4 PERFORMANCE OF TRANSCEIVERS

4.1 INTRODUCTION: PERFORMANCE

The front-end of a transceiver converts a modulated wanted signal into an antenna signal, and vice-versa. This is done by means of a sequence of frequency domain operations: upconversion, downconversion, filtering and amplification. Determining which operations are needed and in what sequence is the architecture design. This design will be mainly based on the function that the receiver and transmitter have to perform in the frequency domain. Whether or not a transceiver architecture performs the required frequency shifting and filtering will determine whether or not an architecture is suited. The actual implementation of the transceiver requires the implementation of all the frequency domain operations described by the architecture as physical building blocks, either on-chip or as discrete components. These building blocks will not be perfect. Apart from the wanted frequency domain operations they will also perform some unwanted operations. Unwanted operations are for instance adding noise to the signal and distorting the signal. These unwanted operations will limit the performance of the transmitter and the receiver.

The performance of a wireless link is given by the ratio between the correctly received information and the total amount of transmitted information. A high perfor-
formance means that most information is transferred correctly. For digital information the performance of the wireless link is often expressed in the form of a bit-error-rate. The performance of the transmitter and the receiver has an influence on the overall performance of the wireless link. Here, the performance of a transmitter or receiver is defined as the ratio between the power of the wanted signal at the output and the total power of all the unwanted signals from which it can not be separated anymore, i.e. the unwanted signals which are located at the same frequencies as the wanted signal. The performance is therefore defined as the output signal-to-unwanted-signal ratio (SUSR). For the transmitter this ratio is taken at the antenna, for the receiver this ratio is taken at its output, before demodulation and after A/D-conversion.

The performance of a transmitter or receiver is determined by the unwanted operations of its building blocks. The magnitude of the unwanted operations of a building block is determined by the building block type (whether it is an amplifier, bandpass filter, mixer, ...), its wanted operation (bandwidth, operating frequency, ...) and two cost parameters : power consumption and chip area. The specifications for the different building blocks, concerning both its wanted and unwanted operations, have to be chosen carefully in order to minimize the cost parameters. This is the high-level design. During the high-level design the specifications given for a certain application are translated in the most optimal specifications for each building block of a given architecture.

In order to do a high-level design it is necessary that the following relationships are known and taken into account:

- All relationships within a building block : specifications of wanted operations, specifications of unwanted operations and cost parameters can not be changed independently.

- The relationships between building block specifications within an architecture and their influence on the total transceiver specifications set by the application.

It is believed that it is very hard to formally describe and quantize all these relationships for all types of building blocks and transceiver architectures. Today, high-level transceiver design is therefore mainly based on experience, re-use of results from previous design and greatly simplifying the design problem. A good feeling for all interdependencies is often only obtained after the lengthy design process has been done all the way down to the transistor level, leaving in this way no room for any optimization. Consequences of this only limited optimization are too high cost parameters (too much power and area consumption) and it has also an influence on the performance that can be achieved. Moreover, the limited knowledge on the relationships between architecture and building blocks makes it very hard to use and select new topologies. A new topology must not only prove to realize the wanted frequency domain operations, it must also achieve the required performance at a very low power and area cost. This