In this chapter, the notion of network QoS systems is introduced. It is contrasted against network QoS architectures which are only the technical part of a network QoS system. There are several network QoS architectures under discussion for use in the Internet but the number of possible network QoS systems which can be built from these architectures is much larger and may even be regarded as an infinite spectrum. The most important proposals in the domain of network QoS architectures are presented and discussed with respect to the spectrum of network QoS systems they may cover. By the adoption of a systemic view on network QoS, it is also tried to capture the time-variant characteristics of heterogeneous network QoS systems. That means they can not be introduced top-down by following a grand design plan but they evolve over time. This is even more true in a world of increasing deregulation and free competition among network providers. Furthermore, by taking a systemic view, it is attempted to include "the man in the loop" of network QoS systems which induces certain policies when running a network QoS system. After the discussion of existing QoS architectures and how they fit into the conceptual model of QoS systems, some prominent alternative approaches are discussed. It will be argued that these still fit into our definition of network QoS systems although they are often characterized as antagonists of network QoS approaches. Note that in the following a QoS system always denotes a network QoS system and service always refers to network service.

2.1 General View on Network QoS Systems

In this section, a general conceptual view on the domain of QoS systems is introduced. The basic building blocks and concepts influencing a QoS system are identified and their relations to each other are clarified. Thereafter, the major building blocks are discussed in more detail.

The conceptual model derived in this section is not meant to be the only possible model of a network QoS system nor is it meant to cover all the many details QoS systems exhibit but it represents, from our point of view, a particularly suited model to investigate a heterogeneous collection of such QoS systems and their interworking.
2.1.1 Conceptual Model and Building Blocks

In Figure 1, an entity-relationship model is used to introduce the conceptual model of a QoS system and its basic building blocks. A QoS system is modeled to have two major attributes: *granularity* and *time scale*. The former is with regard to the granularity of the units of service for which QoS assurances are given. Systems that provide a low resolution of individual units of service are coarse-grained whereas systems that allow for a higher resolution are fine-grained. The time scale under which the system operates refers to the response time at which the system replies to service requests. Systems with extremely large response times (in the order of hours, days, or even months) are called static while systems virtually reacting immediately (in the order of ms) are called dynamic. For both, granularity and time scale of a system, there is a spectrum of possibilities.

A QoS system consists of a QoS architecture and a QoS strategy. The QoS architecture describes the technical part of the QoS system while the QoS strategy determines how a network provider exploits the technical features offered by the chosen QoS architecture. To do so, a QoS strategy uses a certain policy which could, e.g., be to enforce the strategy by a suitable tariffing of the offered services. The QoS architecture is at the heart of a QoS system as it represents the main constraint for the properties of a QoS system. But the actual selection of the properties of the system within this constraint is done by the QoS strategy.

In any QoS architecture design decisions on the components and their consistent orchestration are based on a QoS model that has been presumed for that QoS architecture. The QoS model consists of a traffic and a control model. The traffic model describes the assumptions of the QoS architecture with respect to the expected traffic mix under which the QoS architecture operates most efficiently. The control model

![Figure 1: Entity-relationship model of network QoS systems.](image-url)