporting equipment, so it ranks among the largest. As you might guess, the noise generated by all those machines in all that open space is considerable!



To hear how loud the raised-floor environment is, play this 15-second video clip featuring Dave Anderson, a hardware expert from IBM's Customer Briefing Center team in Poughkeepsie, who talks (or, more accurately, shouts) about the operating systems and workloads that run on the z9 EC. During the first few seconds, notice the "white noise" that sounds like static, but actually is the noise generated by hundreds of machines running in the background.

The mainframe's footprint

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Mainframe environment > The mainframe's footprint

During their largest period, in terms of physical size, a single mainframe occupied 2 000 to 10 000 square feet, or 600 to 3 000 square meters. The actual surface area of the raised floor that a single piece of hardware requires is called the *footprint*.

Today, the z9 EC has a footprint of approximately 27 square feet, or 2.5 square meters, and is 76 inches tall—just a bit taller than a large refrigerator.

Mainframes, however, are much heavier; the smallest System z9 model weighs over 2 000 pounds, or 1 000 kilograms.



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Mainframe environment > The z9 EC's processing capacity

Within that small but dense z9 EC is computing capacity that is far greater than the room-sized Big Iron from the 1960s. Mainframe processing power is measured in MIPS, or the number—in millions—of instructions the processor can execute per second.

One of the first mainframes, the IBM S/360™, ran one million instructions per second; in contrast, the z9 EC can execute almost 18 000 MIPS. Storage capacity also has grown over the years, from less than one megabyte to today's 512 gigabytes. And that 1964 machine had one only processor; the z9 EC can have up to 54!

Because of this storage and processing capacity, the mainframe has the ability to store and process vast quantities of data. In fact, mainframes are estimated to store and process between 70 and 80% of the world's data.



Other mainframes on the raised floor

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Mainframe environment > Other IBM mainframes

If you get to work in or tour your company's raised floor, you will probably see earlier mainframe models as well as the System z9 models...

The previous mainframes might include the IBM eServer™ zSeries® 990 and 900 models, known as the z990 and z900, respectively. These models are all approximately the same height and weight as their System z9 counterparts, with similar footprints.

You also might see one of the smallest mainframes: The eServer zSeries 800, known as the z800. The z800 is even closer in size to a refrigerator, weighing in at 1 201 pounds, or 545 kilograms, with a footprint of approximately nine square feet, which is less than one square meter.



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Mainframe environment > Which one is the System z9?

How can you tell the difference between the IBM System z9 and eServer zSeries models?

If the front covers are on the machines, look for the color of the stripe running vertically along the edge. The System z9 models have a blue metallic stripe, and the zSeries models have copper stripes.

IBM was the first mainframe manufacturer to use copper circuitry in processor chips, so those earlier machines have a copper stripe to advertise that new technology.

Although the System z9 models still use copper circuitry, other significant advances in semiconductor technology give System z9 models much more powerful processors and greater storage capacity than the zSeries models.



Other hardware on the raised floor

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Mainframe environment > Other hardware on the raised floor

Along with the mainframe models on the raised floor, you can find several different types of peripheral devices, including printers, tape and disk storage racks, and other input/output devices.

Although many of these devices provide services that you also use for your home computer system, such as printing and storage back-up, the examples shown here will likely be unfamiliar.

The physical sizes and capacity of these devices are far greater than what you might need to connect to your computer or notebook for personal use.



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Mainframe environment > IBM printers

One peripheral device you might see on the raised floor is the IBM Infoprint® 4100, a high-speed digital continuous-forms printer, which is capable of printing from 175 to 330 linear feet, or 53 to 100 linear meters, of paper per minute.

Not only is it fast, it is also quite large, with a weight and footprint similar to that of the z9 EC: Over 2 000 pounds, or over 1 000 kilograms, with a footprint of approximately 28 square feet (which is 2.6 square meters).

And just as the z9 EC requires an air-conditioned setting, so does the Infoprint 4100, which operates best when the temperature ranges from 65 to 75 degrees Fahrenheit, or 18 to 24 degrees centigrade.



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Mainframe environment > IBM disk storage: ESS 800

Storage devices come in many forms and sizes, and much of the raised floor space is devoted to them. Mainframes typically are connected to storage devices that use either disk or tape media. Two examples of disk storage systems are the IBM TotalStorage® DS8000™ and the earlier generation IBM Enterprise Storage Server® (ESS) 800.

Announced in 2000, the ESS 800 was IBM's first disk storage system to provide up to 55 terabytes of high performance, scalable storage for various open computing systems (for example, UNIX® and Windows®), as well as proprietary systems such as z/OS®.

For disk storage capacity, one terabyte is 1 000 000 000 000 bytes. To give you a better idea of how much data this is, consider that the US Library of Congress contains an estimated 10 terabytes of printed material so, generally speaking, one ESS 800 is capable of storing the contents of five national libraries!



Mainframe environment > IBM disk storage: DS8000

A more recent disk system, the DS8000 series, is based on ESS 800 technology, so it also works with open systems and has built-in hardware-based disaster recovery functions. These built-in functions maintain a synchronous copy—always up-to-date with the primary copy—of data in a remote location. Customers use this backup copy to quickly recover from failures without losing any transactions or data.

The amazing difference between the ESS 800 and the DS8000 is capacity: With the DS8000, IBM has increased potential disk storage capacity from 55 up to 195 terabytes, in a footprint that is approximately 20% smaller than the ESS 800.



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Mainframe environment > IBM tape storage

Just as disk storage improves significantly from one generation of machines to the next, tape storage devices also have come a long way since the archetypal reel-to-reel machines of the early 1960s. Although modern tape storage machines might be an equivalent size to the reel-to-reel machines, their design and technology is far more advanced and provides exponentially improved capacity.

An example of a modern tape storage device is the IBM System Storage™ TS3500 Tape Library, which resides in one base frame that can be connected with up to 15 additional expansion frames. The TS3500 base and expansion frames each have a footprint of approximately 10 square feet (almost one square meter), so a full bank of frames has a footprint of 160 square feet (almost 15 square meters).

Inside the TS3500 frames are tape controllers or drives, which connect the tape library with the z9 EC, and tape cartridges, which store data.



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