Runtime environments: explanation and examples

We use a variety of computer programs every day, for tasks like photo editing, word processing, and calculation. It’s become expected that these programs run as fast and smoothly as possible under a variety of conditions. However, this poses a challenge for developers, since [**operating systems**](https://www.ionos.com/digitalguide/server/know-how/what-is-an-operating-system/) can differ significantly from each other, and different versions of the same operating system are in use at any given time. In theory, it would be necessary to adapt programs to each operating system. To avoid this extra hassle, developers use runtime environments.

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What is a runtime environment?

Runtime environments (RTE for short) act as small operating systems and provide **all the functionality** necessary for a **program to run**. This includes interfaces to physical parts of the hardware, user interactions, and software components.

A runtime environment loads applications and has them run on a platform. All the resources necessary for running independently of the operating system are available on this platform. That’s why, for example, playing Flash videos is only possible with the right runtime environment - in this case the Adobe Flash Player. Within this environment, Flash videos can be played in the same quality and with the same functionalities regardless of which browser or operation system is being used.

How does a runtime environment work?

An application that’s currently running interacts with the runtime environment via a runtime system. The runtime environment in turn acts as a go-between **between the application and the operating system**. As soon as a program is executed, it sends instructions to the computer’s processor and RAM, and accesses system resources. The runtime environment thus includes hardware, memory, variables in the environment, and interactions with the user and software components.

 Fact

The term “**runtime**” has two meanings: In the context of runtime environments, it refers to the execution of a program in a specific runtime context. But it also has a second meaning in other contexts, namely the amount of time that a program needs to execute a task.

A runtime environment provides various basic functions for memory, networks, and hardware. These functions are carried out by the runtime environment instead of the application and work independently of the operating system. They include reading and writing files, managing input and output devices, searching and sorting files, and transporting data via networks.

 Note

The individual modules of a runtime environment are saved in runtime libraries. In Windows, you can identify these libraries based on the extension .*dll* (dynamic link library); in Linux they have the file suffix .*so* (shared object).

One major benefit of runtime environments is that programs have access to all the functionalities they need and thus work independent of operating systems. Additionally, programs have **identical user interfaces** regardless of whether they’re run on Windows, macOS or Linux. Developers also use runtime environments to **test applications** in their execution. In the case of an error, the RTE reports the reason for the crash. [Frameworks](https://www.ionos.com/digitalguide/websites/web-development/web-frameworks-an-overview/) are also related to runtime environments. These program structures simplify software development and can contain runtime environments that the programs are executed in.

 Tip

If an application is **based on a runtime environment**, then the RTE is required to execute the program.

What are the advantages of runtime environments?

As mentioned above, runtime environments enable **cross-platform functionality** for applications. This simplifies the development process, since the program does not need to be adapted to different operating systems. If a program uses the functionalities of a runtime environment for its execution, people using different operating systems can benefit from the same functions and a near-identical user interface.

A further advantage is the conservation of resources: Similar applications can use the same runtime environments and share common components.

Well-known examples of runtime environments

One of the best examples of a runtime environment is Java: The **Java Runtime Environment** is a prerequisite for running Java programs. This makes Java programs largely independent of operating systems and thus able to be executed in any operating system with the right runtime environment. Since the Java Runtime Environment is a software platform, it’s called the “**Java platform**” and consists of a [programming interface](https://www.ionos.com/digitalguide/websites/web-development/what-is-an-api/), a [virtual machine](https://www.ionos.com/digitalguide/server/know-how/virtual-machines/), and various libraries.

Some other well-known examples of runtime environments include:

* **ActionScript Application**(ASAP): Offers building blocks for Flash developers.
* **Blueprint**: This CSS framework addresses deficits in the compatibility of browsers and simplifies the optimization of CSS. It’s also available as a CMS basis theme for Drupal and WordPress.
* **Common** **Language** **Runtime**: A virtual runtime environment for .NET applications that interprets the Common Intermediate Language Code.
* **Crystal Space**: Includes a 3D engine and is used for game development and the development of other 3D visualizations; free.
* **Cygwin**: A runtime environment for Linux applications that allows them to run on Windows, macOS, and other operating systems.
* **.NET Framework**: Windows .NET applications can only be run with this Microsoft framework.
* [Node.js](https://www.ionos.com/digitalguide/websites/web-development/introduction-to-nodejs/): This JavaScript runtime environment enables the use of script languages on the server side. However, even its creator is critical of several aspects of it and is developing [Deno](https://www.ionos.com/digitalguide/websites/web-development/deno/), a new, more modern and secure runtime environment for JavaScript on the server end.
* **Visual Basic Runtime**: Required for several shareware and freeware programs.
* **WINE**: This runtime environment can be used to run Windows apps on other operating systems, such as Linux, FreeBSD, and macOS. However, it’s not 100% compatible.
* **XULRunner**: A runtime environment for XUL applications like Firefox, Thunderbird and Songbird. Generally these applications also run without XULRunner. However, in the future, this shared runtime environment will be implemented more consistently in order to save resources.