Solving the DAB Ensemble Planning Problem with Tabu Search

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1 Introduction

As pointed out in the previous article "DABTool - A Test Environment for DAB Ensemble Planning" by Albert Gräf, the SFF and GFF algorithms represent two basic solution ideas for the ensemble planning problem (EPP), GFF (in contrast to SFF) taking advantage of the possibilities to reduce the demand of frequencies needed by oversupplying some or all of the vertices $v \in V$ of the area graph $G = (V, E)$ with services $s \in S$ not necessarily required ($s \notin R_v$). We will see later that for quite some problem instances SFF or GFF (but usually not both) can find optimal or near optimal solutions, yet there are many problem instances, for which both SFF and GFF yield rather poor results. In consequence, our goal is to contruct a solution method, the results of which are at least as good as the better of SFF and GFF in all cases, and which takes into account especially those problem instances, for which both SFF and GFF fail to deliver good results. In this latter case we expect considerable improvements in result quality.

We have decided to use Tabu Search (TS) techniques as the conceptual basics of our solution method due to good experiences made with TS in a wide variety of telecommunication applications and related fields [1], [7], [11], including frequency assignment problems [6]. Unfortunately, we will not be able to go into all details of the solution method in this article. Therefore, for a complete description see [8]. Let us start the development of the solution method by having a brief look at the basic conceptual ideas behind TS, but already including the slight modifications needed for our purposes.

2 Tabu Search – The Basic Framework

TS is a heuristic technique for solving discrete optimization problems and is regarded as a member of the family of so called meta-heuristics [9], [10]. It can be understood as a form of neighborhood search, expanded by a few components the most crucial of which is the concept of setting so called tabus on some transitions, blocking any development in direction of these transitions as long as the tabus set on them are valid. The underlying idea is to avoid a problem arising with classic neighborhood search, which for conceptual reasons tends to easily get trapped in a local optimum, providing no mechanism to enable a renewed escape.

As an expanded variation of neighborhood search, the first step in adapting TS to a given optimization problem is to define a neighborhood suitable for the problem, that is, given a