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COMPUTATIONAL COMPLEXITY OF INTEGRATED MODELS OF NETWORK DESIGN AND FACILITY LOCATION

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Abstract. Transportation Network Design and Location Theory are two related areas that have been extensively studied in the past, primarily in isolation of each other. This is unfortunate because when the network is designed improperly, customers get extremely poor service even when service facilities are located optimally. Thus there is a need to investigate models where transportation networks are designed with future facility locations in consideration. In a partial attempt to address this gap, we develop a framework for an integrated model of transportation network design and facility location. In this model, transportation network is to be designed to allow the residents of the network to avail of the service provided by a single facility whose location is predetermined. Our principal contributions are to show that (i) our model reduces to a constrained minimal spanning tree problem and that (ii) it is NP Complete. We demonstrate that this complexity result holds even in the simple case where the customer sites are assumed to be given by the vertices of a convex polygon. This result thus shows that integrated models of facility location and network design can be computationally hard even in the simplest case, where only one facility needs to be located.

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