

Deploying autonomous mobile lockers in a multi-echelon parcel operation

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ABSTRACT

An autonomous mobile locker is introduced into the current city logistics network to solve problems, such as shortage of parking places in the CBD area, traffic congestion on the roads, the high cost of depot rent, and transportation cost. The proposed system consists of couriers working with autonomous mobile lockers that visit the couriers in the field and transfers the collected parcels to the depot. Consequently, couriers can continue their tours without having to make hourly returns to the depot. At the same time, the autonomous mobile locker can enlarge the coverage of depot and therefore reduce the number of depots, saving on rent. In addition, the high frequency of collection by autonomous mobile locker can shorten the maximum delivery time of parcels in the same city.

CONTRIBUTIONS

Cost saving:

- Enlarge the coverage of depots, which subsequently reduces the establishment cost of facilities.
- Reduce the number of vans to relieve traffic jam and reduce vehicle and transportation cost, which could also reduce environmental pollution
- Decrease the peak of shipments and reduce workload on hubs, prolong the period of hub usage.
- Increase the utilization of staff and equipment, such as hubs and vehicles.

Time saving:

- Increase the frequency of transfer between the courier and depot, thereby reducing the shipment life cycle time.

METHODOLOGY – Minimize the total cost

Minimizes the total of the travel costs of autonomous mobile lockers and the costs for the opened depots

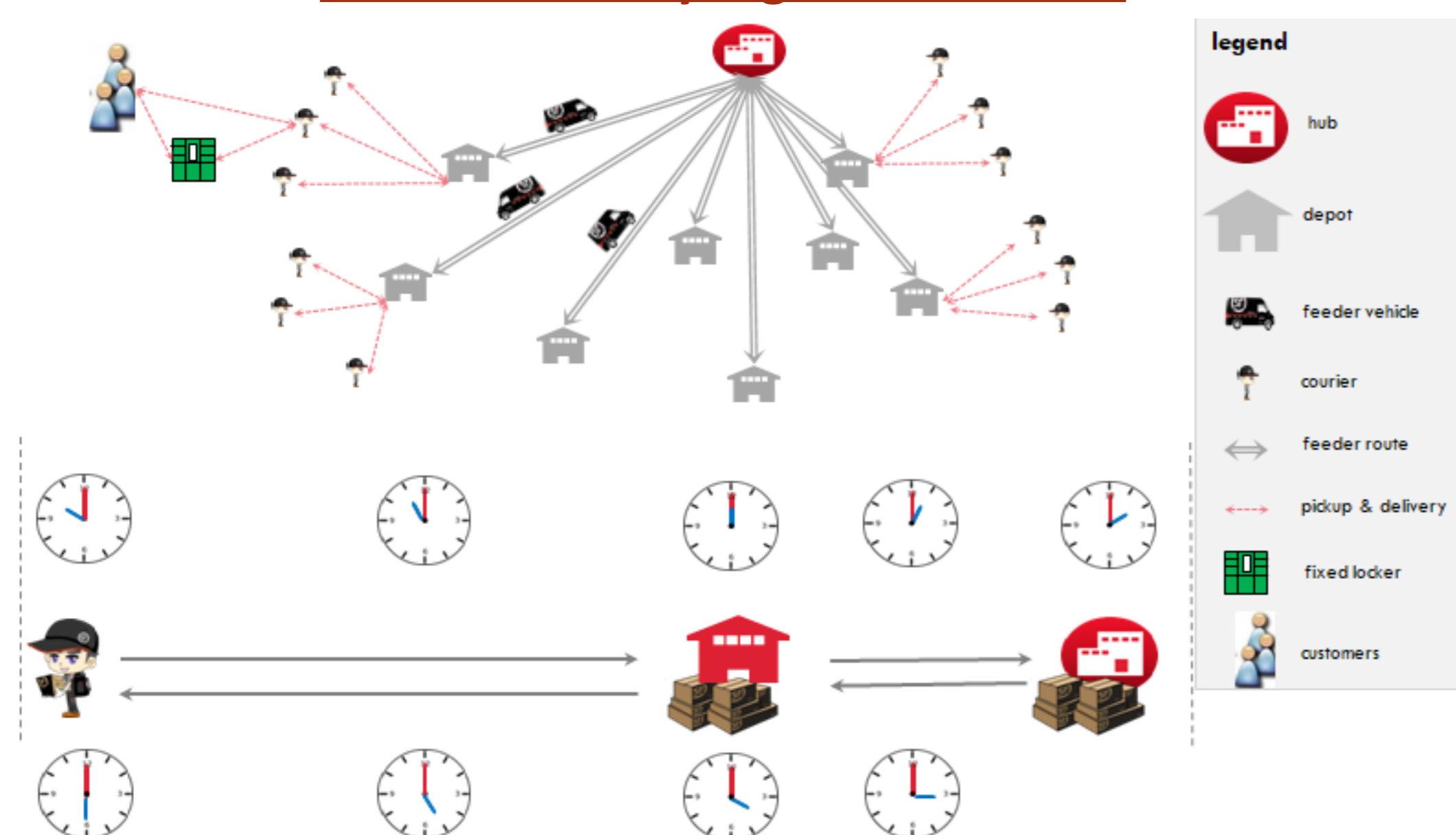
$$\text{Minimize } \sum_{i \in N, j \in N, k \in K} x_{ijk} c_{ij} + \sum_{m \in D} v_m f_m$$

Notation	Definition
x_{ijk}	A binary variable which takes 1 if an autonomous mobile locker $k \in K$ travels from node $i \in N$ to node $j \in N$, and 0 otherwise
c_{ij}	Average travelling cost of autonomous mobile locker from node i to node j , where $(i, j) \in A$
v_m	A binary variable which takes 1 if a depot $m \in D$ is open, and 0 otherwise
f_m	A fixed opening cost of depot $m \in D$

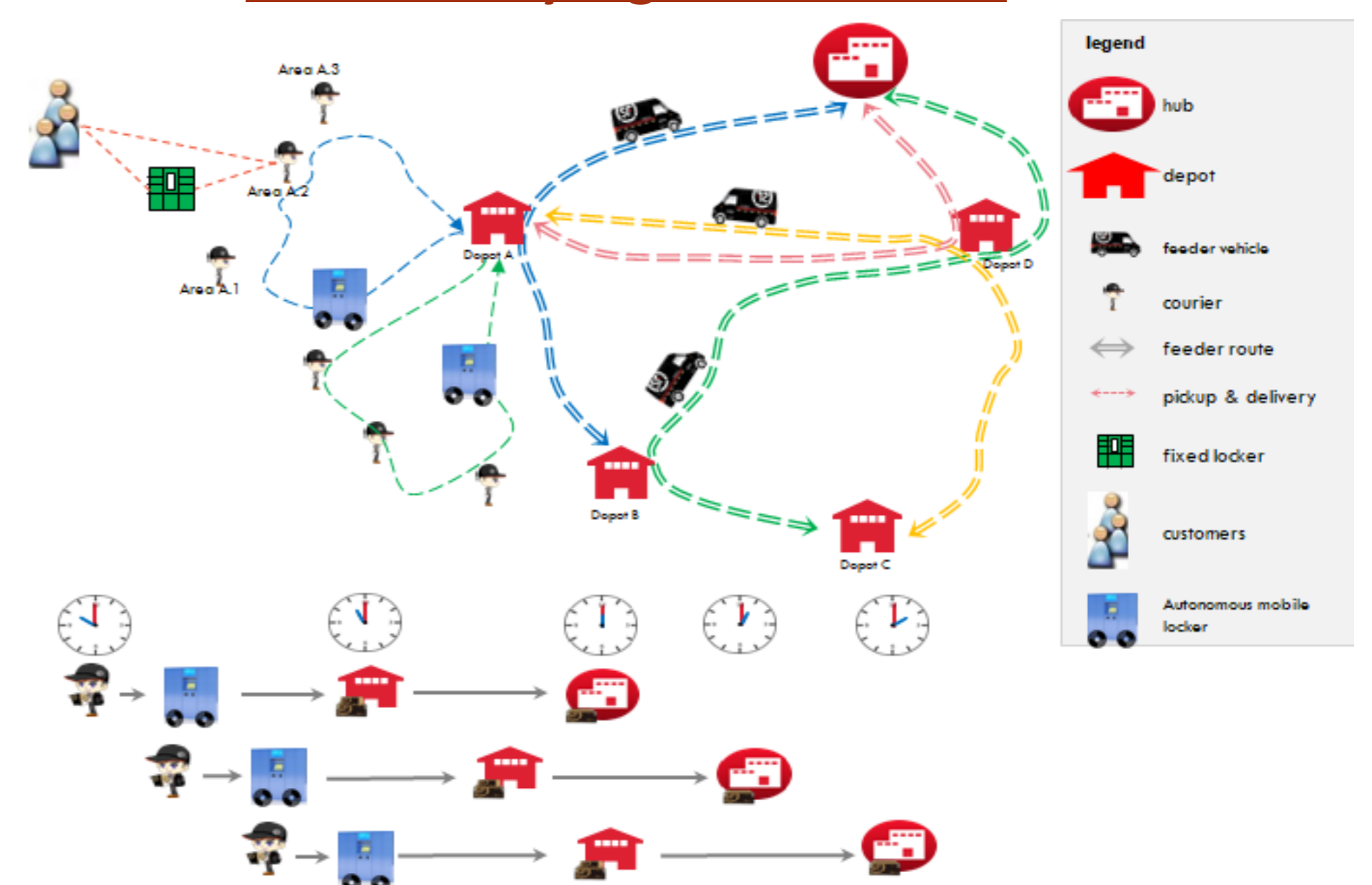
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The current city logistics network



The new city logistics network



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