

Logistics Tracking and Synchronization Solution of CommaTech

Dr. Leon Kong
10 July 2019

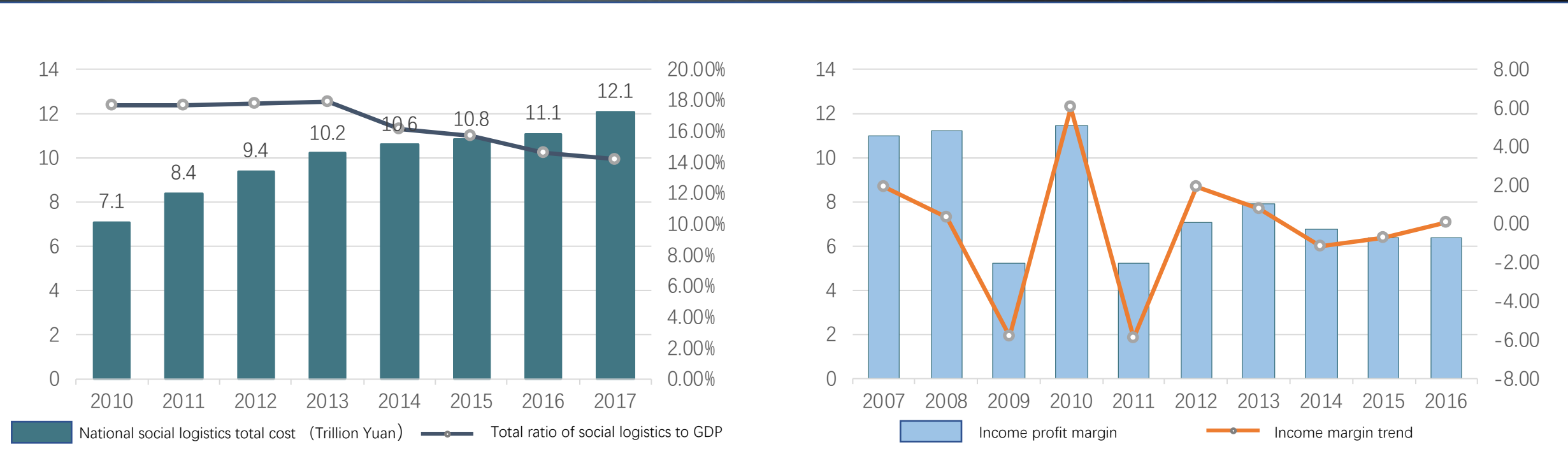


Part One

01

Background

1

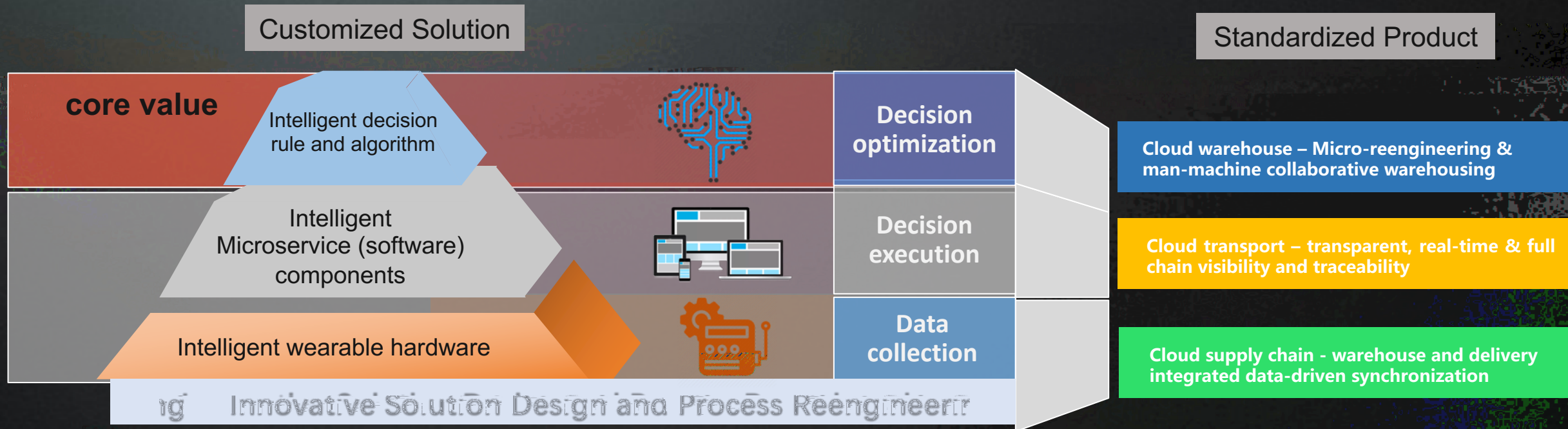


- The China logistics market is huge. The total social logistics cost in 2017 was 12.1 trillion, with a compound growth rate of 7%.
- The maturity of the logistics industry needs to be improved, and the total logistics cost accounts for 14% of GDP, which is far from the countries of Europe, America and Japan (on average 8%-10%).
- The overall profit margin of the logistics industry is around 5%, and the cost reduction is urgently needed.

“Over the past three years, we have contacted and served more than 100 logistics supply chain companies, and almost all 2B companies need an integrated one-stop solution.”

The core value of enterprise empowerment lies in the third layer (realizing cost reduction and efficiency increase), and with the abundant scenes and data, the decision is more precise and effective.

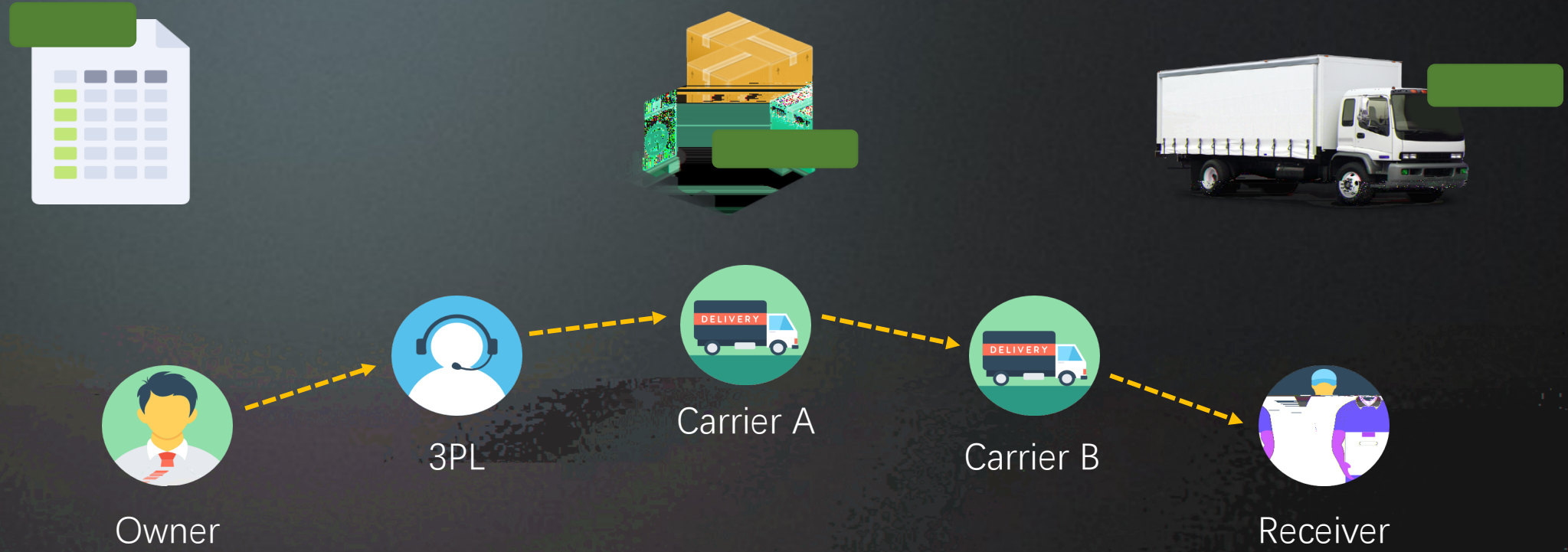
However, the current status is the lack of data or inaccurate, incomplete, and untimely data collection.



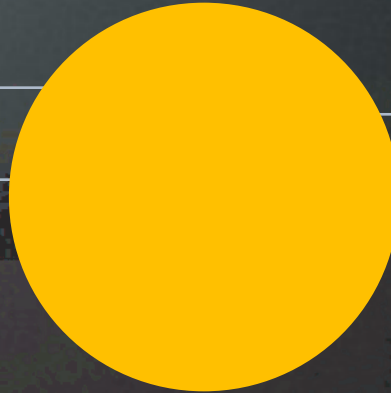
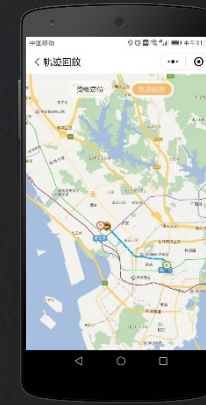
CommaTech core competitiveness: Algorithm-driven software and hardware integrated and innovative solution.

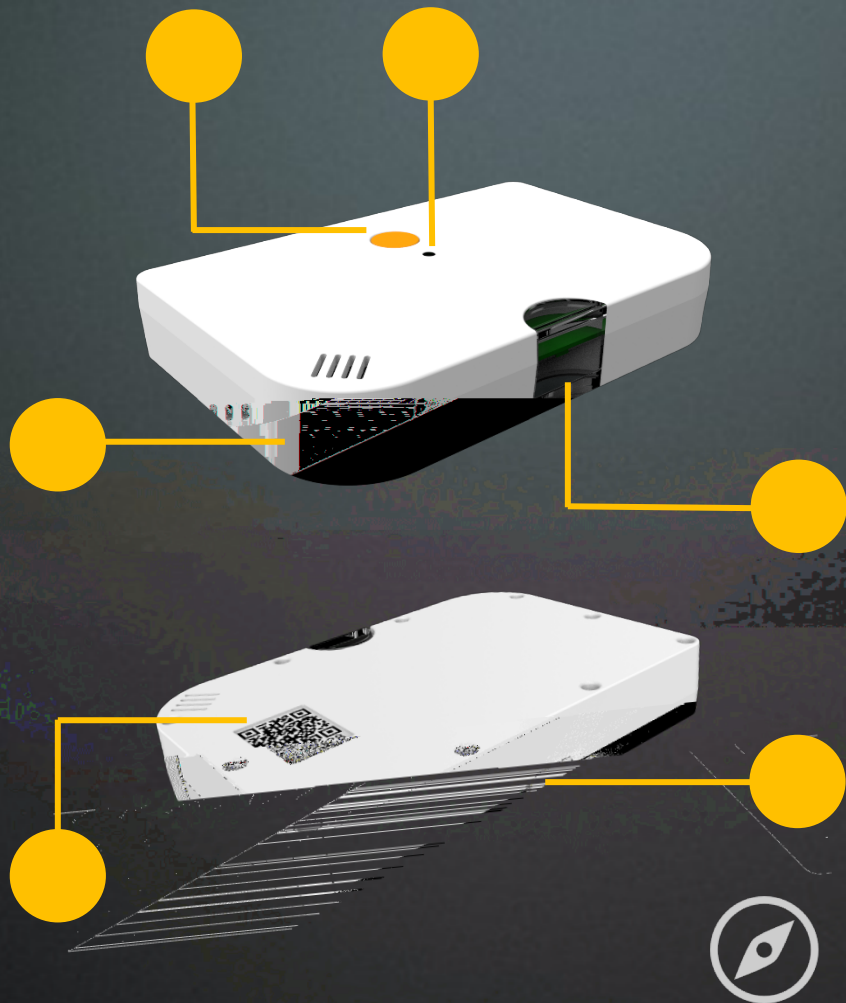
Part Two

02



*Challenges in China's
transportation logistics market:*

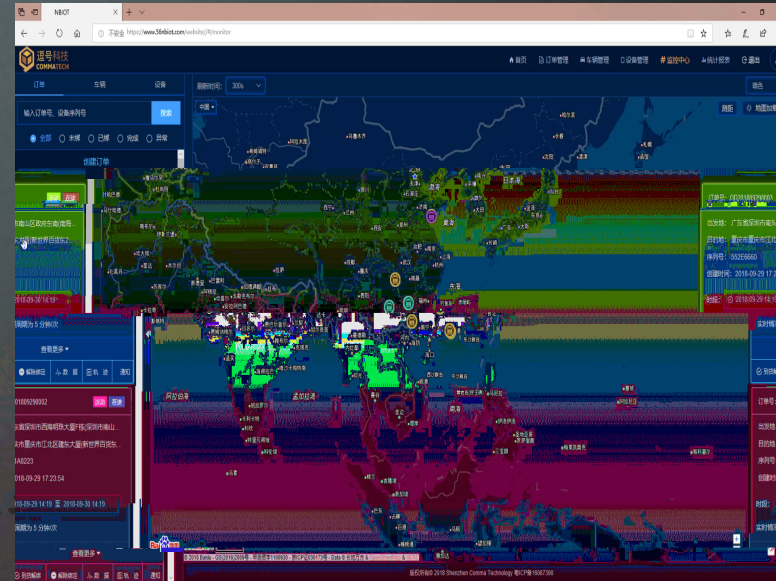




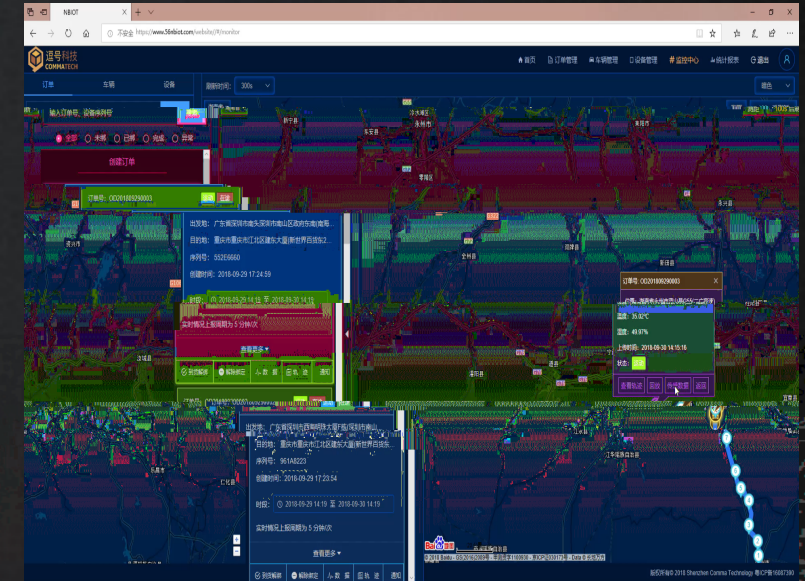
No.	Name	Description
	power button	view battery status
	LED flashing light	green, yellow, and red indicate that the device has sufficient, medium, and low battery levels.
	light sensor	collect light data
	temperature and humidity sensor	collect temperature and humidity data
	device serial number	device unique code
	USB interface	for device charging and upgrading



- big data visualization
- understand the location distribution and usage of all devices
- master different types of abnormal alarm conditions (e.g., temperature, humidity, light, position, etc.)
- get real-time KPI information



- create orders, customize data upload content (including latest arrival time, temperature and humidity range, etc.)
- define users who receive abnormal alerts for each order across logistics chain



- query on the real-time location of orders, vehicles and equipment, and support trajectory playback
- display multi-dimensional data (including temperature and humidity, light, etc.) of orders and vehicles in transit



can be used inside WeChat, go away when you run out



share the order data to others for a one-time view by sharing



real-time data update, abnormal warning information is known at the first time



3PL



driver



owner



receiver

Part three

03



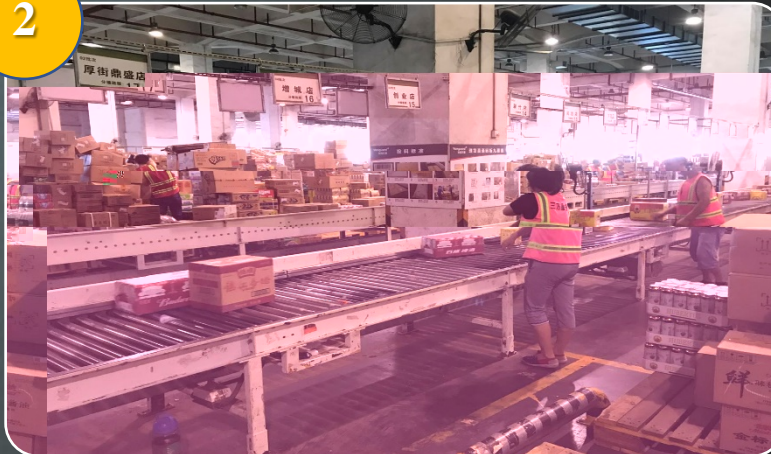
- More than 10 RDC, 3000+ stores nationwide, covering 29 provinces in China, 242 cities, 2000+ cars per day;
- Logistics costs account for a high proportion of total operating expenses, **with annual logistics costs of 1.5 billion**;
- The inventory of urban stores is small, the frequency of replenishment is high, the demand for single stores cannot fill the vehicles, and carpooling is required;
- Shops in urban areas are densely distributed and delivery routes need to be properly designed.

1

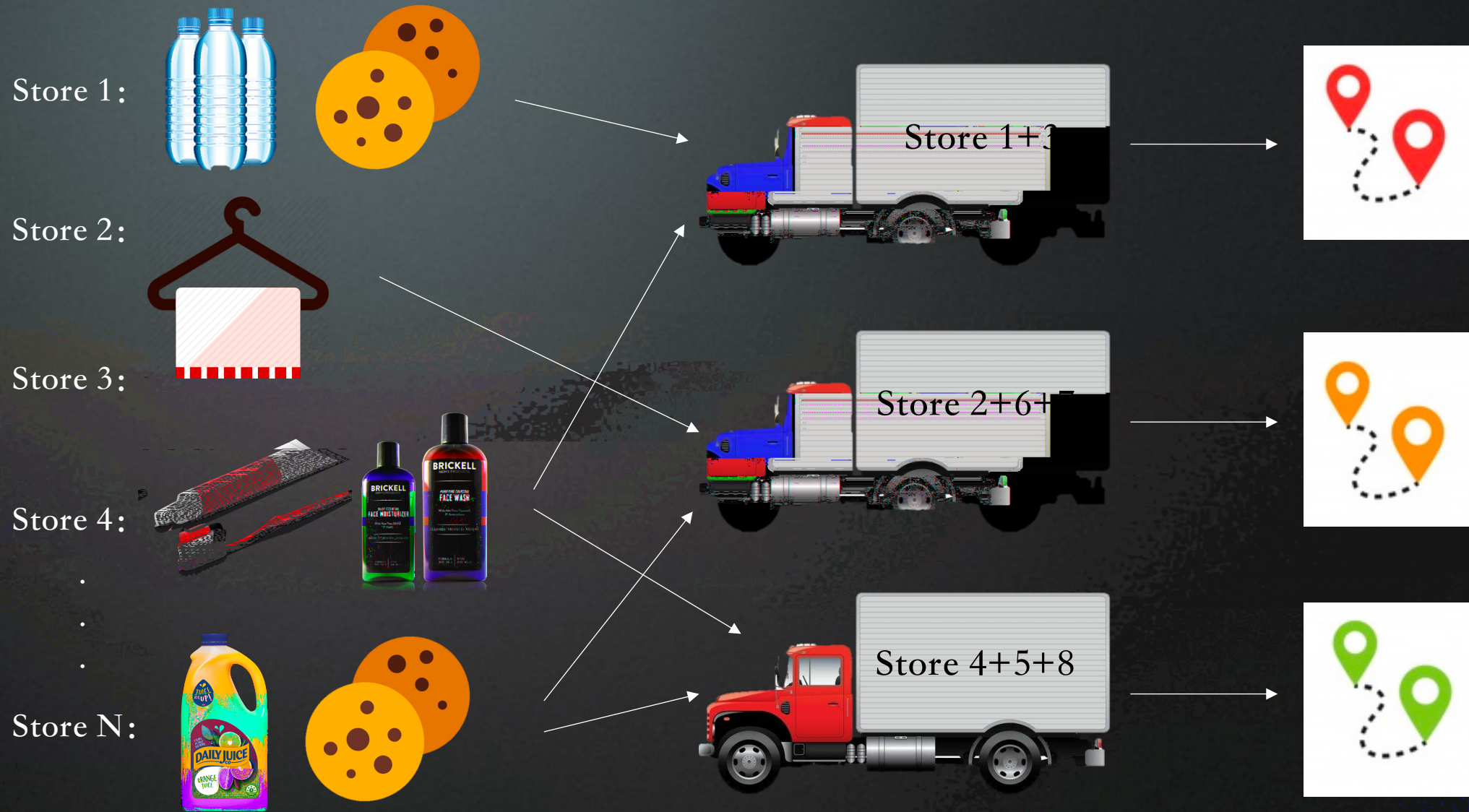


High-rise shelf

2



Sorting



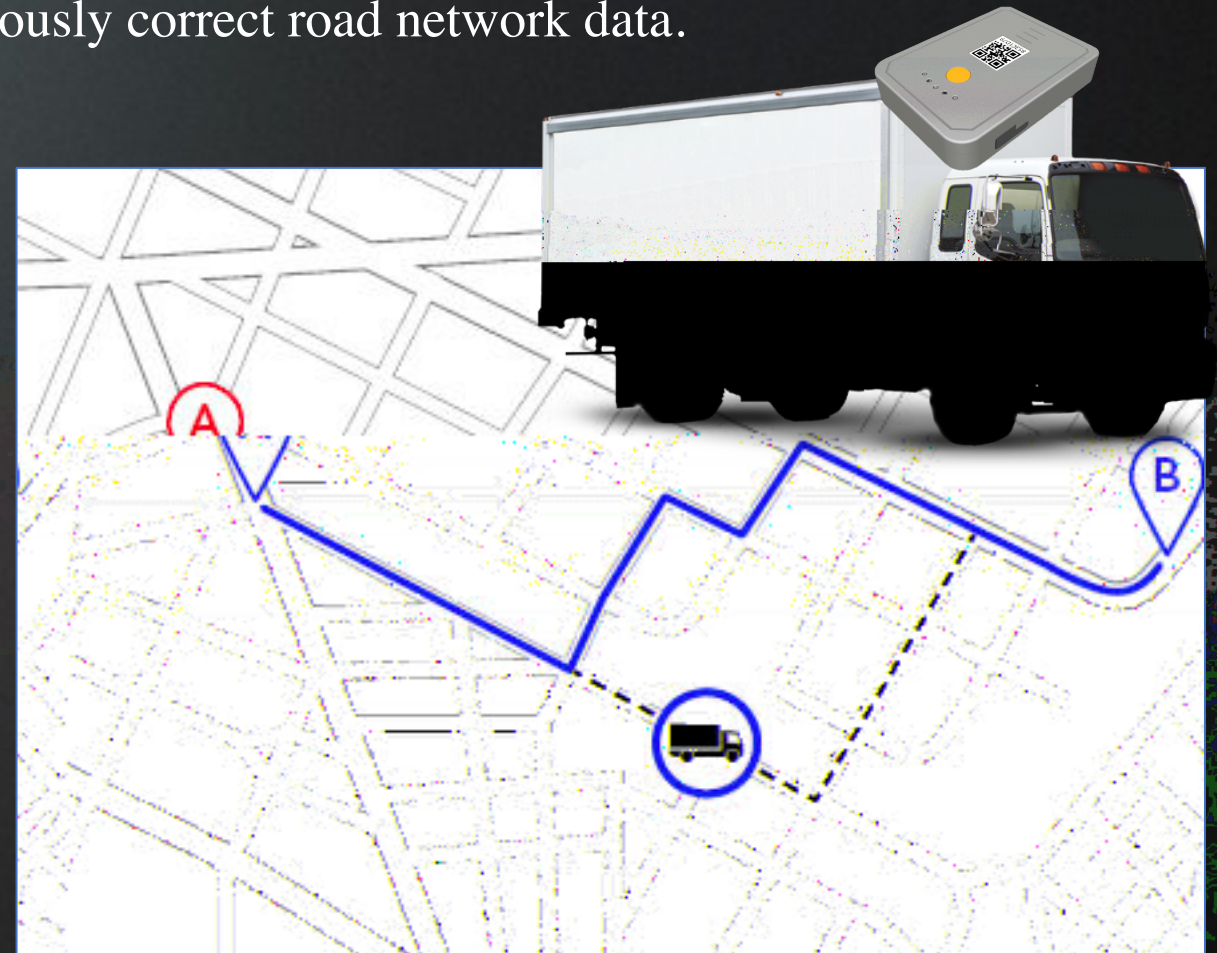
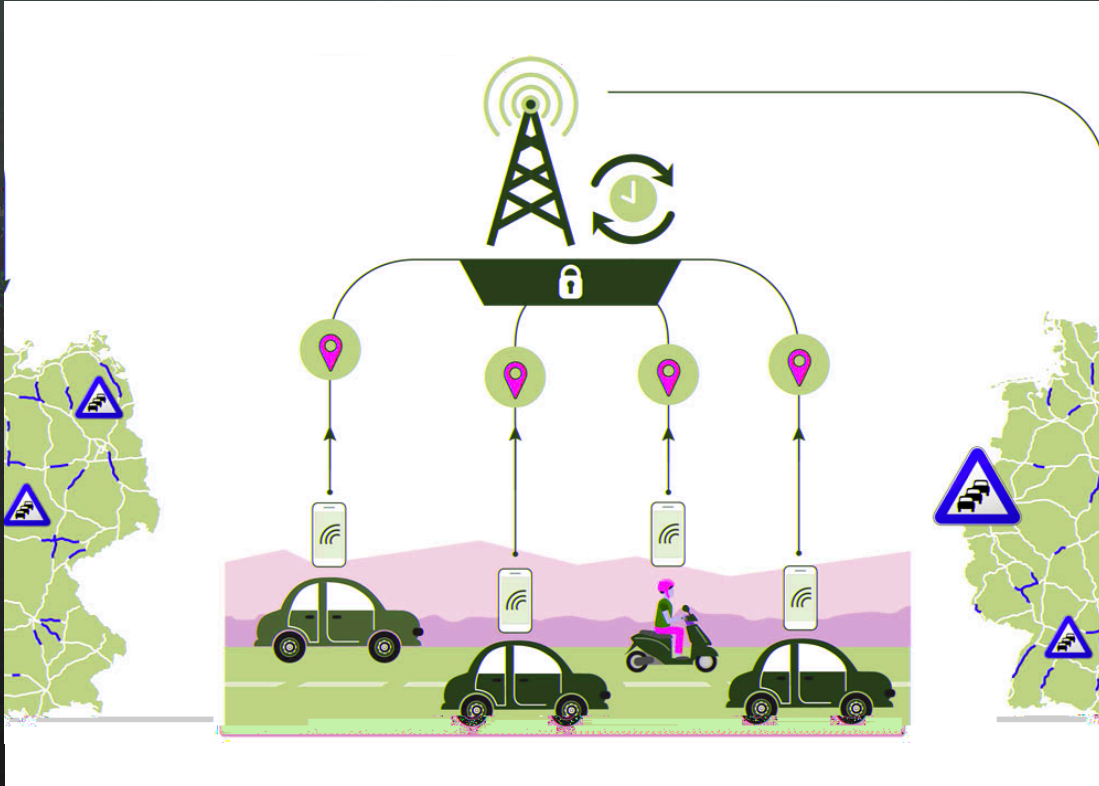
Y	明细数(个)	配送点
5	6	宝源路分店,文汇分店,天骄世家便利店,骏丰园分店,滨海大厦便利店
7	7	东海国际便利店,华强电子便利店,盛唐大厦店,侨香村便利店,皇城广场分店,卓越便利店,经贸中心分店
7	11	东海国际便利店,华强电子便利店,盛唐大厦店,侨香村便利店,卓越便利店,皇城广场分店,经贸中心分店
6	7	汉京大厦便利店,美年广场店,中心路便利店,数码大厦分店,招商广场分店,南海便利店
6	6	汉京大厦便利店,美年广场店,中心路便利店,数码大厦分店,招商广场分店,南海便利店
6	6	汉京大厦便利店,中心路便利店,美年广场店,数码大厦分店,招商广场分店,南海便利店
6	9	汉京大厦便利店,中心路便利店,美年广场店,数码大厦分店,招商广场分店,南海便利店
7	7	华强电子便利店,东海国际便利店,盛唐大厦店,侨香村便利店,皇城广场分店,卓越便利店,经贸中心分店
7	7	华强电子便利店,东海国际便利店,盛唐大厦店,侨香村便利店,卓越便利店,皇城广场分店,经贸中心分店
5	5	锦绣分店,Ole深圳海上世界店,山海逸居分店,Ole深圳壹方城店,蔚蓝海岸分店
5	6	莲塘聚宝便利店,海山分店,壹海城三分店,君逸华府便利店,海轩广场便利店
5	5	六约二分店,万象汇分店,六约三分店,六约一分店,万象分店
5	5	六约二分店,万象汇分店,六约三分店,六约一分店,万象分店
5	5	六约二分店,万象汇分店,六约三分店,六约一分店,万象分店
5	5	龙岗天安数码,嘉宏湾花园便利店,东方沁园店,摩尔城便利店,益田假日天地二分店
6	6	龙岗天安数码,嘉宏湾花园便利店,摩尔城便利店,东方沁园店,益田假日天地二分店,天健城分店
5	5	前海便利店,三诺大厦便利店,浪琴半岛便利店,前海湾物流园便利店,汇景豪苑便利店
5	5	前海便利店,三诺大厦便利店,浪琴半岛便利店,前海湾物流园便利店,汇景豪苑便利店
5	5	前海便利店,三诺大厦便利店,浪琴半岛便利店,前海湾物流园便利店,汇景豪苑便利店
5	5	前海公馆分店,海运分店,新时代二分店,兰溪谷分店,桃花源分店
5	5	万科麓城分店,南方科技大学分店,清湖地铁2便利店,水木丹华分店,深圳龙胜地铁二店
6	6	粤商中心一分店,赛龙豪轩分店,龙华九方分店,卓越城分店,莱蒙春天分店,南方明珠
6	8	粤商中心一分店,赛龙豪轩分店,龙华九方分店,卓越城分店,莱蒙春天分店,南方明珠
6	6	粤商中心一分店,赛龙豪轩分店,龙华九方分店,卓越城分店,莱蒙春天分店,南方明珠

门店名称	当前车型报价(按车计算)	货量(箱)	到达时间	最早收货时间	最迟收货时间
云里智能园分店	249.26	29.93	15:36	06:00	07:30
壹海城二分店		299.24	11.46	09:21	06:00 07:30
创建大厦店		294.06	27.47	09:19	06:00 07:30
南方科技大学分店		304.93	11.45	09:04	06:00 07:30
优越时代分店		273.05	58.68	08:46	06:00 07:30
万象分店		297.22	41.62	08:45	06:00 07:30
太阳花		276.9	21.49	08:44	06:00 07:30
深圳龙胜地铁二店		272.04	11.03	08:42	06:00 07:30
连城新天地便利店		287.47	49.51	08:40	06:00 07:30
财富广场便利店		308.33	11.67	08:33	06:00 07:30
科学园分店		315.9	73.6	15:54	08:00 15:00
摩尔城便利店		296.84	19.8	08:04	06:00 07:30
红树绿洲分店		297.86	204.95	15:33	08:00 15:00
新时代二分店		338.84	19.42	07:33	06:00 07:30

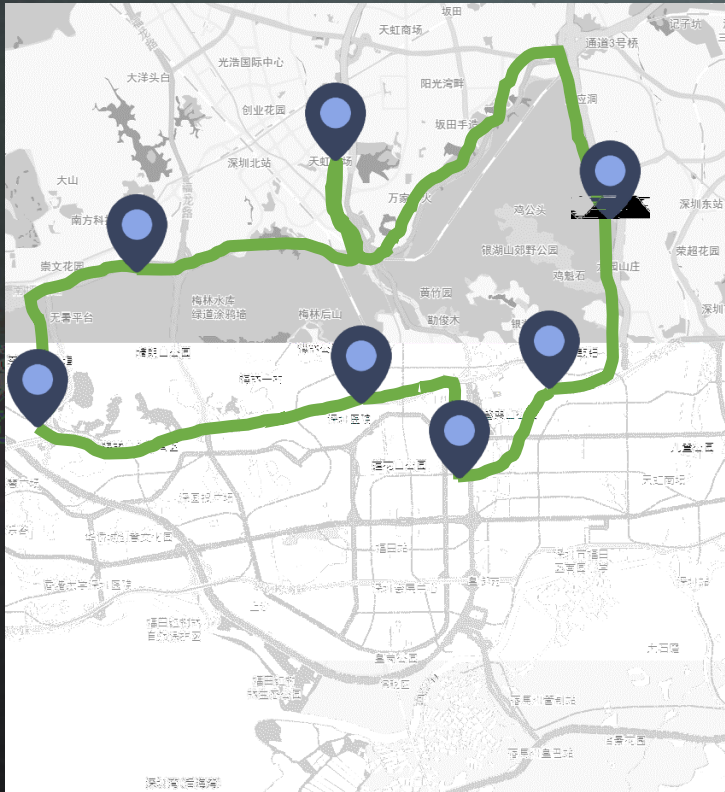
门店名称	当前车型报价(按车计算)	货量(箱)	到达时间	最早收货时间	最迟收货时间
万象汇分店	225.95	1.37	11:02	06:00	07:30
清湖地铁2便利店	246.67	12.32	11:00	06:00	07:30
深圳北地铁二店	315.36	21.56	10:22	06:00	07:30
滨海大厦便利店	335.46	13.62	10:20	06:00	07:30
万象分店	297.22	19	10:11	06:00	07:30
壹海城二分店	299.24	20.94	10:04	06:00	07:30
嘉宏湾花园便利店	320.42	29.39	10:01	06:00	07:30
深圳龙胜地铁二店	272.04	23.39	09:28	06:00	07:30



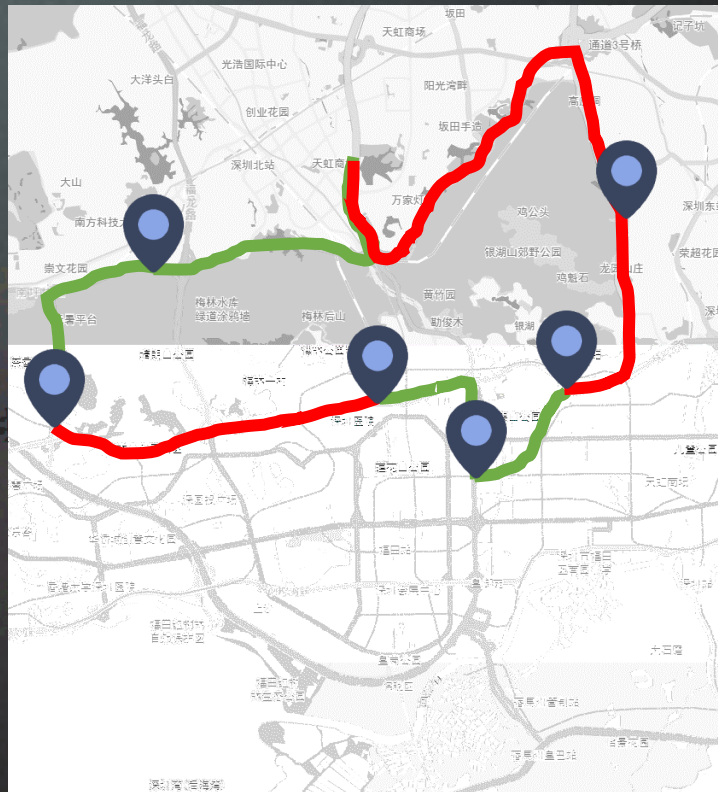
- The initial data comes from an open platform such as Baidu / Gao De (Chinese Google Map).
- Track vehicles by intelligent hardware and continuously correct road network data.



Leisure time road condition



Peak road condition



- Usually not blocked, blocked at peak
- The journey is not blocked, the return is blocked.
- Workday is not blocked, weekend blocking
- Dynamic road conditions have certain regularity
- Time series analysis based on historical data
- Predict future road conditions



Go through the congested roads during the non-congestion time period, arrange the trip reasonably

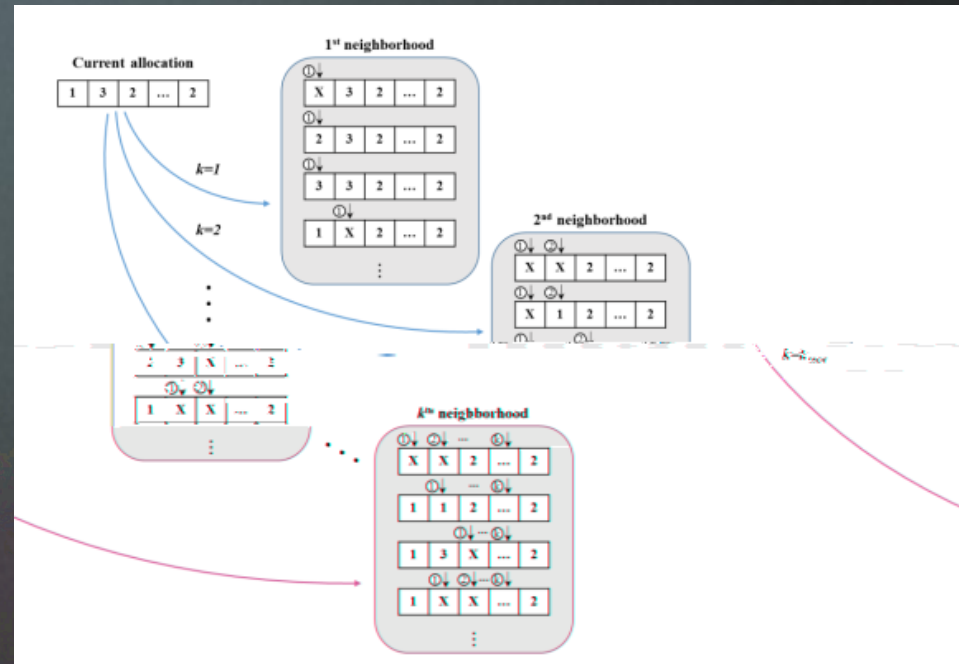
The screenshot displays a PyCharm IDE window titled "untitled [C:\Users\hku\PycharmProjects\untitled] - vanguard.public.nodes [vanguard@localhost] - PyCharm". The main editor shows a table with 32 rows of data. The table has columns: route_id, result_id, paired_id, origin, destination, tag, distance, duration, toll, toll_distance, and ctin. The data represents various routes between different locations, with coordinates and associated costs.

route_id	result_id	paired_id	origin	destination	tag	distance	duration	toll	toll_distance	ctin
1	1534415674172293120	1534415674151	1-2	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.72299, \"lng\": 114.545926}	常规路线	59885	3894	¥25.00	40066 2018-
2	1534415674347037696	1534415674333	1-3	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 23.093939, \"lng\": 114.421979}	常规路线	35919	3654	¥0.00	0 2018-
3	1534415674472877312	1534415674458	1-6	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.603421, \"lng\": 114.480584}	常规路线	81880	4750	¥40.00	64613 2018-
4	1534415674688593920	1534415674672	1-4	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.618875, \"lng\": 114.076526}	常规路线	92751	5592	¥45.00	78333 2018-
5	1534415675632108544	1534415675611	1-5	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.548791, \"lng\": 114.10065}	常规路线	100417	6393	¥50.00	88889 2018-
6	1534415680573399296	1534415680560	1-7	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.6443, \"lng\": 114.02287}	常规路线	97754	6391	¥45.00	78333 2018-
7	1534415680798617344	1534415680783	1-10	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.565853, \"lng\": 114.149465}	常规路线	92538	6146	¥40.00	72994 2018-
8	1534415681096580480	1534415680991	1-9	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.552337, \"lng\": 114.237986}	常规路线	98259	6409	¥45.00	79189 2018-
9	1534415681190582528	1534415681175	1-8	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.565412, \"lng\": 113.987163}	常规路线	106217	6474	¥45.00	78333 2018-
10	1534415681365548544	1534415681350	1-11	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.563542, \"lng\": 114.055615}	常规路线	101763	6315	¥45.00	78333 2018-
11	1534415681581710848	1534415681567	1-12	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.553893, \"lng\": 114.155655}	常规路线	94975	6549	¥40.00	72994 2018-
12	1534415681848948992	1534415681833	1-17	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 23.089945, \"lng\": 114.452728}	常规路线	34007	3153	¥0.00	0 2018-
13	1534415682066334208	1534415682001	1-14	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.546095, \"lng\": 113.951229}	常规路线	111336	6871	¥45.00	78333 2018-
14	15344156822524719616	1534415682509	1-13	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.548583, \"lng\": 113.940319}	常规路线	112164	6939	¥45.00	78333 2018-
15	1534415682758091808	1534415682742	1-18	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.608143, \"lng\": 114.380863}	常规路线	88665	4888	¥50.00	79014 2018-
16	1534415682983354368	1534415682968	1-19	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.52908, \"lng\": 114.031765}	常规路线	109428	6801	¥45.00	78333 2018-
17	1534415683283675648	1534415683225	1-22	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 23.061994, \"lng\": 114.395882}	常规路线	40721	3929	¥0.00	0 2018-
18	1534415683491910656	1534415683476	1-20	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.554526, \"lng\": 114.021742}	常规路线	104919	6397	¥45.00	78333 2018-
19	1534415683858938112	1534415683843	1-24	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.623078, \"lng\": 114.14335}	常规路线	87022	5644	¥45.00	73118 2018-
20	1534415684058597632	1534415684035	1-21	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.62444, \"lng\": 114.064759}	常规路线	94898	6047	¥45.00	78333 2018-
21	1534415684375655168	1534415684361	1-23	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.552056, \"lng\": 114.01729}	常规路线	105207	6423	¥45.00	78333 2018-
22	1534415684717738496	1534415684652	1-25	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.609949, \"lng\": 114.060463}	常规路线	96609	5961	¥45.00	78333 2018-
23	1534415684992891904	1534415684935	1-26	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.59152, \"lng\": 114.151632}	常规路线	90925	6140	¥40.00	72994 2018-
24	1534415685310088960	1534415685295	1-28	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.520689, \"lng\": 114.069463}	常规路线	104998	6676	¥45.00	78333 2018-
25	1534415685642936064	1534415685627	1-29	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.592859, \"lng\": 113.972314}	常规路线	105204	6425	¥45.00	78333 2018-
26	1534415686009811712	1534415685943	1-27	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.507211, \"lng\": 113.887252}	常规路线	121314	7839	¥45.00	78333 2018-
27	1534415686335290368	1534415686320	1-30	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.549985, \"lng\": 114.051523}	常规路线	103417	6421	¥45.00	78333 2018-
28	153441568651987456	1534415686636	1-32	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.690231, \"lng\": 114.345124}	常规路线	64441	4197	¥25.00	47782 2018-
29	1534415686897009408	1534415686881	1-33	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.727719, \"lng\": 114.273937}	常规路线	68111	4504	¥25.00	54160 2018-
30	1534415687179896064	1534415687165	1-31	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.558885, \"lng\": 113.950809}	常规路线	110419	6700	¥45.00	78333 2018-
31	1534415687513800960	1534415687498	1-34	{\"lat\": 22.989761, \"lng\": 114.728518}	{\"lat\": 22.73726, \"lng\": 114.261761}	常规路线	69253	4843	¥25.00	78333 2018-
32										

- Building an electronic road network: **taking a certain city as an example, the data volume is about 25GB**, and the working mode of “online update, offline operation” is realized.
- Based on the characteristics of the algorithm, the database is consolidated and optimized to speed up the database query.

Using a mathematical language,
describe:

- Various optimization goals
- "around the road"
- "corner"
- "Generally not splitting the order"
- "Not worthwhile"



One of the most advanced algorithmic architectures in the world of VRP : VNS + TS

- VNS (Variable Neighborhood Search) : Responsible for controlling search depth
- TS (Tabu Search) : Control search accuracy
- Introduce "matching set", "elite solution strategy", "perturbation strategy", etc. to improve search quality
- Self-learning adjustments to algorithms and operators based on actual customer data

Algorithm 1: Overall Framework

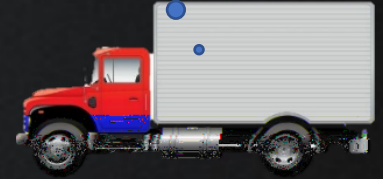
```

1   $A \leftarrow$  Choose a random allocation
2   $S' \leftarrow \text{Construct}(A)$ 
3  IF  $S'$  is feasible
4       $S^* \leftarrow S'$ 
5  END IF
6   $k \leftarrow 1$ 
7  REPEAT
8       $A' \leftarrow \text{Shake}(A, k)$ 
9       $S' \leftarrow \text{Construct}(A')$ 
10     IF  $\text{obj}(S') > \lambda * \text{obj}(S^*)$ 
11          $S' \leftarrow \text{TabuSearch}(S')$ 
12         IF  $\text{obj}(S') > \text{obj}(S^*)$ 
13              $S^* \leftarrow S'$ 
14              $A \leftarrow A'$ 
15              $k \leftarrow 1$ 
16              $\text{count} \leftarrow 1$ 
17         ELSE
18              $\text{count} \leftarrow \text{count} + 1$ 
19         END IF
20     ELSE
21          $\text{count} \leftarrow \text{count} + 1$ 
22         IF  $\text{count} = \text{StepSize}(k)$ 
23              $k \leftarrow k + 1$ 
24              $\text{count} \leftarrow 0$ 
25         END IF
26     END IF
27 UNTIL  $k > k_{\max}$ 

```


driver has
opinions

store have
opinions

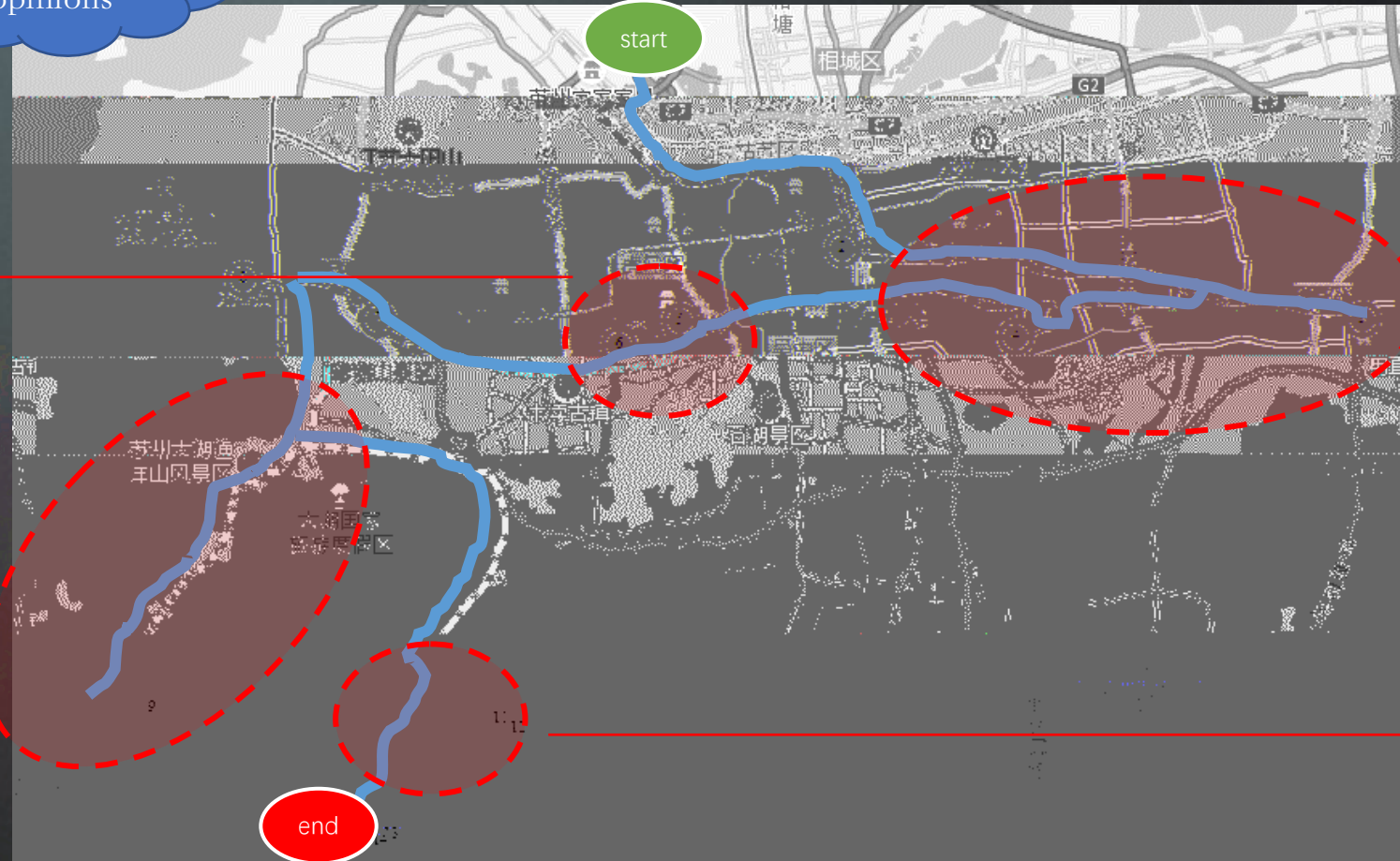


"It is best not to split the order"

"Route has a return"

"Round the road"

"Not worthwhile"



The algorithm needs to consider the complex game between the owner and the driver, the driver and the driver, and take care of the interests of all parties.

- 1. Multiple types of vehicles, as well as limited travel policies (electric vehicles)



- 2. Multiple quotation methods :
 - Parcel-share valuation (by volume, by weight, number of boards)
 - Vehicle pricing
 - Loading/Unloading fee
 - Minimum cost...

- 3. driver :
 - Balance of income between drivers
 - Work intensity balance, fatigue assessment

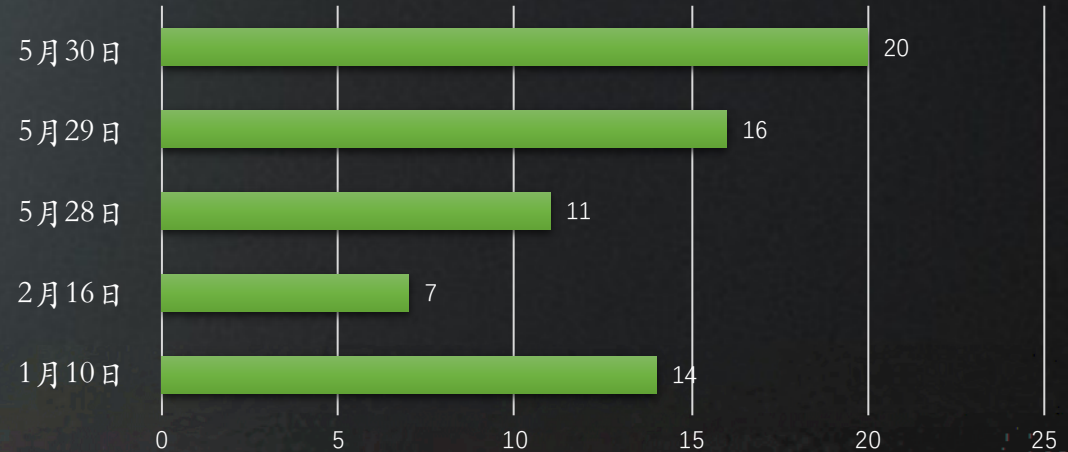
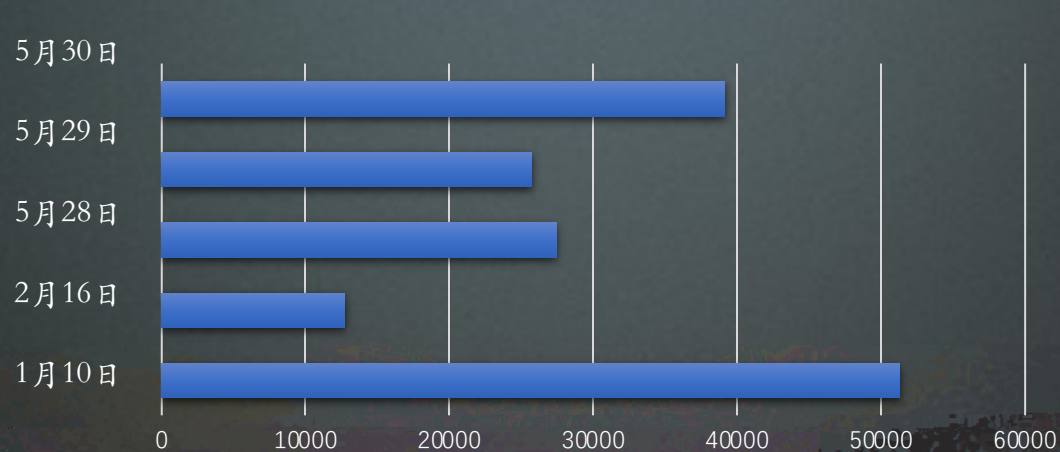
- 4. Multiple central warehouses
 - Dry goods
 - Fresh, vegetable and fruit warehouse
 - Frozen warehouse
 - Partial sharing between vehicles





For the "with comments" route, you can click X, after a round of evaluation, real-time recalculation, iterative improvement





- The total cost is reduced by 25-30%, the driver's total driving mileage is reduced by about 30%, and the average driver's revenue per kilometer is increased by about 5%.

日期	人工			算法			对比		
	总费用 (元)	总里程 (KM)	费用/公里	总费用 (元)	总里程 (KM)	费用/公里	总费用 (元)	总里程 (KM)	费用/公里
1月10日	51283	4984	10. 29	42139	3853	10. 94	-18%	-23%	6. 3%
2月16日	12726	1585	8. 03	9729	1147	8. 48	-24%	-28%	5. 6%
5月28日	27438	3079	8. 91	17828	1878	9. 49	-35%	-39%	6. 5%
5月29日	25704	2605	9. 87	18859	1877	10. 05	-27%	-28%	1. 8%
5月30日	39132	3930	9. 96	28785	2784	10. 34	-26%	-29%	3. 8%
均值	31256. 6	3236. 6	9. 41	23468	2307. 8	9. 86	-25%	-29%	4. 8%



THANKS

THANKS FOR YOUR ATTENTION



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