Exact Solution for a Bandwidth Packing Problem with Queueing Delay Guarantees

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The bandwidth packing problem concerns the selection of calls from a given set and the assignment of one path to each selected call. We want to maximize profit while the routings of the selected calls observe the capacity constraints of the links. Here, we additionally consider queueing delays in the network, which possibly deteriorate quality of service to users if they exceed the acceptable limits. The integer programming formulation for the bandwidth packing problem assuring queueing delay restriction contains nonlinear constraints intrinsically. We reformulate the problem as a linearly constrained one by applying the Danzig-Wolfe decomposition to the original formulation. Since it has exponentially many variables, branch-and-price procedure is proposed to solve it. Then the nonlinearity in the original formulation is transferred to the knapsack subproblem and we can efficiently solve this nonlinear knapsack problem by modifying the dynamic programming algorithm for the ordinary knapsack problem slightly. We report computational results on some realistic telecommunication networks which show that the exact solutions can be obtained in a reasonable time.