

## **Developing a Computational Infrastructure for Auctioning Vertically Integrated Online Services**

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We develop three auction-based pricing and allocation solution methods for the case where a capacity-constrained online service provider offers multiple classes of unique, one-time services with differentiated quality. Consumers desire exactly one of the many service classes offered. We call such a setting a vertically integrated online services market. Examples of these services are webcasting of special events over the Internet, provision of video-on-demand, and allocation of grid computing resources. We model the pricing and allocation decision faced by firms in such a setting as a knapsack problem with an added preference elicitation dimension. We present a variety of computational solution approaches based on adaptations of the traditional greedy heuristic for knapsack problems. The solution approaches vary in efficacy depending on whether bidders are restricted to bid in one service class or allowed to bid in multiple service classes, as well as on the overall variability of the demand. In the case bidders can bid in multiple classes but are interested in consuming only one service class, a direct application of the heuristics developed for the single service case results in a nonfair allocation. We develop a novel data structure to eliminate the unfair allocation while maintaining the original computation complexity of the simpler setting. The paper contributes by presenting a menu of auction clearing mechanisms for selling vertically integrated online services.

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