The quantity $\pi_M^R(G)$, which we call the *clique packing number* of G w.r.t. R and M, is a weighted generalization of the clique number which, instead of merely counting the vertices contained in a clique, weights cliques according to the packing number of their requirements. While computing the clique packing number is NP-hard, in practice it is much easier to approximate than other lower bounds like the minimum $\omega(G^{\mathcal{B}})$, for which we would have to consider all admissible ensemble assignments. Here we can employ a generalized version of the *Carraghan/Pardalos* algorithm, a branch-and-bound method for computing the clique number of a graph [2], which we have found to work quite well on not too dense graphs with a few hundred vertices. The algorithm can also be terminated at any time to give a lower bound on the clique number. It can easily be adapted to any weight function which is "monotonous" in the sense that if $W \subseteq W'$ then the weight of W is at most the weight of W'.

One complication is that since the bin packing problem is NP-complete, we can only approximate the clique weights. That is, we actually compute a lower bound

$$\varphi_M^R(G) = \max\{f(R_W, M) : W \text{ clique of } G\} \tag{10}$$

on the clique packing number, where $f(X, M)$ is a lower bound on $p_M(X)$ which can be computed efficiently. We usually employ the "sum bound"

$$f(X, M) = \lceil \mu_X / M \rceil, \tag{11}$$

which is always at least half the packing number.

6 DABTool

The algorithmic techniques sketched out in the preceding sections haven been implemented in an interactive software environment for UNIX systems, called *DABTool*. The current version of the software has been developed and tested under SuSE Linux 6.x with kernel 2.2, libc6, X11R6, GNU C++, LEDA 3.8 and Tcl/Tk 8.0. However, the system should be portable to any POSIX-compliant UNIX system with recent versions of the X11 windowing system, GNU C++ compiler and the LEDA library. The test configuration and database interface modules require Tcl/Tk (including the Tix extension) and a recent ADABAS version, but these are optional add-ons which are not required for the remaining parts of the software to work properly. In fact, previous versions of the software have been ported to SUNOS 4.x and 5.x systems with minor effort.

We emphasize that the system described here has mainly been designed for research purposes and as such is not (yet) a program for the end user. The main purpose of the program is to carry out systematic testing of different solution approaches some of which are still in development. However, it already provides the basic facilities needed to actually perform calculations on real-world DAB network planning problems.

The DABTool program (see Figure 1) is in fact a heavily modified version of the LEDA graph editor tailored for the DAB ensemble planning problem (LEDA = *Library of Efficient Data Structures and Algorithms* is a C++ library featuring high-level graph classes and operations, which is being developed at the Max Planck Institute of Saarbrücken, Germany; see http://www.mpi-sb.mpg.de/LEDA). It supports automatic generation of graphs with up to 200 nodes and arbitrary edge densities. (The number 200 is more a practical limit for interactive usage, since even for, say, only 100 nodes the display becomes a bit crowded. Internally, and when the program is run in macro/batch mode, the system can handle much