



Introduction to Local Hub Planning Problem

2021.04.19

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ABOUT SF

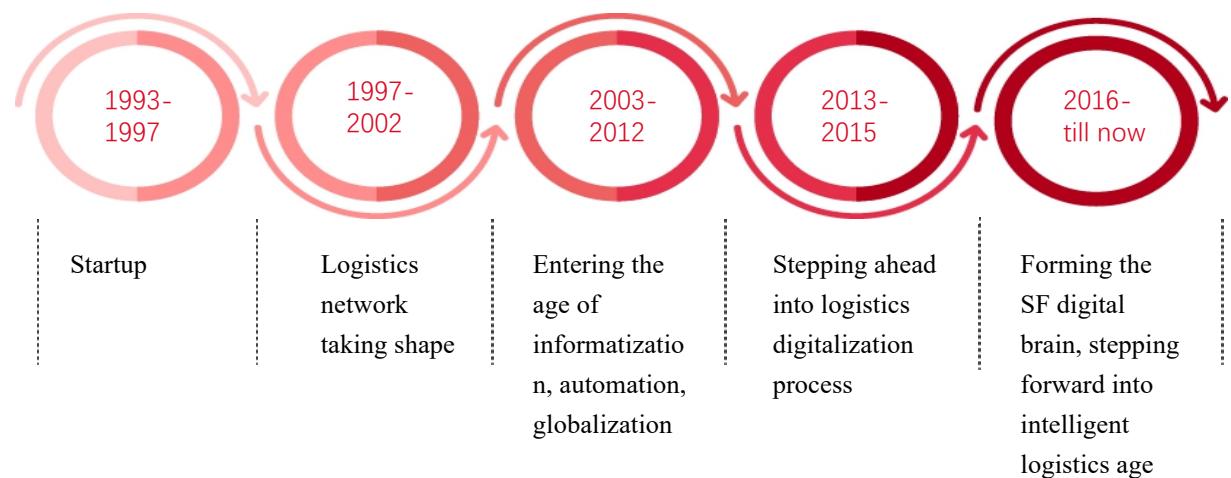
P 01



SF is one of the leading integrated express logistics service providers in China. After years of development, SF has accumulated fundamental capabilities for providing customers with one-stop integrated logistics solutions, extending from high-quality logistics service from the last mile delivery, to the front-end of the value chain includes production, supply, sales and distribution phases.

SF is an intelligent logistics provider with the competence of network scale. SF focus on business operation and strategic network development since its establishment, and has built an integrated logistics three-in-one networks of “Aviation”, “Ground” and “Information” covering domestics China and overseas.

SF adopts the direct operation mode, through central controlled operation and management from headquarter to local branches, to maintain the operation quality level throughout the networks.



WHAT WE DO

At a Glance



Express



Cargo Freight



Cold Chain



Healthcare



International



Warehousing



Industry Park



Finance

SF Express

P 03

SF is the 1st express delivery company in China with an all-cargo air fleets subsidiary, as of data by 1H 2019, SF has **75** all-cargo aircrafts handling over millions of shipments per day.

SF has **10** hub-level distribution centers, **39** aviation and railway sites (excludes shared venues), **147** regional hubs (includes hubs of Shunxin Express), in **121** of which fully automatic and efficient sorting systems have been put into use to guarantee the punctuality and safety of shipment delivery.

SF also has **4** independent call centers with 4200 service representatives serving **1 million** customers per day.

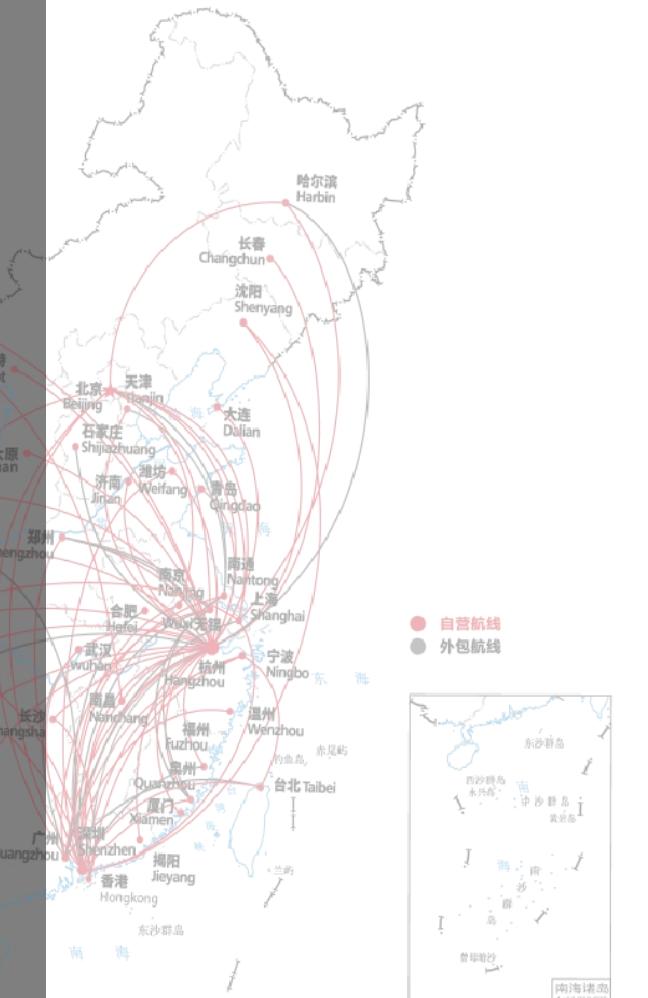
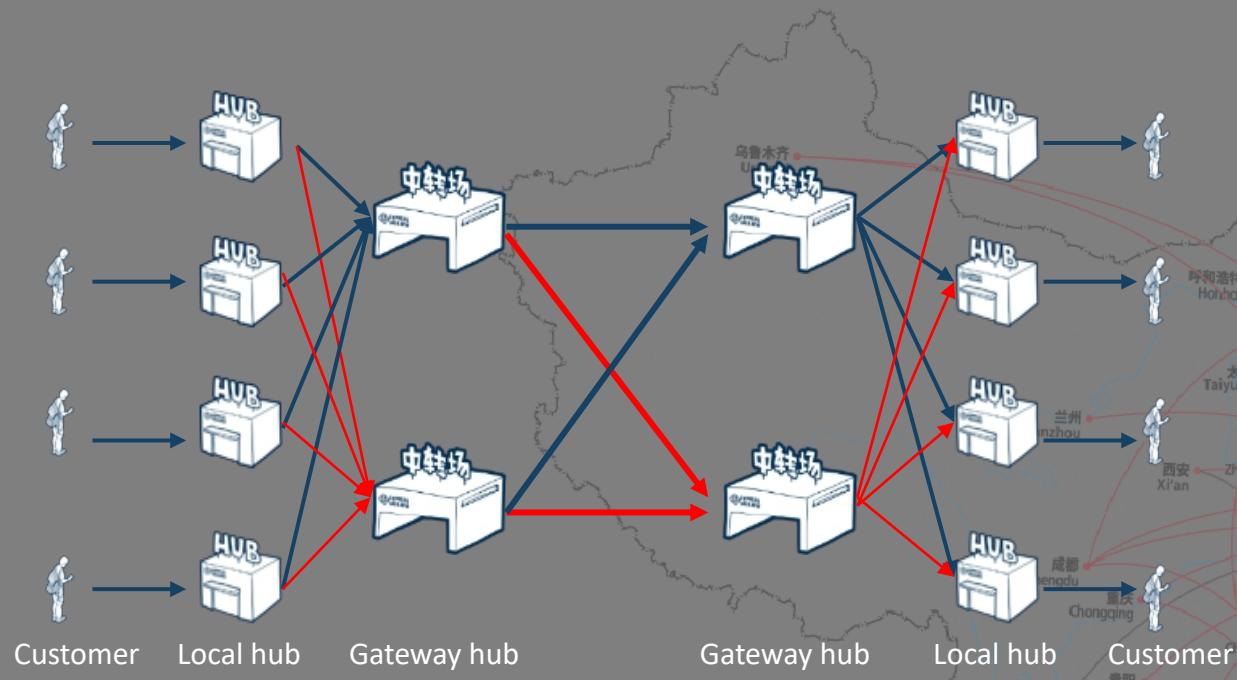


Data source: 2020 SF Holding Semi-Annual Report; K indicates 000s.



Service Network

Nodes:	Arcs:
Customer	Couriers
Local hub	Vans
Gateway hub	Trucks/Aircrafts



320K
couriers

58K
operation vehicles self-owned and outsourcing

75
cargo aircraft

Service Network



18K

local hub

Local hubs are also called service centers and act as intermediate nodes connecting the gateway hubs and customers. Based on local hubs, the couriers could provide pickup and delivery service for customers.



147

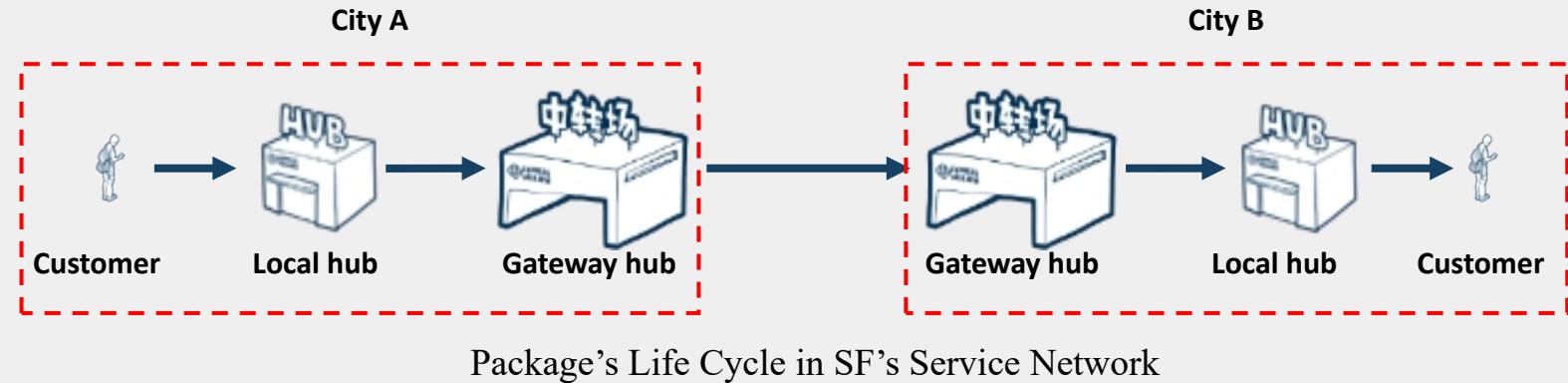
gateway hub

Gateway hubs cover local hubs. They provide sorting service and sent packages to local hubs in the same city or sent packages to gateway hubs in other cities.



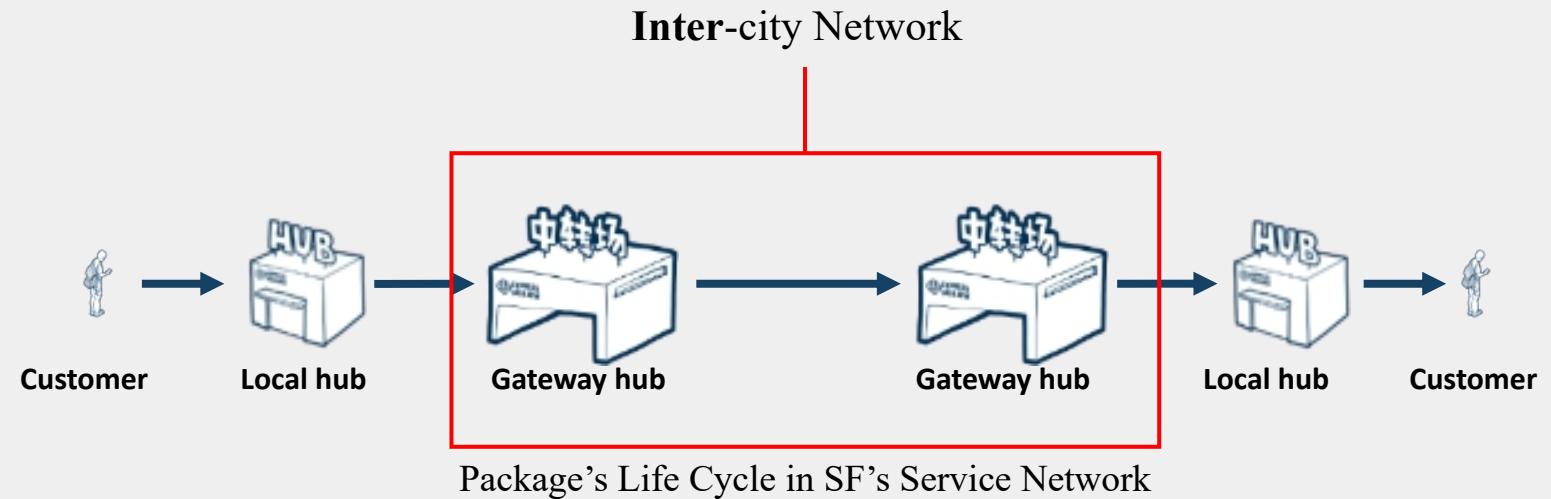
Service Network

/ Package's Life Cycle /



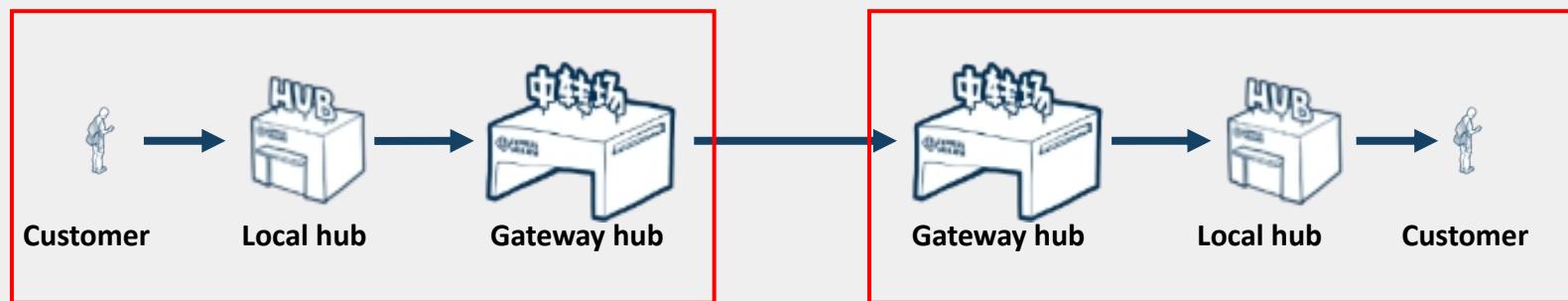
Service Network

/ Package's Life Cycle /



Service Network

/ Package's Life Cycle /



Package's Life Cycle in SF's Service Network

Intra-city Network



Project Requirements

/ Local hub planning /

Output

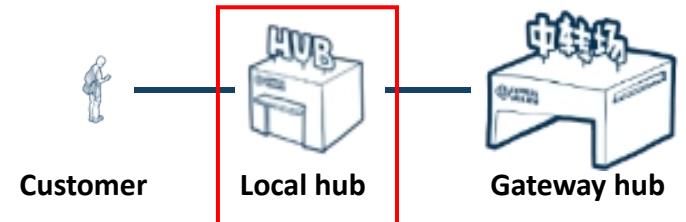
- (1) number
- (2) location
- (3) function
- (4) total cost
- (5)

Design a proper algorithm to

- (1) minimize total cost;
- (2) satisfy customer demand

Analyze and discuss the result

Creative thinking and rational assumptions
are welcome



Problem Description



2021

customer areas

/ Customer area /

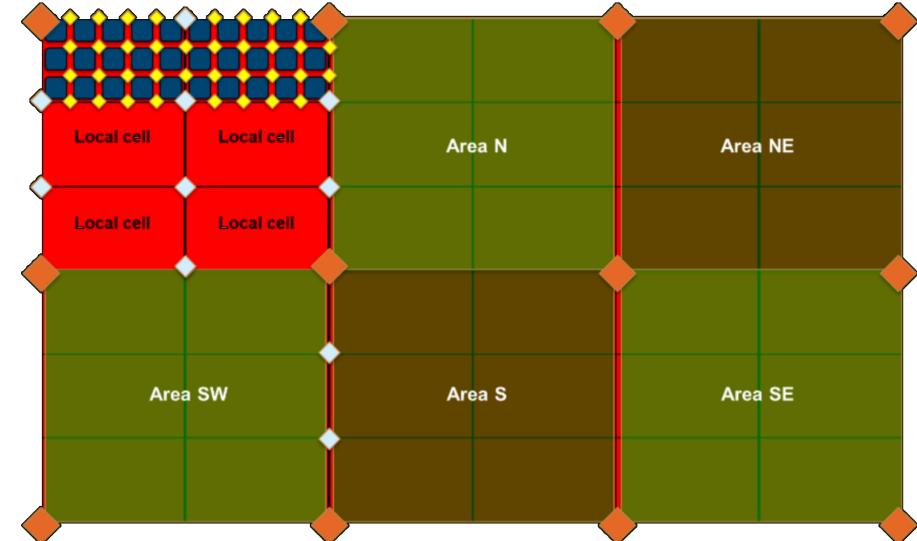
Cluster of customers

Smallest unit

2021 customer areas

Demand

total demand of all the customers in this area.



Problem Description



/ Local hub /

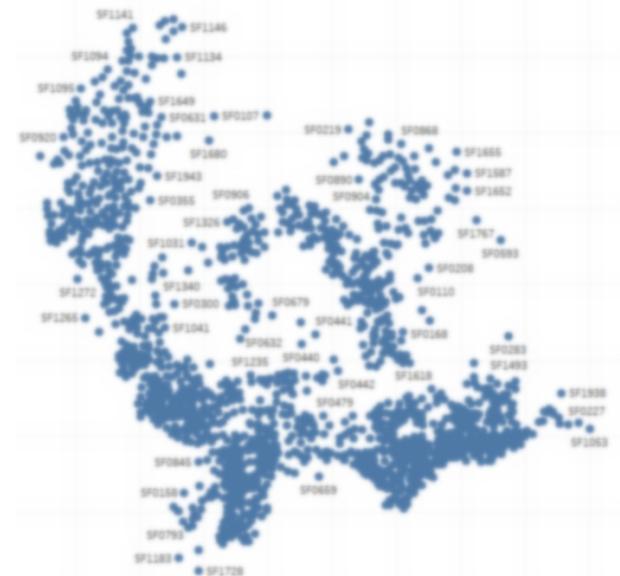
Candidates

2021 customer areas

Fix cost

20 yuan per local hub

Once one customer area is selected as a local hub,
both the distance and transportation cost between
this customer area and the local hub are 0.



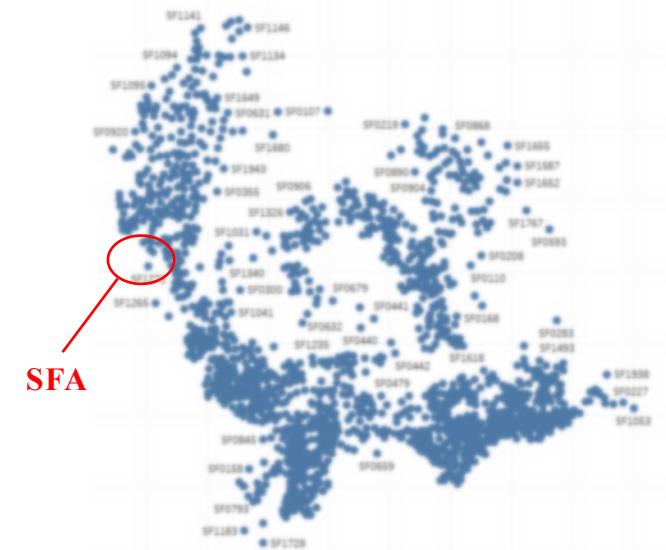
Problem Description

/ Gateway hub /

Gateway hub

One gateway hub, denoted as “SFA”

Location is fixed



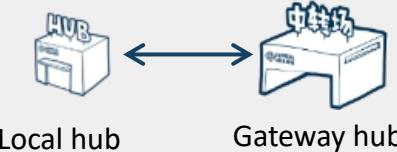
Problem Description

Transportation resource



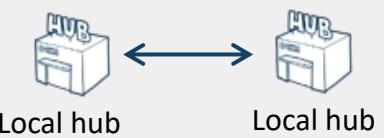
Type A Van:

used between gateway hub and local hubs.



Type B Van: (Optional)

used between local hubs, if needed.



Type C Van:

used by couriers between local hub and customer area.



Table 1. Vehicle information

Resource	Type A Van	Type B Van	Type C Van
Cost (Yuan)	$\max(70, 70 + 4.5 * (\text{dist} - 5))$	$\max(30, 30 + 4 * (\text{dist} - 5))$	$6 * \text{dist}$
Capacity (Piece)	800	200	40

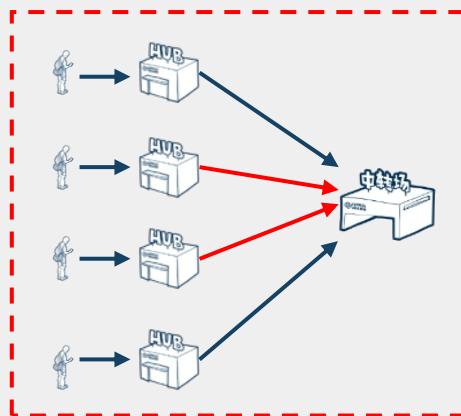
PS: *dist* is the travel distance (unit: km).

Problem Description

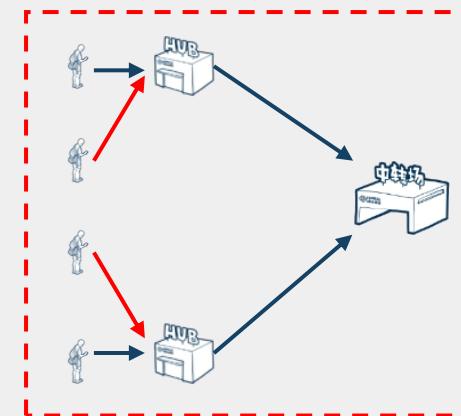
/ Cost /

Transportation cost

Local hub fix cost



Local hub fix cost ↑
Type A van cost ↑
Type C van cost ↓



Local hub fix cost ↓
Type A van cost ↓
Type C van cost ↑



Data & Parameters

P 13

/ Data /

Customer demand

customer_code: customer area code ;

demand: demand of one customer area, unit (piece).

demand.xlsx

customer_code	demand
SF0001	6
SF0002	111
SF0003	37
.....

Distance matrix

node_1, node2: customer code or gateway hub code;

dist: distance between node_1 and node_2, unit (km).

dist_matrix.txt

node_1	node_2	dist
SF1681	SF1681	0
SF1681	SF0871	14. 354
SF1681	SFA	24. 406
.....

/ Parameter /

Vehicle cost and capacity: see table 1 ;

Fix cost of local hub: 20 yuan;

Gateway hub code: “SFA”.

Table 1. Vehicle information

Resource	Type A Van	Type B Van	Type C Van
Cost (Yuan)	max(70, 70+ 4.5 * (dist - 5))	max(30, 30 + 4* (dist - 5))	6*dist
Capacity (Piece)	800	200	40



Thank you!

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Q&A

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