A system is often modeled by a description of its observable behavior, that is, global states and steps. However, to implement a system, it is often more practical to identify local state components and actions whose cause and effect are limited to a few state components. At first, we will discuss this problem using the example of the light/fan system, and then give the problem a precise form and solve it in the rest of this chapter. The techniques presented here will be used in the case study in Chapter 21 to systematically create an asynchronous hardware architecture.

### 7.1 Example: The Light/Fan System

The reader is probably familiar with the common connection between lighting and air ventilation in (windowless) bathrooms: If the light is switched on while the fan is off, the latter will start as well after some time. If the light is then switched off, the fan will continue running for some time. If the fan is off and the light is first switched on and then quickly switched off again, the fan will not start at all. If the fan is running and the light is switched off and then quickly switched on again, the fan will continue running without interruption.

Traditionally, systems are often modeled as state automata: a state automaton consists of states and steps. One state is the initial state. Every step transforms one state into another and thereby executes an action. Several steps may quite well execute one and the same action. Technically, a state automaton can be described as a graph, with states as nodes and steps as labeled edges.

Figure 7.1 shows the behavior of the light/fan system as a state automaton $Z$. It has four global states and four actions,
two of which (switch light on and switch light off) can occur in two states each.

Figure 7.2 shows the system as an elementary system net $N$. It has four places describing the local states as well as four transitions, one for each action of the system.

The representation as a system net clearly describes the cause and effect of each action. switch light off, for example, can only occur if the light is on. The current state of the fan is irrelevant for this action. The fan itself, however, only starts if it is not running and the light is on at the same time.

In Fig. 7.2, we have modeled the switching of the light as cold transitions, since nobody is forced to use the light switch. The fan is a different matter. It has to react appropriately. The difference between hot and cold transitions is not modeled in Fig. 7.1, and it is irrelevant for the rest of this chapter.