Real-Time and Performance Testing

This section considers tests dedicated to nonfunctional system requirements that relate to the timing of the system behavior as well as to the utilization of system resources. Real-time and performance aspects relate to different kinds of nonfunctional system requirements as shown in Figure 8.1.

Hereby [22], *reliability* is understood as the ability of a system or component to perform its required functions under stated conditions for a specified period of time. *Usability* is the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component. *Efficiency* is the degree to which a system or component performs its designated functions with minimum consumption of resources including CPU, memory, I/O, peripherals, or network resources. *Adaptability* is the degree to which a system or component facilitates the incorporation of changes once the nature of the desired change has been determined. *Portability* refers to the ease with which

![Fig. 8.1. System requirements and their relation to real-time and performance aspects](image-url)
a system or component can be transferred from one hardware or software environment to another.

The timing of the system behavior influences in particular

- the reliability of a system by, for example, providing timely recovering reactions to erroneous situations,
- its usability by, for example, providing timely responses to user requests, and
- its efficiency by, for example, invoking system resources for a limited time.

Performance aspects relate by definition not only to the system efficiency but also to the system usability as the overall system performance influences the user interaction with the system. By that, real-time and performance-oriented tests are special kinds of nonfunctional tests as shown in Figure 8.2.

![Fig. 8.2. Classification of nonfunctional tests](image)

### 8.1 Real-Time Testing Concerns

Real-time tests focus on real-time systems such as embedded and/or distributed systems, which are becoming even more important in daily life. Real-time systems are used in business and administration (e.g., e-commerce), home use (e.g., home brokerage), teaching (e.g., tele-teaching and tele-tutoring), and process control (e.g., air traffic control). We separate real-time tests into tests for **hard real-time constraints** and for **soft real-time constraints**.

**Hard real-time constraints** have to be fulfilled by a system in any case. Systems with hard real-time constraints are often called real-time systems. Please note that hard real-time constraints are not about the speed of a system but only about the fact that the time limits are met. It could be a time limit of an hour or longer as well as a limit in the range of milli- or microseconds. For example, if a hard real-time constraint is defined on the duration of a request response, then a late answer indicates a failure in the system. Other examples of real-time constraint violations that can be more severe could be an aircraft autopilot system, where a violation of hard real-time constraints may lead to an airplane crash. In UML Testing Profile (UTP), hard real-time requirements can be described by time constraints.