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 [3], 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. For instance, in our example in Section 3, the areas I, II and V form a clique of the area graph whose requested services sum up to a total bandwidth of 24. Hence the clique packing number for this instance is at least $\lceil 24/9 \rceil = 3$, which proves that the solution with 3 frequency blocks is optimal (and also shows that the clique packing number is exactly 3). Note that in this example we have that $\pi_M^R(G) = \chi_M^R(G)$. This is *not* true in general; just as with chromatic and clique numbers, there may be a "dual gap" between χ_M^R and π_M^R which can be arbitrarily large.

7 Test Results

To validate our solution approach, we have done some tests using the DABTool program. While these results are still rather preliminary, and will have to be confirmed with more systematic studies in the future, they already show some interesting characteristics of the SFF and GFF algorithms. The tests were performed using randomly generated problem instances. As area graphs we chose so-called *unit disk* (UD) graphs, which, because of their geometric structure, are commonly employed as simple models of broadcast networks [4].

UD graphs are intersection graphs of equal-sized disks in the Euclidean plane. They are usually specified by a point set $V \subseteq \mathbb{R}^2$ and a diameter d. The edges of the graph are then those pairs vw of distinct vertices v, w for which $||v - w||_2 \leq d$, where $|| \cdot ||_2$ denotes the Euclidean norm in $\mathbb{R}^2$.

We performed two test series with diameters $d = 0.25$ and $d = 0.4$, where the point coordinates were generated uniformly and independently in the range $[0, 1]$ using 31 bit