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Pricing a Public Logistics Network

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Extended Abstract

A public logistics network (PLN) is proposed as an alternative to private logistics networks for the ground transport of parcels. Using the analogy between the packages transported in the network and the packets transmitted in the Internet, a package would be sent from a store and then routed through a sequence of public distribution centers (DCs) located throughput a metropolitan area and then delivered to a home in a matter of hours, making a car trip to the store to get the package unnecessary. The DCs, functioning like routers in the Internet, could also be located at major highway interchanges for longer distance transport. Currently, it is common for a single logistics firm like UPS and FedEx to handle a package throughout its transport. In a PLN, the different functions of the network would be separated so that a single firm is not required for coordination. This would enable scale economies to be realized in performing each logistics function since each element of the network has access to potentially all of the network's demand. The increase in scale would make it economical to have many more transshipment points. Each transshipment point, or DC, could be an independently operated facility that serves as both a freight terminal and a public warehouse, and could be established in small cities and towns that would never have such facilities if they were served as part of a proprietary, private logistics network.

A traditional private logistics network like UPS has multiple rates for parcel transport corresponding to different levels of service, with the highest rate for guaranteed delivery early the next morning and lower rates for later deliveries. The decrease in rates corresponding to the increase in delivery times provides an estimate of the value associated with the package's transport time. Same-day delivery is not offered for common parcel transport because each package is sorted at a small number of hub DCs only during a short predetermined time window during the night. These fixed sortation time windows, along with fixed pickup and delivery time windows, make it possible to provide guaranteed delivery times within each rate class. In a PLN, the trucks do not follow a fixed route or a fixed schedule, making it difficult to provide guaranteed delivery times; instead, after delivering a load at a DC, a truck can select the next load to transport from that DC to any adjacent DC based on which load has the greatest need for transport. A pricing mechanism that allows the load to be selected that has packages with the greatest time-value would allow a PLN to offer different levels service. Instead of being able to offer a guaranteed delivery time like UPS, a PLN would only allow a package to increase the likelihood that it would be delivered sooner rather than later. However, the advantage of a PLN is that the cost of this service would likely be much lower since all of the independently operated trucks and DCs in a PLN are competing with each other to provide this service. In addition, a PLN could provide low-cost same-day local delivery because packages are sorted at local DCs instead of being shipped long distances to hub DCs.

The subject of this presentation is the design of a pricing mechanism for load selection. This selection should reflect the load whose packages place the greatest value in reaching their destinations, and, in cases where the number of packages exceeds the capacity of the truck, packages should be selected for a load based on this same valuation. Thus, at each DC, the loads to adjacent DCs are competing with each other to be selected by a truck as the next load to be transported and packages are competing with each other to be selected to be in that next load. In addition, the trucks themselves can be competing with each other for the right to select the next load for transport. A starting point for the design of this pricing mechanism is the "smart-market" mechanism proposed by MacKie-Mason and Varian in order to provide differentiated levels of service for the Internet, where each packet submits a bid that is paid whenever it reaches a congested router. In a PLN, each package submits a bid that reflects its desired speed of delivery. This bid is then used to pay each truck that transports the package and each DC that stores the package along the path from its origin to its destination. An object-oriented simulation is used to demonstrate the performance of this pricing mechanism.

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