MUSICAM, which allows up to 6 high-quality stereo radio programs to be transmitted together with another 48 Kbit/s of other data on a single DAB channel. However, the actual structure of the ensemble in the MSC can essentially be configured in an arbitrary way; for instance, it may be desirable to reserve more bandwidth for different data services, or mix stereo radio programs with mono programs of reduced audio quality, which are sufficient, e.g., for news programs.

In terrestric transmission, the DAB data stream is actually divided into a large number (typically 1,536, but the actual number depends on the transmission mode) of small subchannels. On each of these subchannels, a small part of the information is transmitted with a relatively low bitrate. This makes it possible to handle *multipath propagation:* whereas with other broadcast systems multiple copies of the same signal with different delays (such as signals emitted by different transmitters, or reflections of a signal from a single transmitter) invariably cause interference, the DAB receiver is able to cope with this situation provided that all copies of the signal arrive within a certain time interval, the so-called *protection interval.* The power of the transmitters in a DAB network is chosen such that normally the protection interval (which is sufficiently large because of the low bitrate on the DAB subchannels) will not be violated. This makes it possible to have clear reception of DAB signals even in environments like tunnels and mountains in which other kinds of broadcast systems fail.

In fact it is this unique feature of the DAB system which has motivated our research, because it also allows broadcast engineers to construct entire networks transmitting the same program ensemble on the same channel, so-called *single-frequency networks* (*SFN*'s), without having to worry about interferences between the individual transmitters. By making a clever choice of SFN's, one can often save a considerable amount of frequency resources. We illustrate this with an example in the following section.

3 Example

Let us take a look at a simple, hypothetical instance of the problem (Figure 1). Since we are interested in ensemble planning, it is convenient to formulate the problem in terms of arbitrary (geographical) "areas" which have to be supplied with given "services" (subsuming both radio programs and data services). In our example, there are five areas (I-V) and eight different services (A-H). For each area, we know which services are to be transmitted in that area: services A, B and D must be supplied in area I, services A, B and E in area II, and so forth. Each service uses up a certain bandwidth in an ensemble, which we have specified in an arbitrary unit. For the purpose of ensemble planning, we only care about the ratio between service bandwidths and the maximum size of an ensemble; here, we assume an ensemble size of 9.

In practice, the areas could actually be anything from the supply area of a single transmitter to a large geographical region covered by an entire network. The only thing we have to know is which areas may *interfere* with each other (or, more precisely, for which pairs of different areas there are transmitters which may interfere when transmitting