

Research on Beijing's Public Transportation Commuting Transit Network

**Beijing Municipal Committee of
Communications**

**Beijing Transportation Research
Center**

World Bank



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Outline

I. Background of Beijing PT Development

II. Problems & Challenges in PT Development

III. Proposals & Goals

IV. A Tentative Plan for BCTN

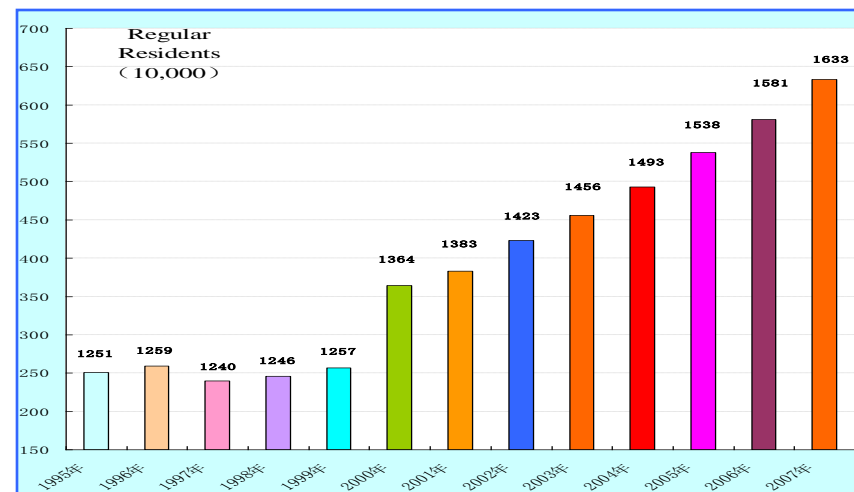
V. A Tentative Plan for BCTN Model Corridor

VI. Working Review and Plan for Next Stage

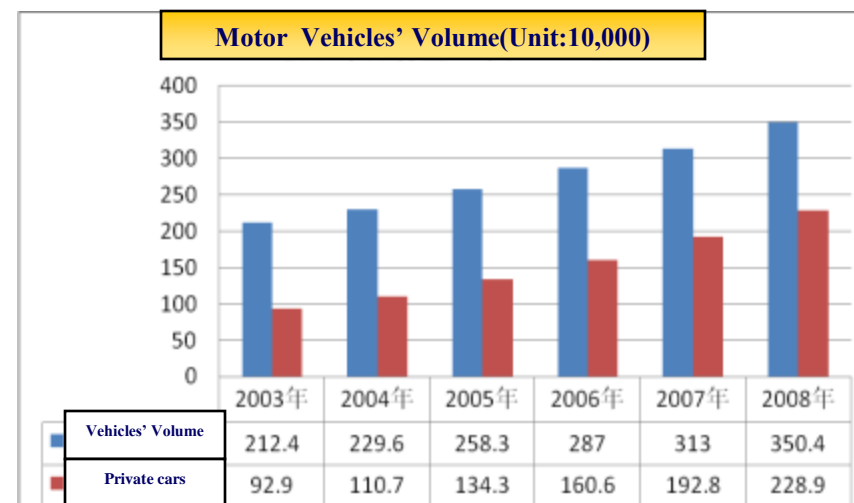
I. Background on Beijing PT Development

Facts & Figures

- **Population:** In recent 5 years, the population has grown by half a million every year, and till 2007, the total population stood at 16.33 million;
- **Economy:** GDP per capita has reached 58,204 yuan, 10% higher than that of 2006.
- **Motor vehicles:** 1,000 new motor vehicles are being purchased every day, and the total number of motor vehicles is 3.5 million.



Beijing's population



The Increase of Beijing's Motor Vehicles

I. Background on Beijing PT Development

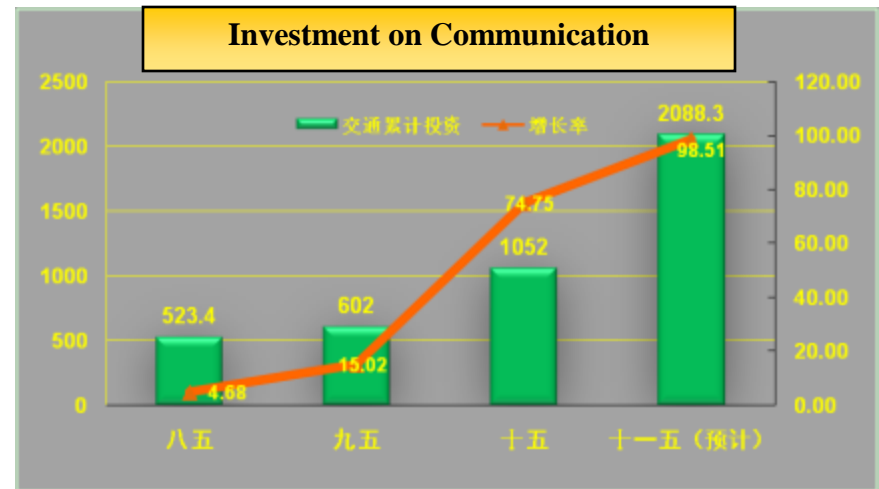
Current situation of Public Transportation (PT) development

Investment on PT development kept rising

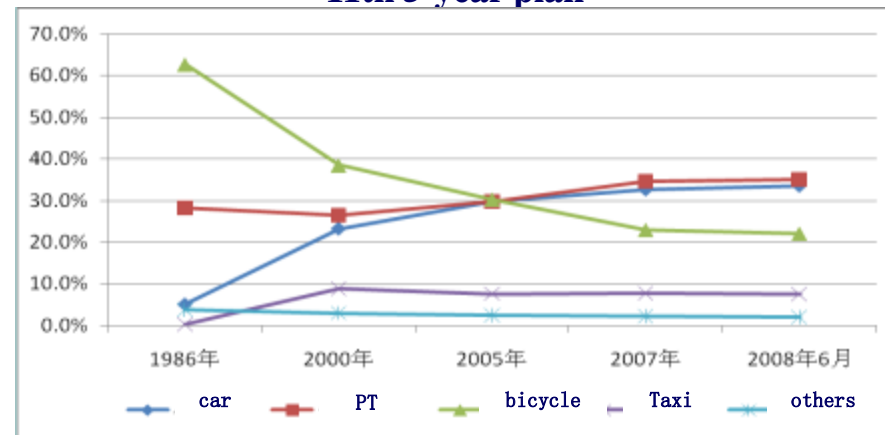
Beijing's investment on traffic infrastructure during the past ten years had kept rising, and PT investment has seen a rapid development. In 2007, municipal investment on track communication reach 13.2 billion yuan, 56% higher than the same period last year. The portion of investment on PT infrastructure accounted for 43.6% of the total investment on communication construction.

Public Transportation is the major means for commuters

In 2007, 34.5% of residents chose PT when going out, almost the same as those who chose cars.



Investment on infrastructure from the 8th to the 11th 5-year plan



How did passengers travel

I. Background on Beijing PT Development

□ Notable achievements were made on priority of PT development

➤ By the end of 2008, there are 8 track communication lines, and the total length is 200 km, in which 86 km is newly built;

➤ Ground PT was optimized. By the end of 2008, there were 644 bus lines, 19,395 vehicles, 4 PT junctions, 24 center stations, and 377 origin stations and terminals.

➤ 3 BRT lines with great capacity, and the total length is 50 km.

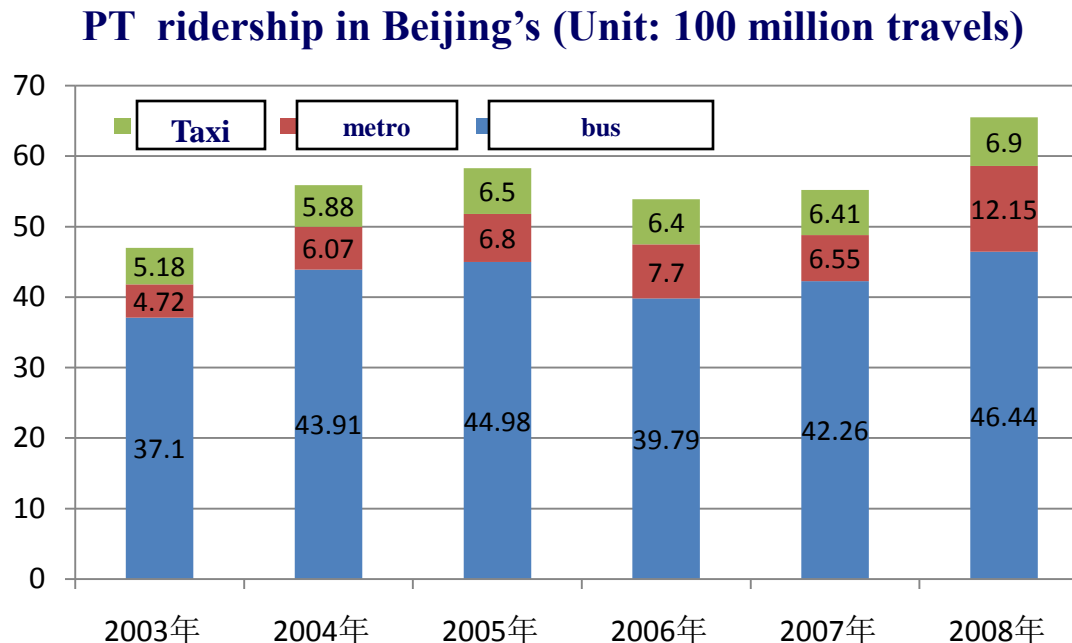
➤ From 2003 to 2008, 14,891 new environmentally-friendly vehicles were purchased and 430 PT lines were adjusted.



I. Background on Beijing PT Development

□ PT ridership increases

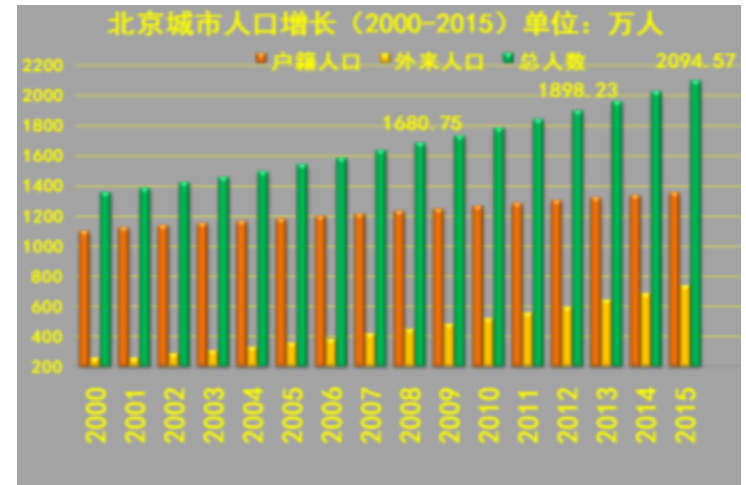
In 2008, the total ridership was 6.549 billion travels, in which 4.644 billion travels were carried by bus, 9.9% up compared to the same period of last year; 1.215 billion travels were by metro, 85.5% up compared to the same period of last year; and 0.69 billion by taxis, 7.6% up compared to the same period of last year.



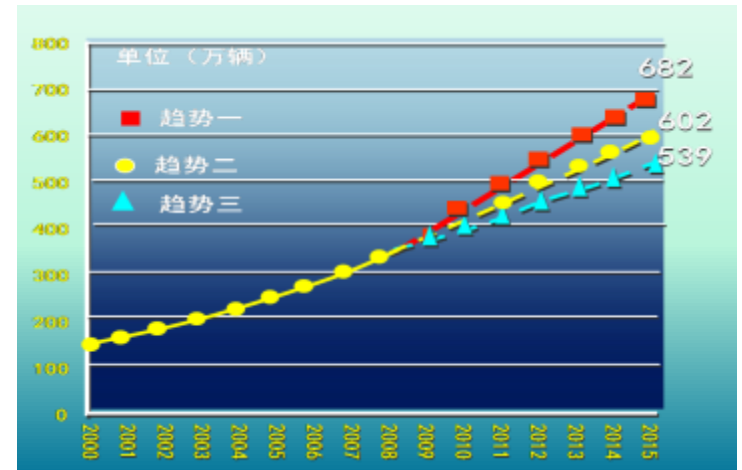
I. Background on Beijing PT Development

Development Trend

1. As the urbanization develops so fast, the population and traffic demand surged
2. Cars increase rapidly, which is beyond the capacity of the limited urban resources and communication infrastructure;



Beijing's population situation and Prediction

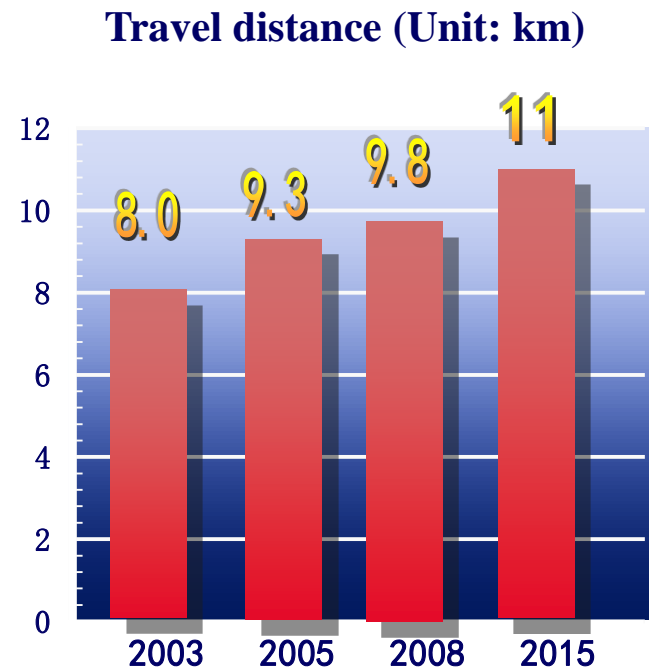
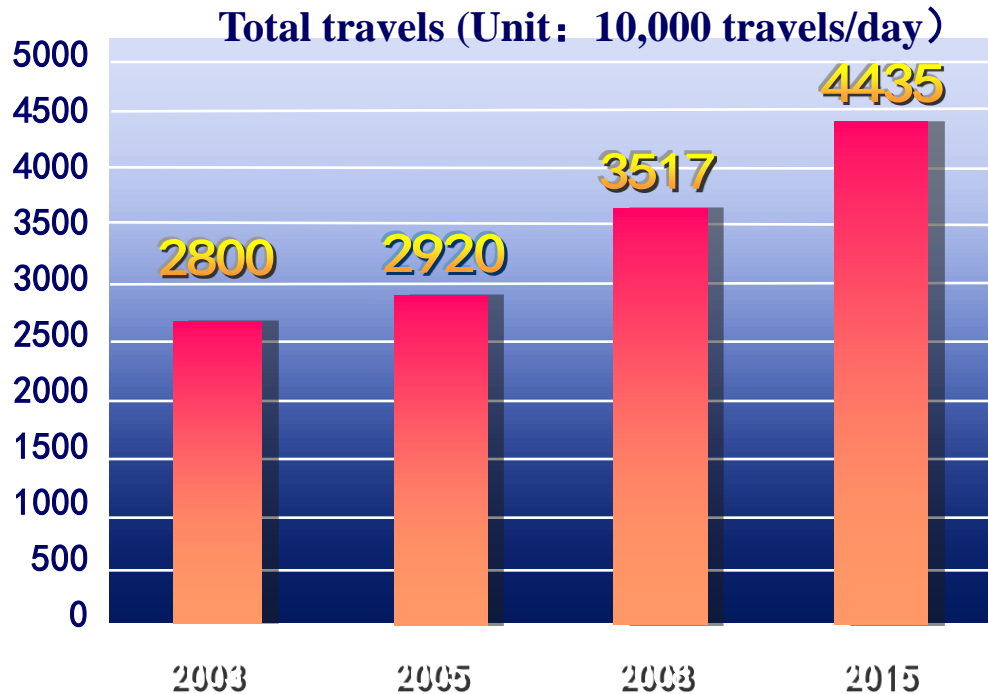


Prediction on motor vehicles development

I. Background on Beijing PT Development

3. The variety of citizens' travel demand requires fast development of Public Transportation (PT);

A lot of changes occurred in residents' travel volume, travel distance and space & time. Citizens' various travel demand requires the establishment of a multi-layer service system.



II. Problems & Challenges in PT Development

Beijing's priority of PT development policy is obviously effective, but the gap between the policy and urban development and social expectation is still huge:

- **Slow and time-consuming:** currently, the average distance of PT travel is 9.5 kilometers at an average speed of 14 kilometers per hour, which takes 66 minutes to travel at the rush hours; while the average distance of car travel is 14 kilometers at an average speed of 22 kilometers per hour, which takes 39 minutes at the peak hours.
- **Inconvenient to transfer:** now the average distance between two PT transfer stops is 355 meters, taking commuters 6 minutes on foot, which is farther than original design (*Code on Urban road traffic planning and designing* sets the maximum transfer distance at 200 meters)
- **Unpunctual and unreliable:** the punctual rate of PT is only 50%

II. Problems & Challenges in PT Development

A survey shows that 80% of the passengers' complaint is related to the problems mentioned above. These problems have greatly affected the running efficiency of the public transport, and reduced the attraction of the PT. The major causes of the problems are:

- **Networks' optimization and adjustment are not completed:** the three-level PT networks system is not perfect, especially for the express lines; there are many overlapped PT lines in the central areas, while PT networks haven't reached some areas in the outskirts of Beijing.
- **PT transfer system is not perfect:** there are inadequate transfer stops.
- **PT road priority is not enough in busy areas:** there's no breakthrough in the heavy-traffic areas, and the overall PT running speed has not been elevated.

III. Proposals & goals

Outlines:

- ✓ **Targetting on the peak-hour commuting & traveling**
- ✓ **Aiming at increasing the ratio of PT for commuting & traveling**
- ✓ **Focusing on increasing bus speed and improving transfer conditions**
- ✓ **Also paying attention to the city's development in a long run, and emphasizing solving the problems in a short run**
- ✓ **Building the public transportation commuting transit network on the base of metro and BRT system.**
- ✓ **Building an express Public Transportation Network (known as BCTN), which integrates bus, subway, and BRT that covers both the urban and the rural areas.**
- ✓ **Attracting commuters who drive cars to take public transportation, in order to increase the traffic efficiency.**

III. Proposals & goals

Working objectives:

■ Improving travel conditions of BCTN

- **Networks:** covering key travel directions for commuters, and setting up Bus Commuting Transit Lines along major busy corridors.
- **Speed:** 40 % up compared to conventional bus, reaching above 20 km/hr
- **Conjunction and transfer:** cut distance & reduce time for transfer; efforts will be made to limit the transfer time within 10 min.
- **Punctuality:** goes up to 90 % from 50 – 60 % for conventional bus

Generally, form a 1-hr commuting circle in the urban areas

III. Proposals & goals

Basic orientation:

- **Service target:** passengers commuting and traveling for work and school
- **Areas to be covered:** central areas of the city and expressways that links the urban and rural areas.
- **Component:** rail, BRT and ground express lines
- **Commuting period:** 6:00 - 9:30am & 4:30 – 7:00pm

III. Proposals & goals

The design for the BCTN

- **Vehicles:** 18 meters articulated buses in urban areas, and single buses in the suburbs.
- **Logo system:** well-marked logo should be seen on the platform and the buses, and the buses should be painted with bright colors that can be distinguished from conventional buses.
- **Departure interval:** 1-3 minutes
- **Speed:** 20 km/hr
- **Road conditions:** set continuous physically or traffic-marking separated special lanes for the Public Transportation only; buses to the suburbs will run on the express ways.
- **Daily transportation capacity:** 50-80 thousand travels.

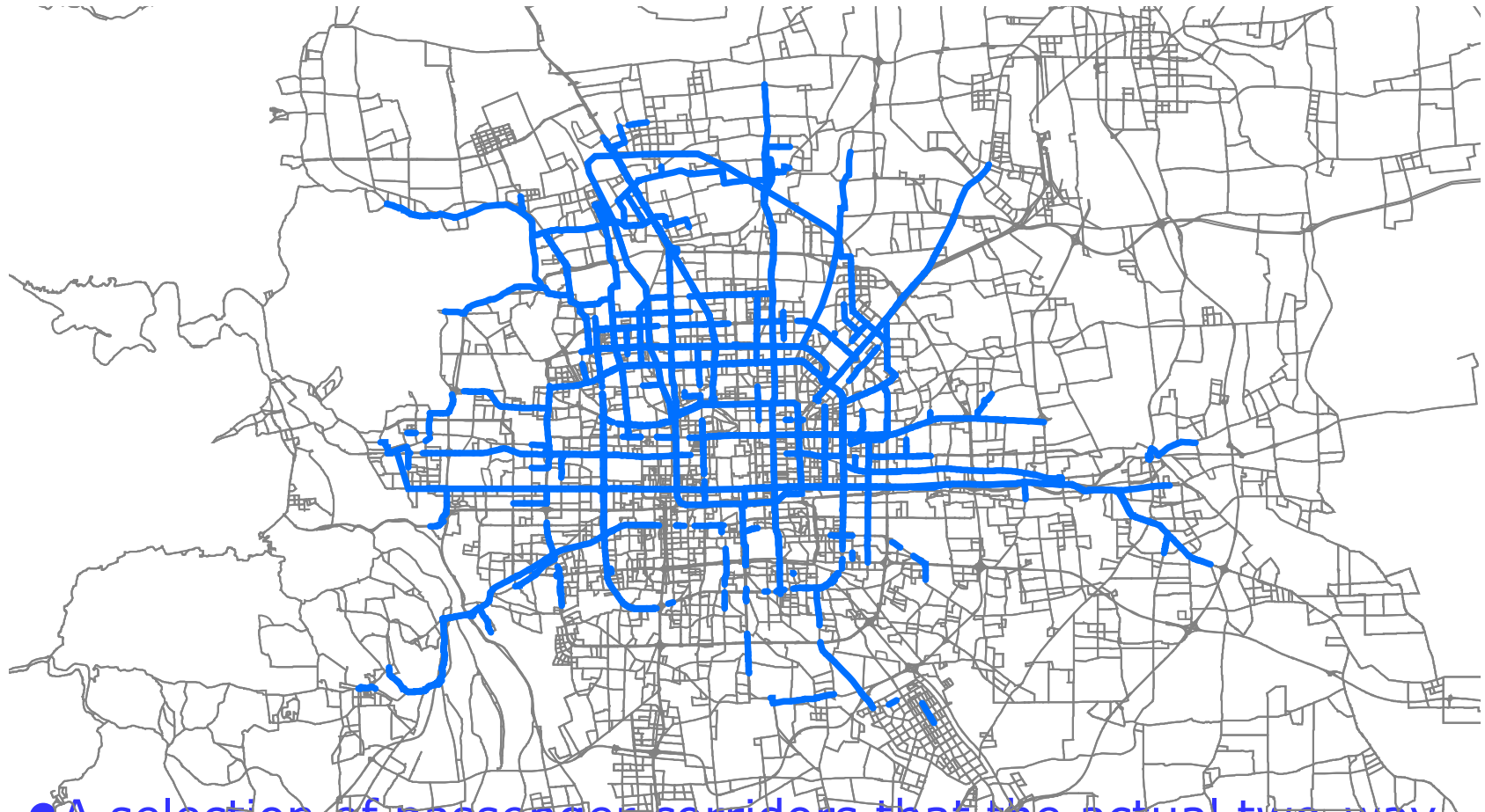
IV. A Tentative Plan for BCTN

An analysis on the BCTN plan based on the following four aspects:

- 1. The PT passengers actual routes and the ideal routes demand**
- 2. PT travel OD distribution**
- 3. Major places of PT passenger flow**
- 4. Roads and bus lane network**

IV. A Tentative Plan for BCTN

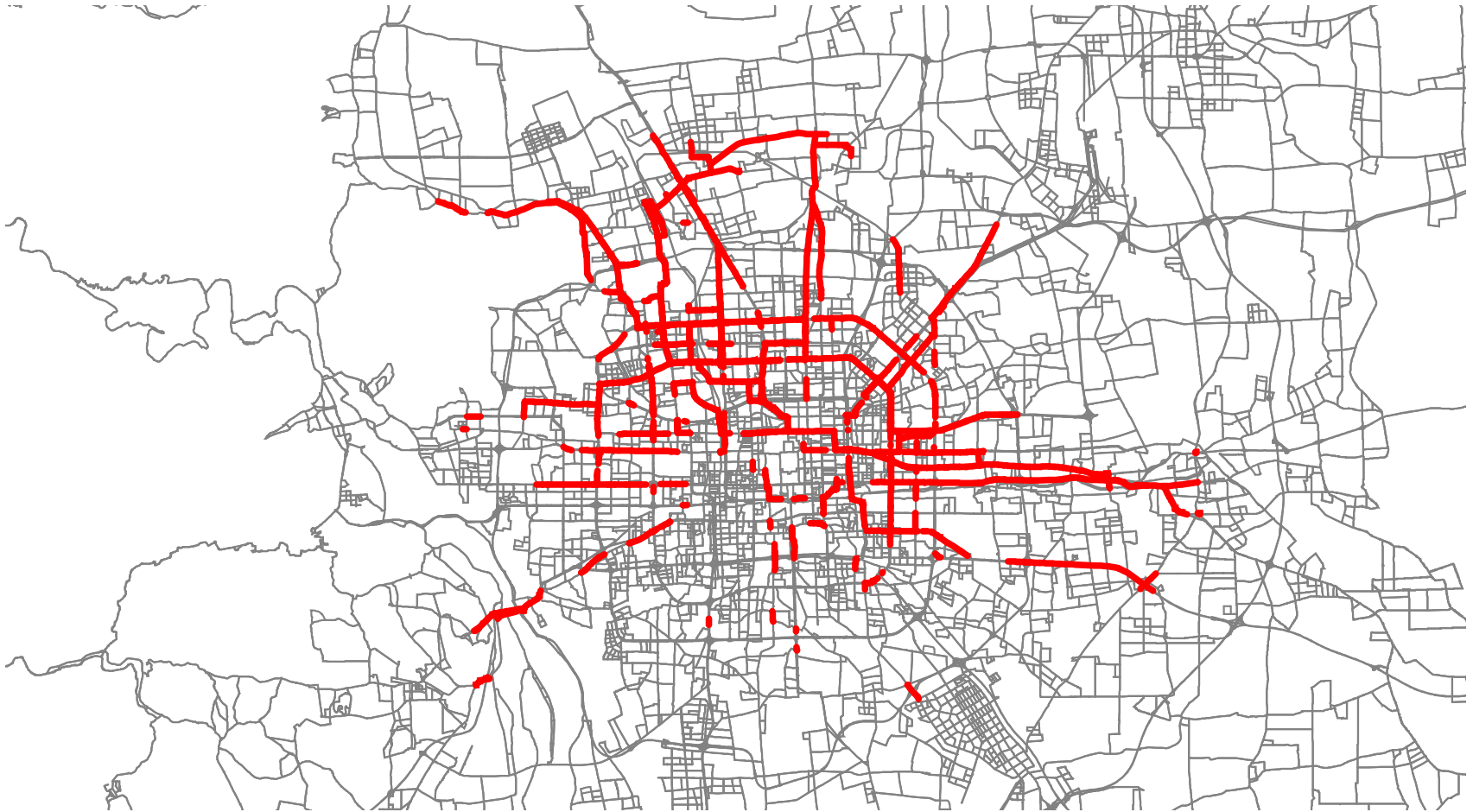
1. Analysis on PT passengers flow



- A selection of passenger corridors that the actual two-way PT passenger flow surpasses 10,000 travels/hr at the peak hours.

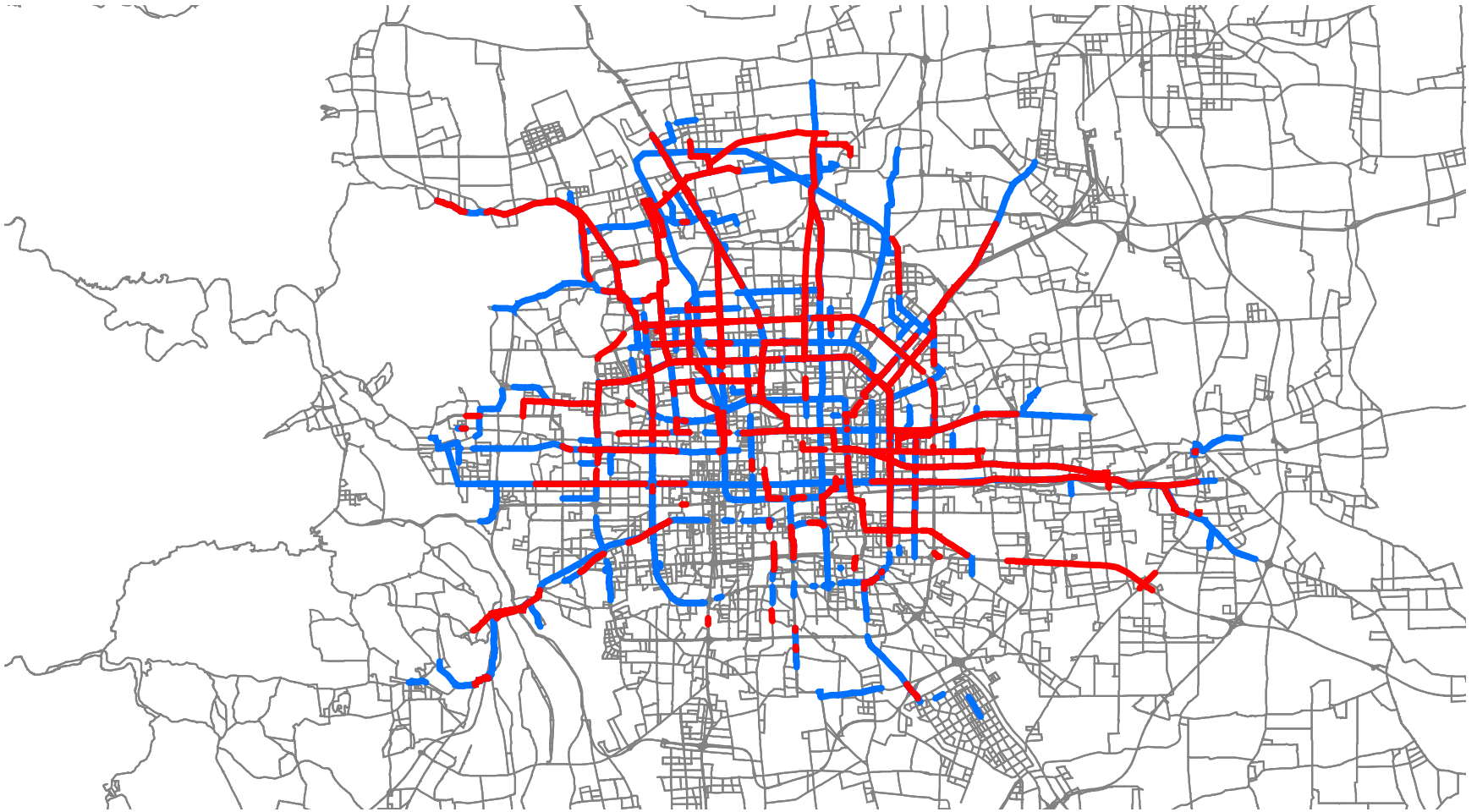
IV. A Tentative Plan for BCTN

1. Analysis on PT passengers flow



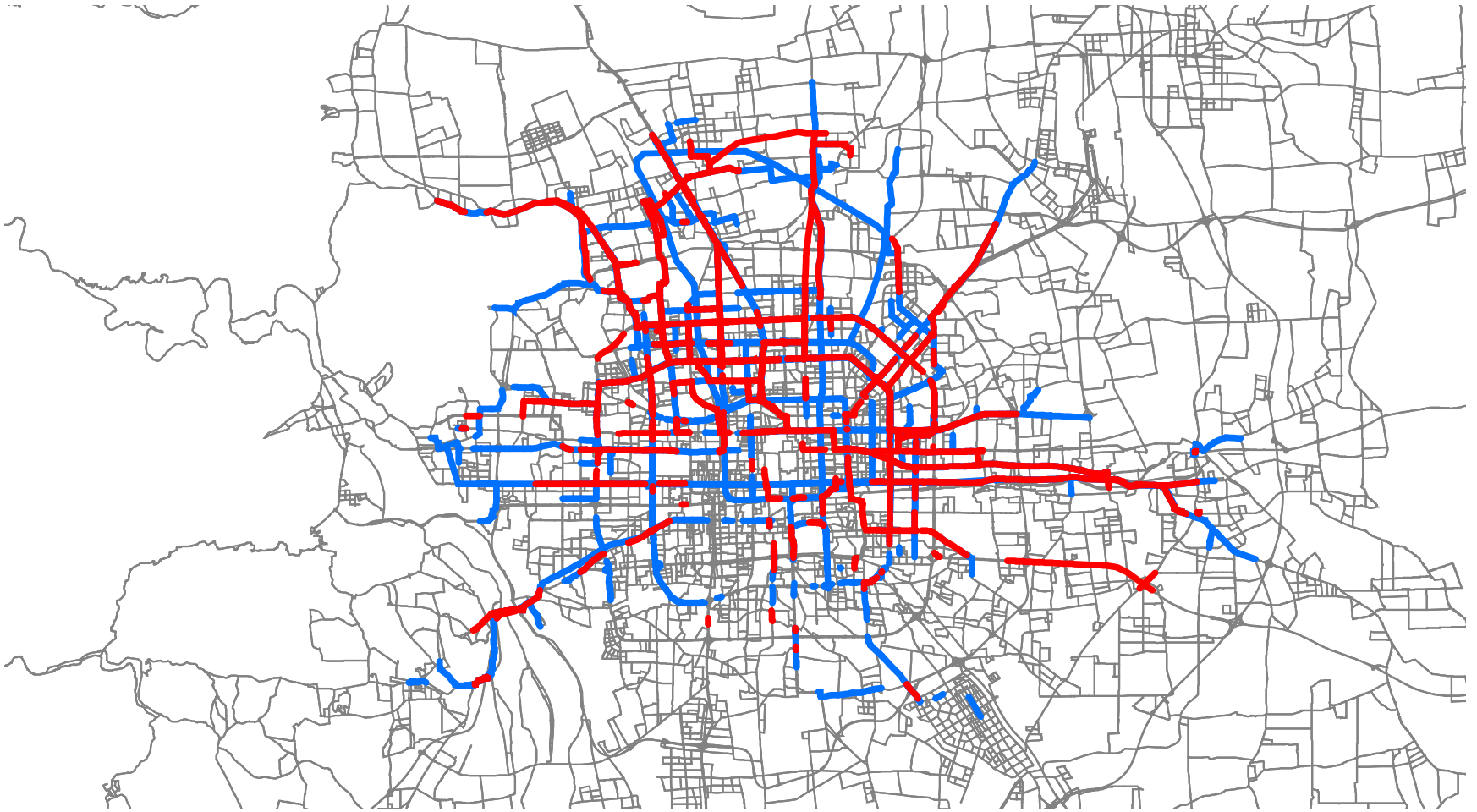
- A selection of passenger corridors that two-way PT passenger flow surpasses 10,000 travels/hr at the peak hours under the ideal passenger flow distribution.

IV. A Tentative Plan for BCTN



Layout of current PT corridors with huge passenger flow

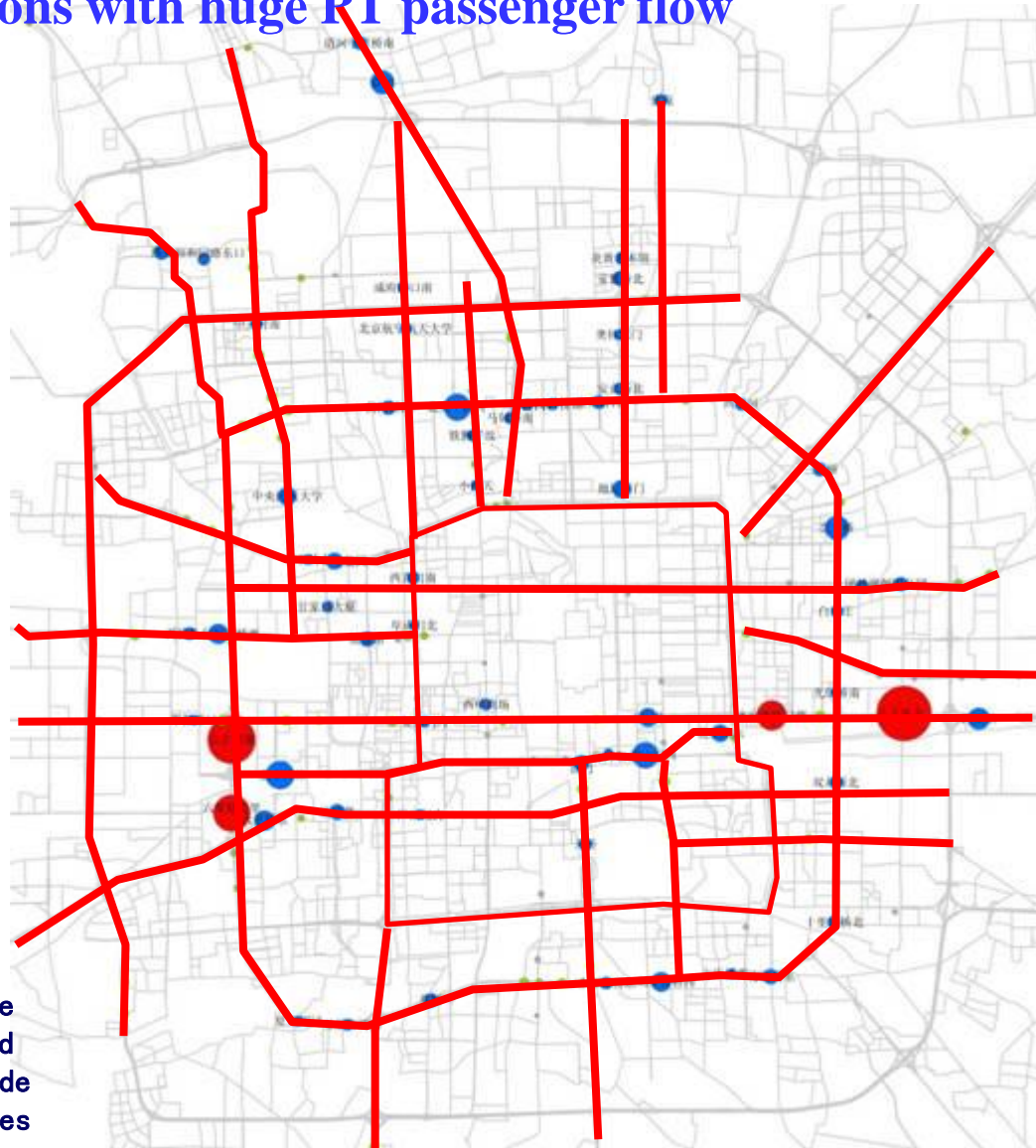
IV. A Tentative Plan for BCTN



Layout of current PT corridors with huge passenger flow

IV. A Tentative Plan for BCTN

3. link big stations with huge PT passenger flow



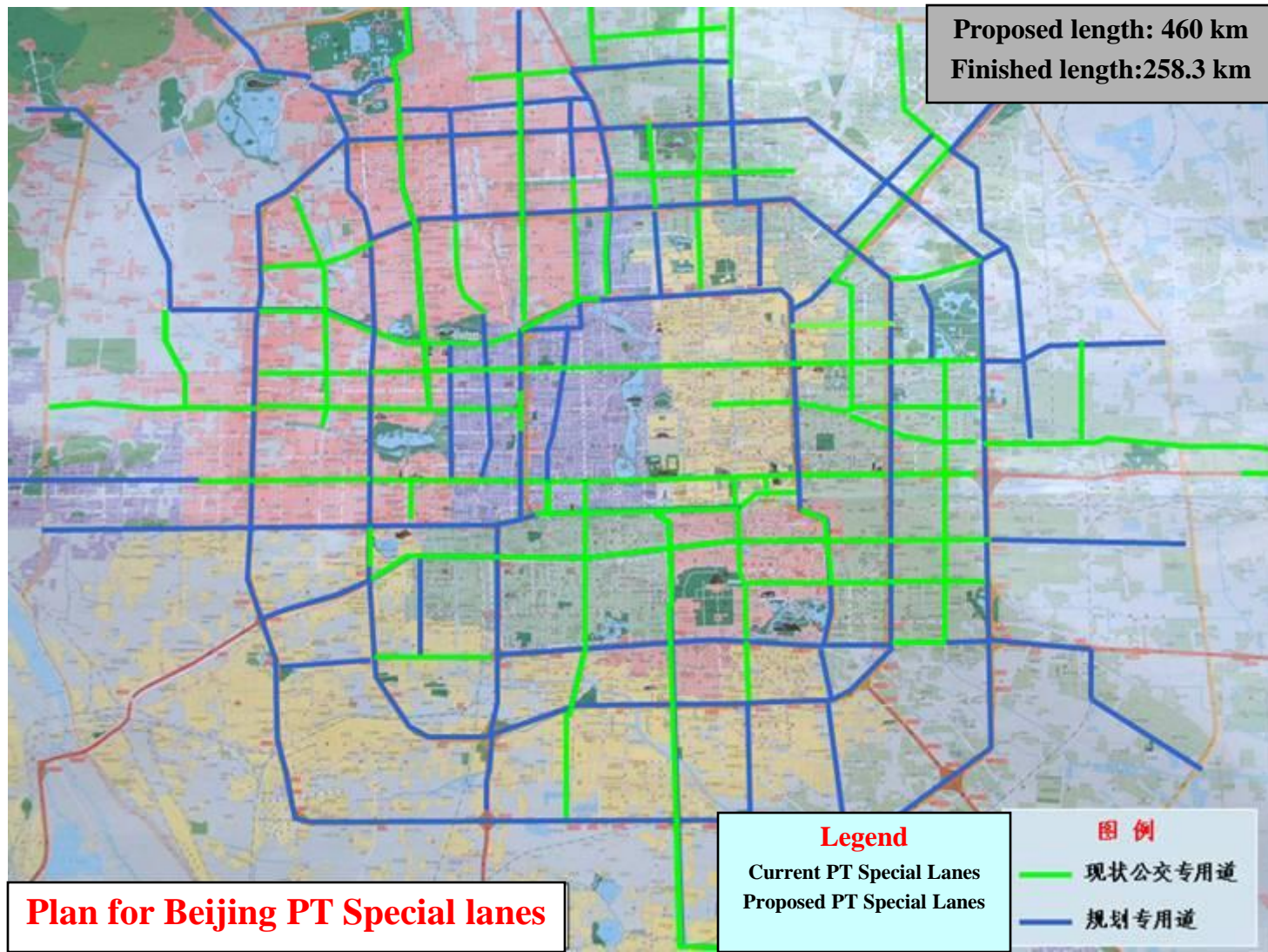
Daily volume of PT passenger flow

- 30,000-50,000
- 60,000-150,000
- >150,000

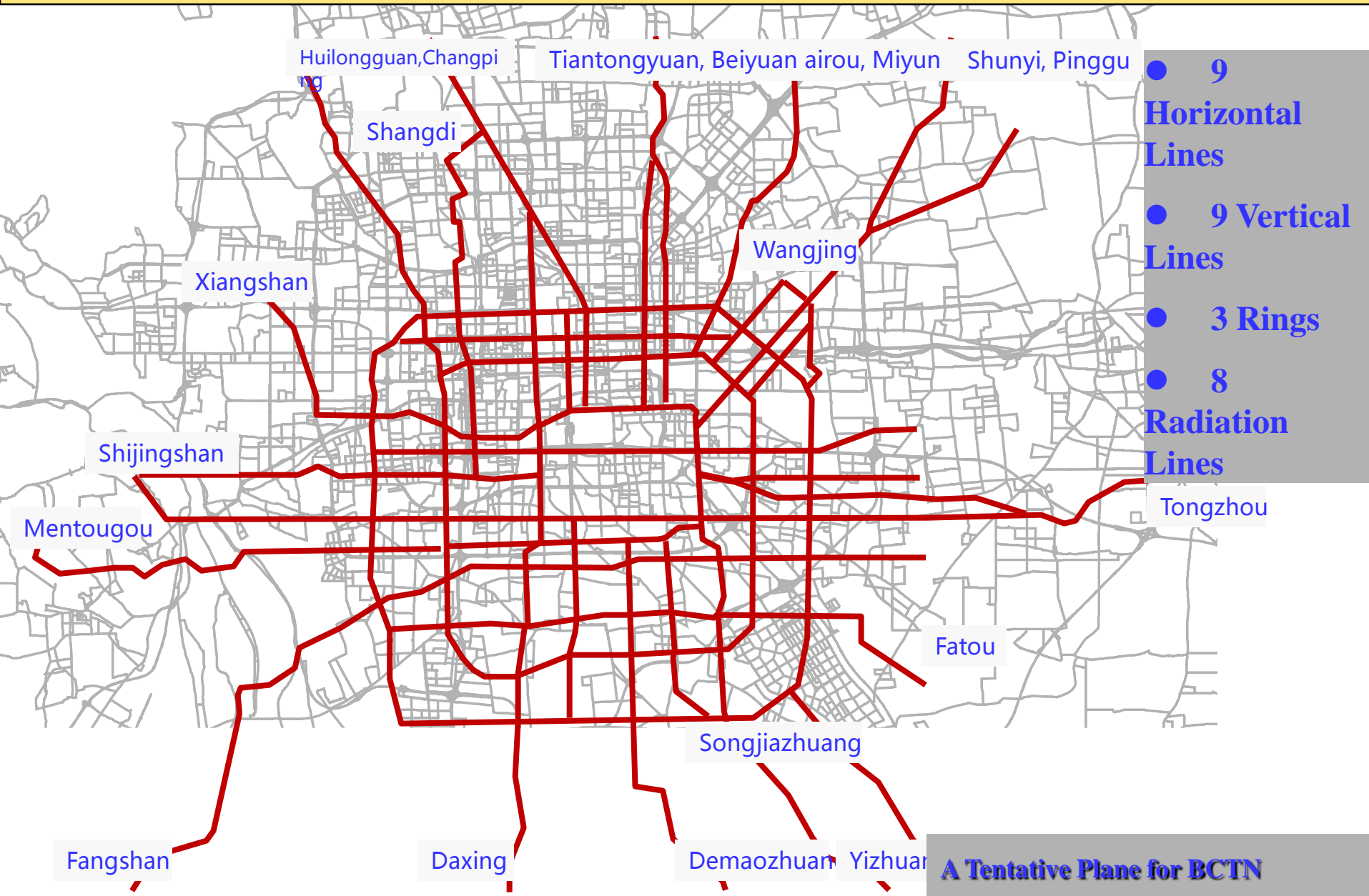
This picture bases on the 2006 PT stop boarding and alighting data, not include Bafangda and 9-begin lines

IV. A Tentative Plan for BCTN

4. Combine Closely with the PT Special Lane's networks

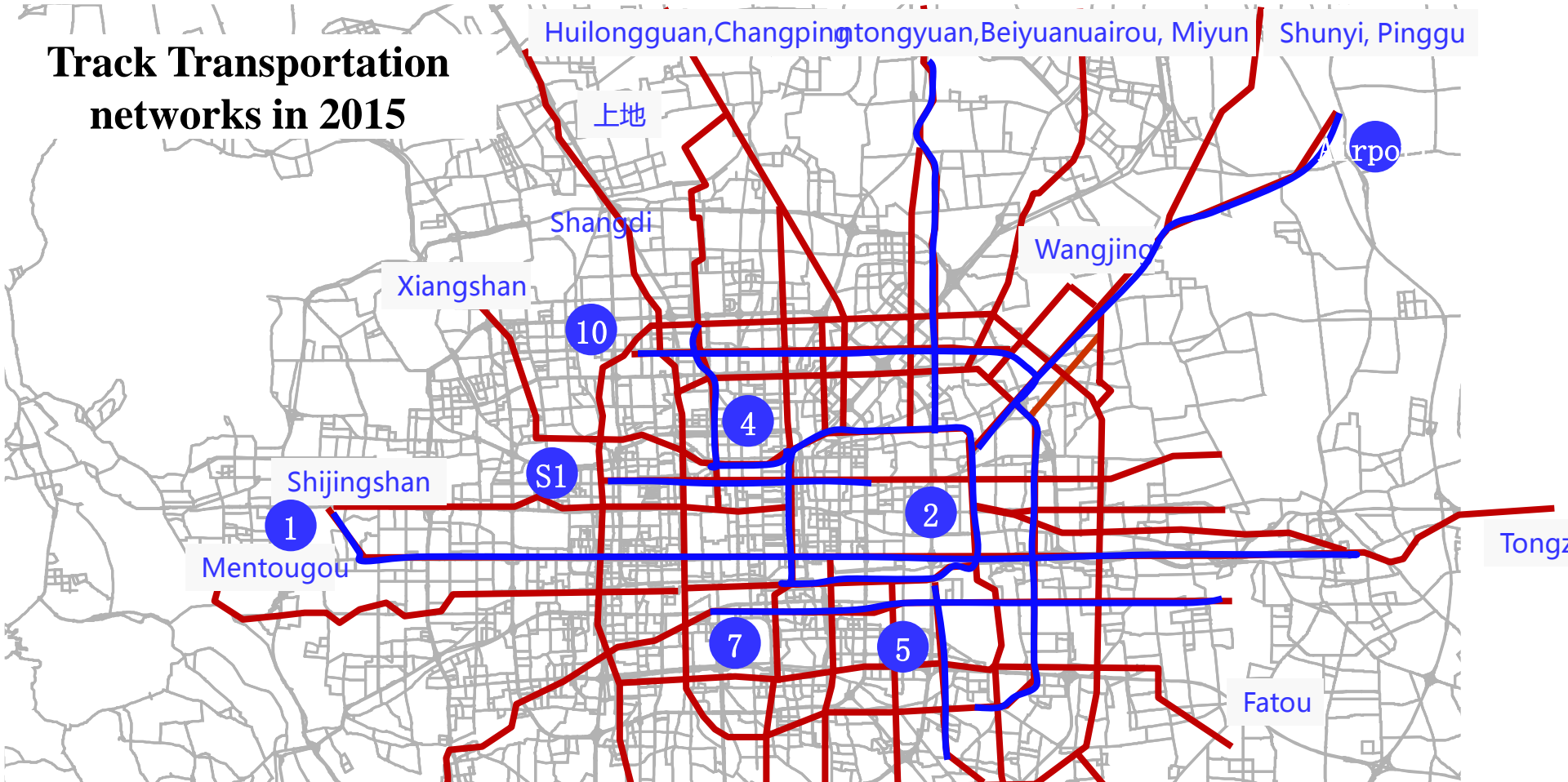


IV. A Tentative Plan for BCTN



Short term plan

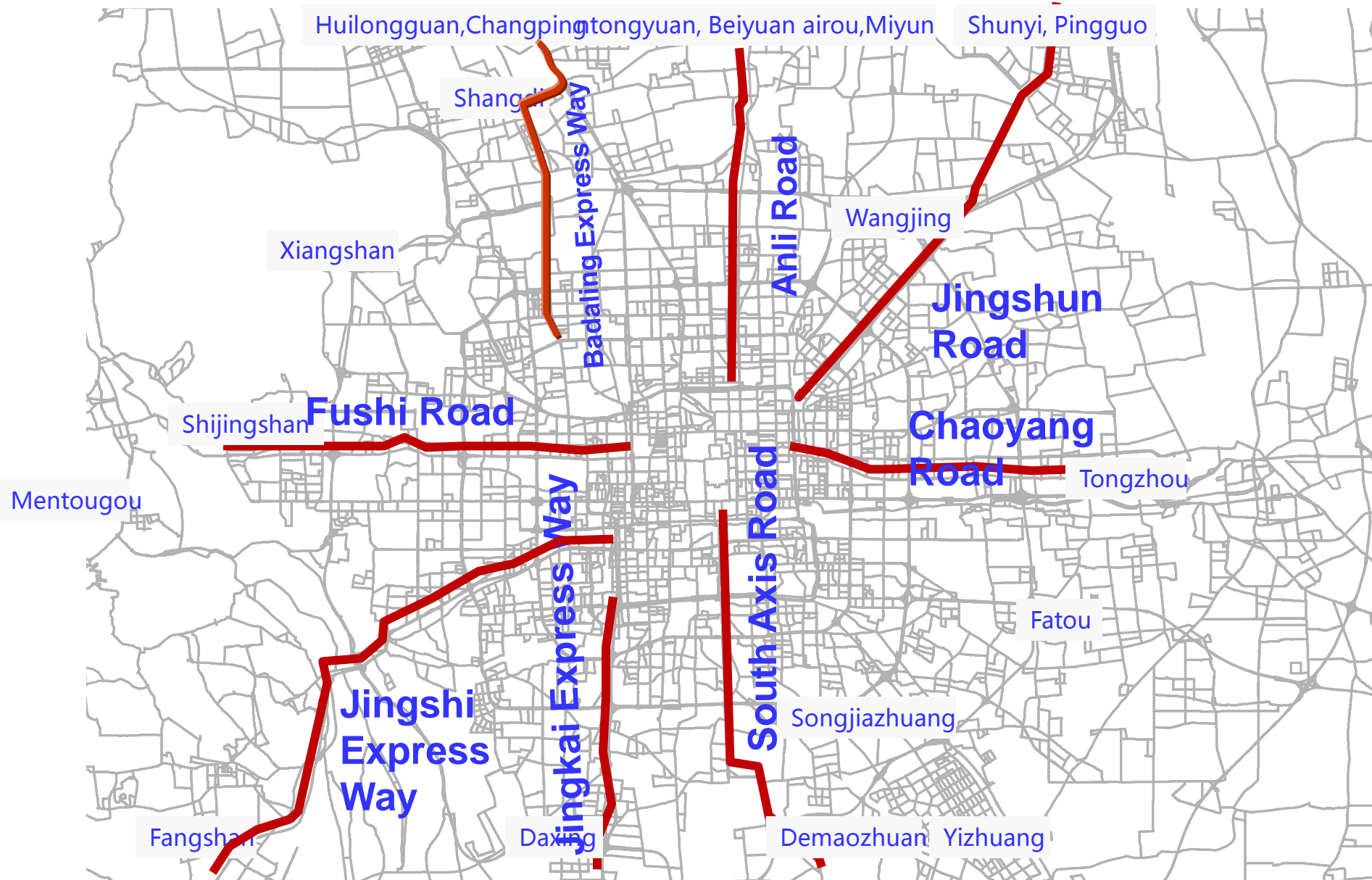
Track Transportation networks in 2015



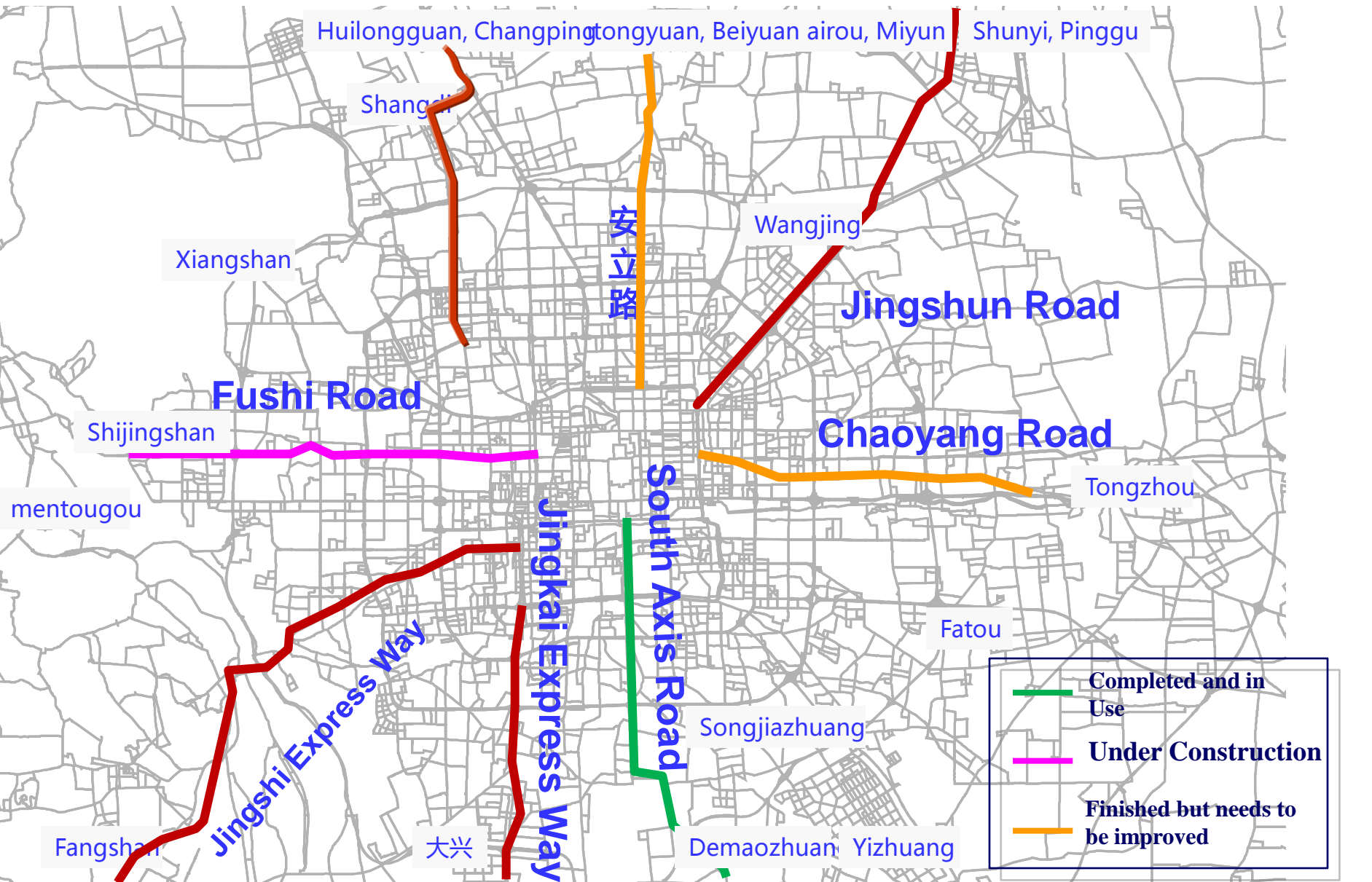
Combine the planned Track Transportation networks, exclude the roads that have and are going to build track transportation lines:

Roads that have built track transportation lines: Chang'an Street, road section from Chongwenmen to Songjianzhuang, 2nd Ring Road, road section from Bagou to Jingcheng Express Way, Airport Express line, East 3rd Ring Road, etc. Roads that is going to build track transportation lines: Ping'an Street, Lianguang Road, Road section from Xizhimen to Zhongguancun

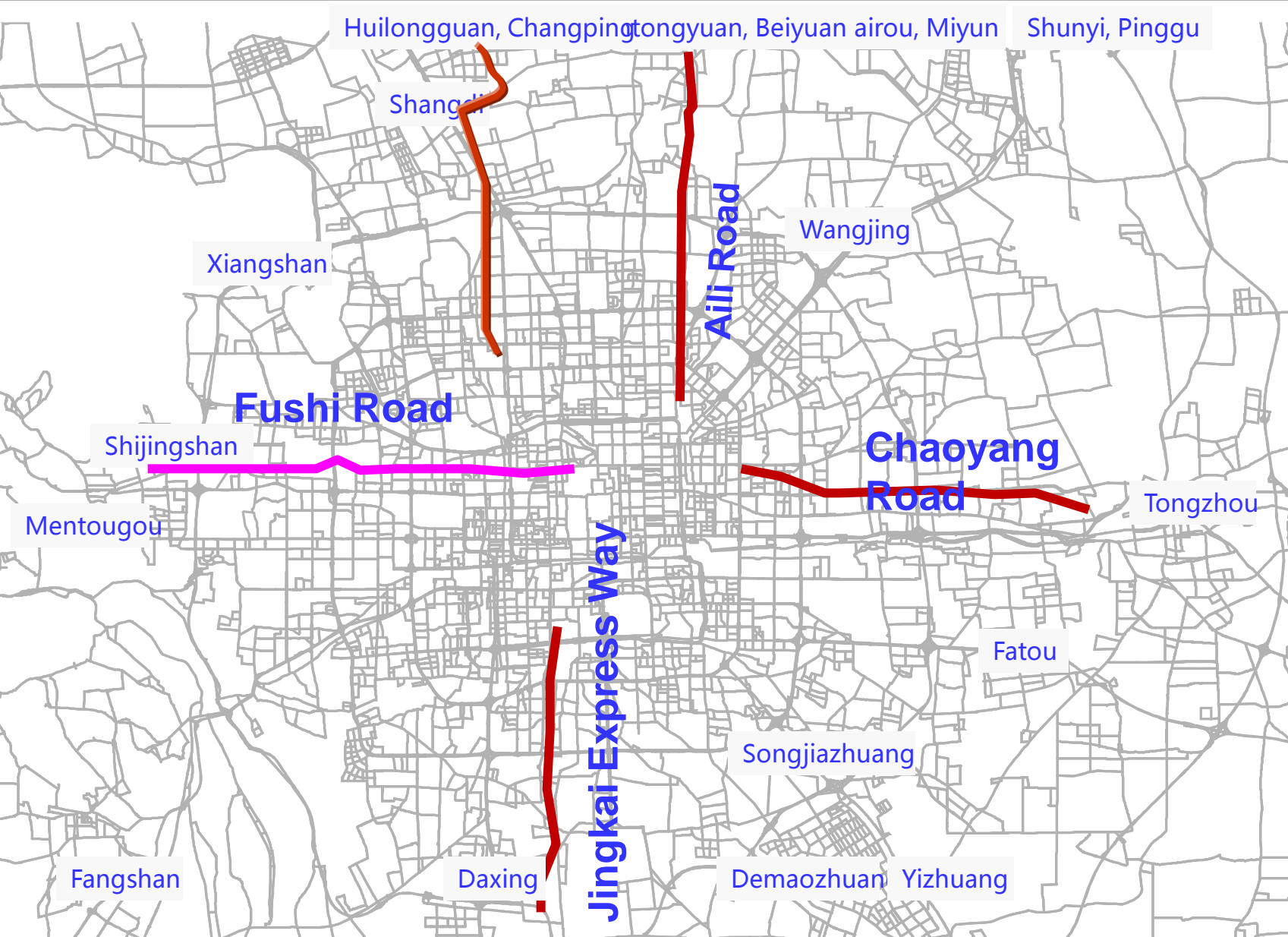
8 primarily selected BRT corridors



A further selection from the 8 primarily selected BRT corridors



5 recently-built BRT corridors



According to the traffic congestion index of the recently-built roads, we choose corridors that are badly suffered from traffic jams: Chaoyang Road and Jingkai Express Way

Roads	Traffic Congestion Index
Anli Road	7.1
Chaoyang Road	7.3
Jingkai Express Way	8.1
Jingshi Express Way	4.4
Jingshun Road	6.2

The selection of model corridor

- After analyzing the existing BRT, road conditions, traffic conditions, and PT commuters volume, finally we tentatively choose Chaoyang Road as a model line.

Road	PT and car section passenger flow at peak hours (10,000 travels/hr)	PT section passenger flow (10,000 travels/hr)	Sharing ratio of PT (%)	Traffic congestion index	Road condition
Chaoyang Road	1.2~1.8	0.8~1.1	53~61	7.3	The existing BRT2 is not effective, and the PT special lane is in good condition
Jingkai Express Way	0.7~1.3	0.3~0.5	40~60	8.1	PT special line needed in the Express way

Suggestions on construction schedule

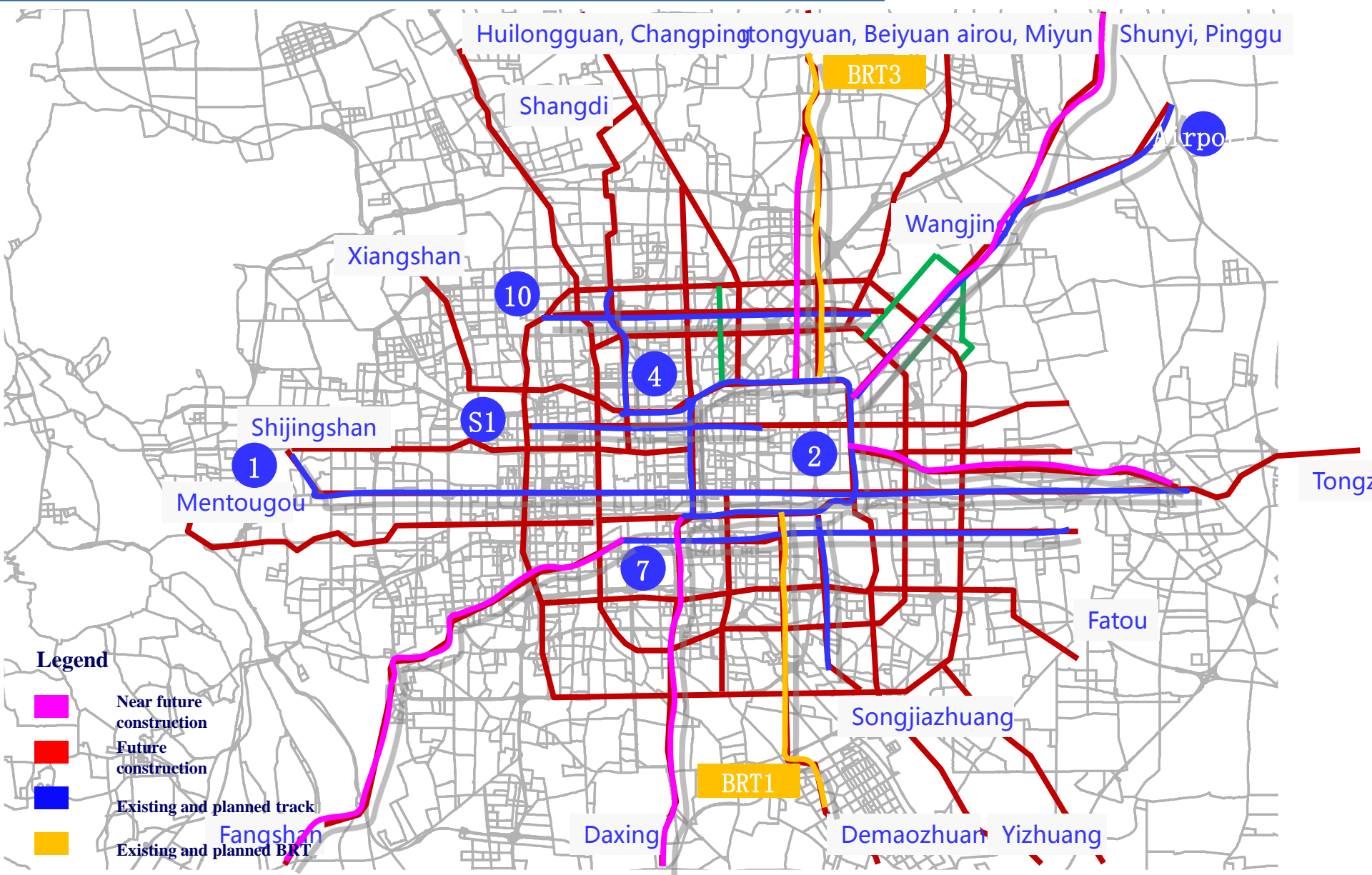
According to the analysis above, we suggest the construction schedule as below:

Recent construction: 5 lines

Future construction: 16 lines

No.	Road	Completed/being built	建设时序
1	Chaoyang Road		An Example Project
2	Fushi Road		Under construction
3	Jingkai Express Way		near future
4	Anli Road	BRT3	near future
5	Badaling-the Old Summer Palace East Road (shangdi-Zhongguancun)	Need to build a main Road	near future
6	Jingshun Road		future
7	Jingshi Express Way		future
8	Badaling Main line		future
9	Road section from Xizhimen to Xiangshan	Partly Planned M4	future
10	Ping' an Street	Partly Planned S1	future
11	Chaoyang North Road		
12	Road section from Fengbei Bridge to Fatou		future
13	Road section from Jianguomen to mentougou	Partly existing M2	future
14	Jingcheng Express Way		future
15	Jingjintao Express Way		future
16	Road section from Huilongguan to the Old Summer Palace East		future
17	Xueyuan Road		future
18	Xidan-Gongyi Bridge		future
19	Road section from Huilongguan to Suzhou Bridge		future

Suggestions on construction schedule



A Tentative Plan for BCTN Model corridor

- **An analysis of the current situation of the corridor**
- **The major problems of the corridor**
- **Tentative solution**

The Current PT Situation of Chaoyang Road

Current condition of BRT2

- OD: Yangzha-Chaoyangmen
- Lengthen: 16 km
- Stops: 21, among which 18 are in use now
- Daily passenger volume: 45,000 travels





Two way 6-lane road
(The special lane is on the right side)

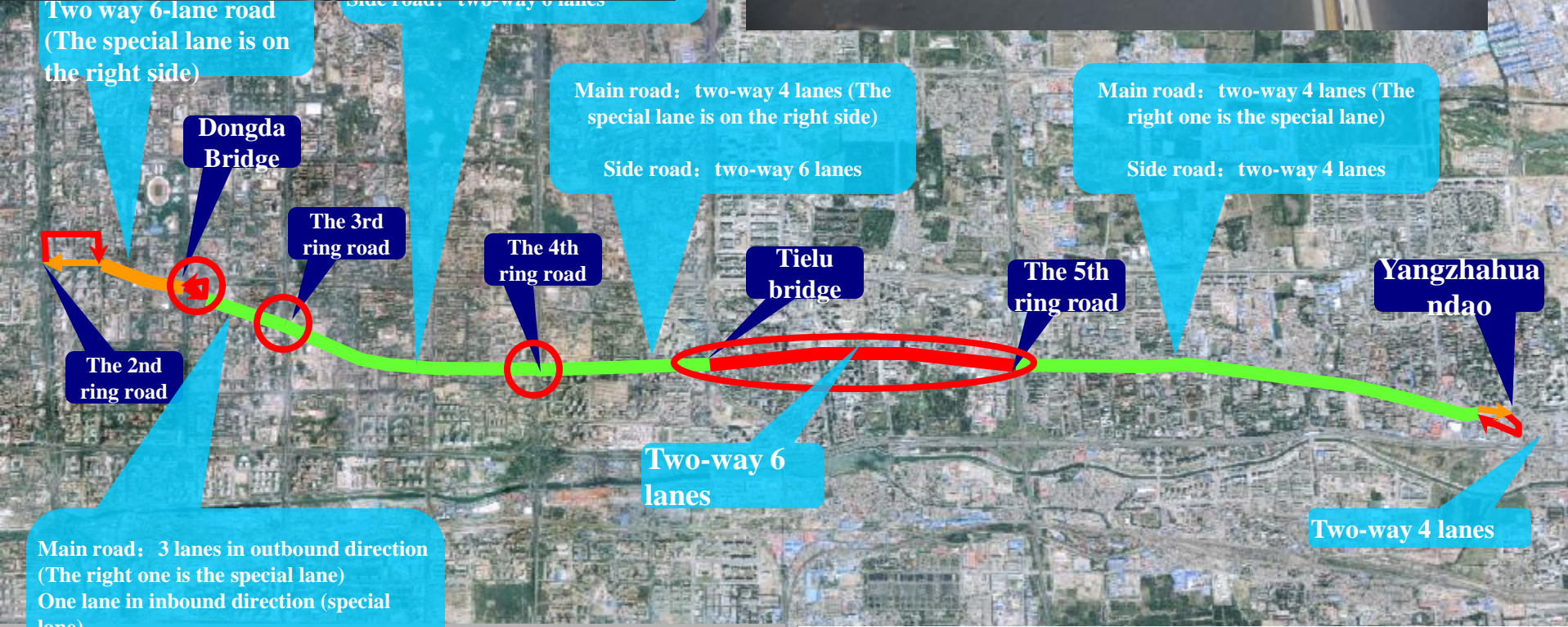


Main road: two-way 4 lanes (The special lane is on the right side)

Side road: two-way 6 lanes

Main road: two-way 4 lanes (The right one is the special lane)

Side road: two-way 4 lanes



Main road: 3 lanes in outbound direction
(The right one is the special lane)
One lane in inbound direction (special lane)

Two-way 6 lanes

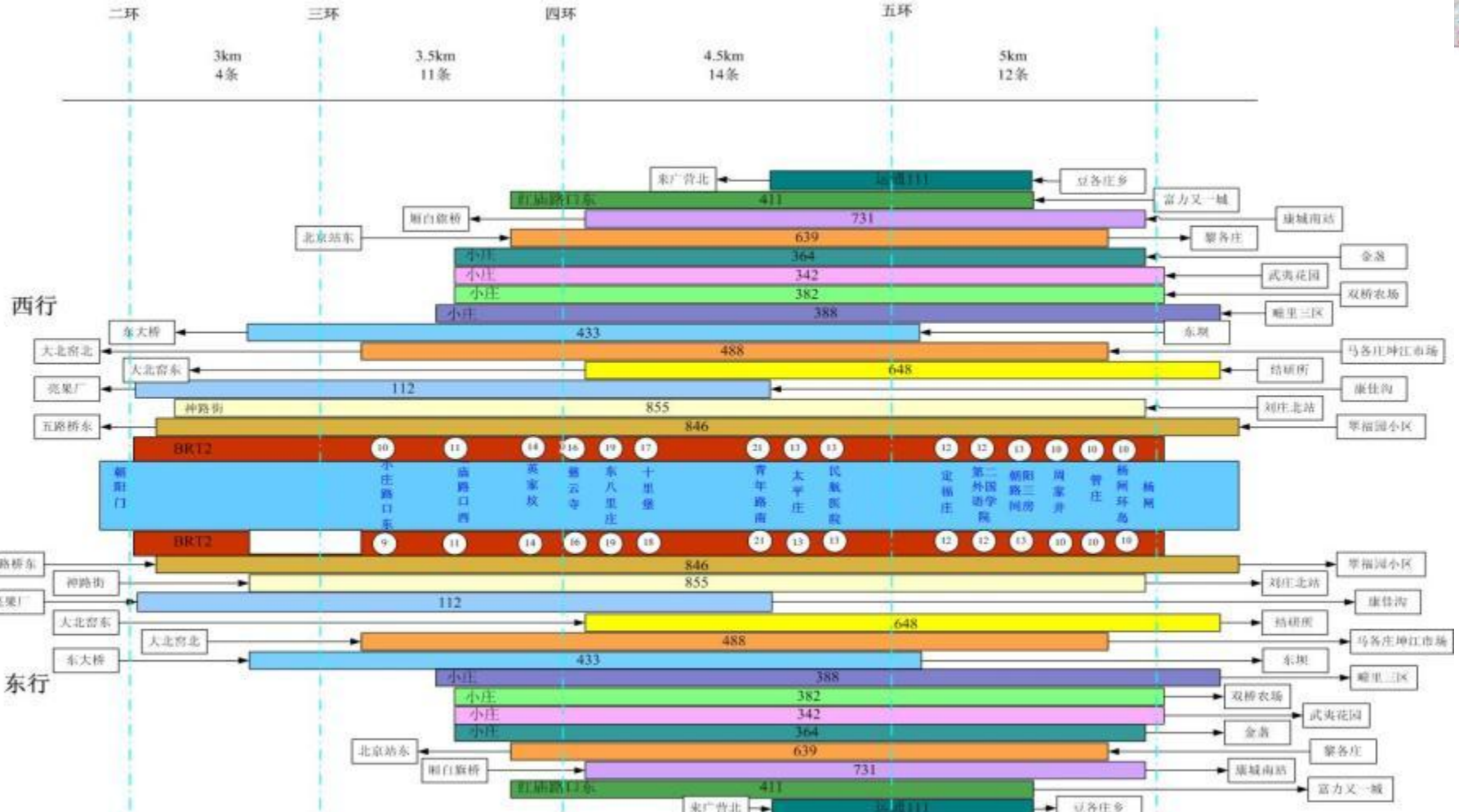
Two-way 4 lanes

There are 25 crossing roads with traffic lights, 9 traffic lights for pedestrian and 3 crosswalks without traffic lights from Chaoyangmen to Yangzhahuandao. There is a traffic light every 450 meters.

Legend

- █ Special lane
- █ Mixed-traffic road
- █ Roadside special lane
- One-way mixed-traffic road
- One-way roadside special lane
- Heavily traffic congested area

PT condition of Chaoyang Road



PT stops and lines along Chaoyang Road

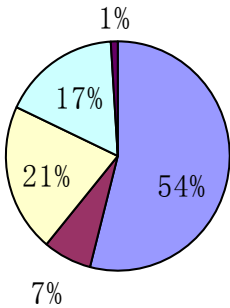
PT running conditions along Chaoyang Road

1. The PT special lane hasn't showed its advantages. BRT2 speed is as slow as the conventional buses, with its speed at 15-16 km/hr at peak hours and 18-20 km/hr at level hours.

We compared the running time between BRT2 and its overlapped line(conventional Bus No.846)at morning peak hours, level hours and evening peak hours.The compared road section is from Chaoyangmen to Yangzhahuandao(some 15 km). The comparison shows that BRT2 is more time-saving than conventional buses, but the advantages are not obvious, especially at the level and evening peak hours.

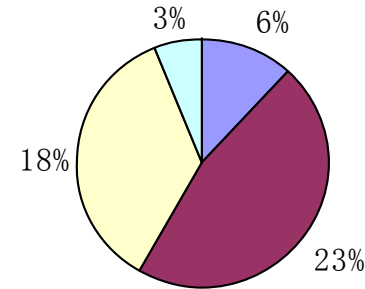
	Morning peak hours	Level hours	Evening peak hours
BRT2	59' 45"	48' 43"	55' 16"
Bus No. 846	76' 44"	56' 44"	60' 25"

BRT2 running time structure at morning peak hours



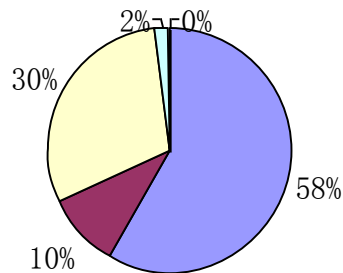
- Driving time
- Time spending at stops
- Time waiting for traffic lights
- Delay caused by traffic congestion
- Delay caused by other factors

Bus No.846 running time structure at morning peak hours



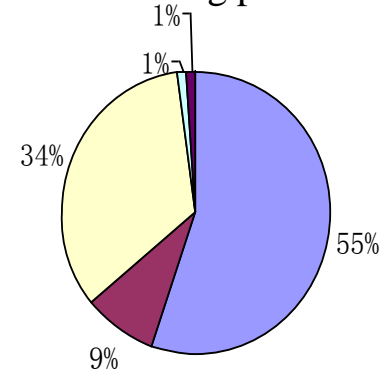
- Time spending at stops 6%
- Time waiting for traffic lights 23%
- Delay caused by traffic congestion 18%
- Delay caused by other factors 3%

BRT2 outbound running time structure at evening peak hours



- Driving time
- Time spending at stops
- Time waiting for traffic lights
- Delay caused by traffic congestion
- Delay caused by other factors

Bus No.846 outbound running time structure at evening peak hours



- Driving time
- Time spending at stops
- Time waiting for traffic lights
- Delay caused by traffic congestion
- Delay caused by other factors

Analysis on Travel time structure– take morning peak hours as an example

- **BRT2 is roughly the same as conventional buses in travel time structure,**
- **Waiting time of the traffic lights is long, accounting for 21% and 23% of the total running time.**
- **One of the major causes that delays the buses is traffic congestion, accounting for 17% and 18% respectively.**
- **Time spending at stops is short, accounting for 7% and 6% respectively**

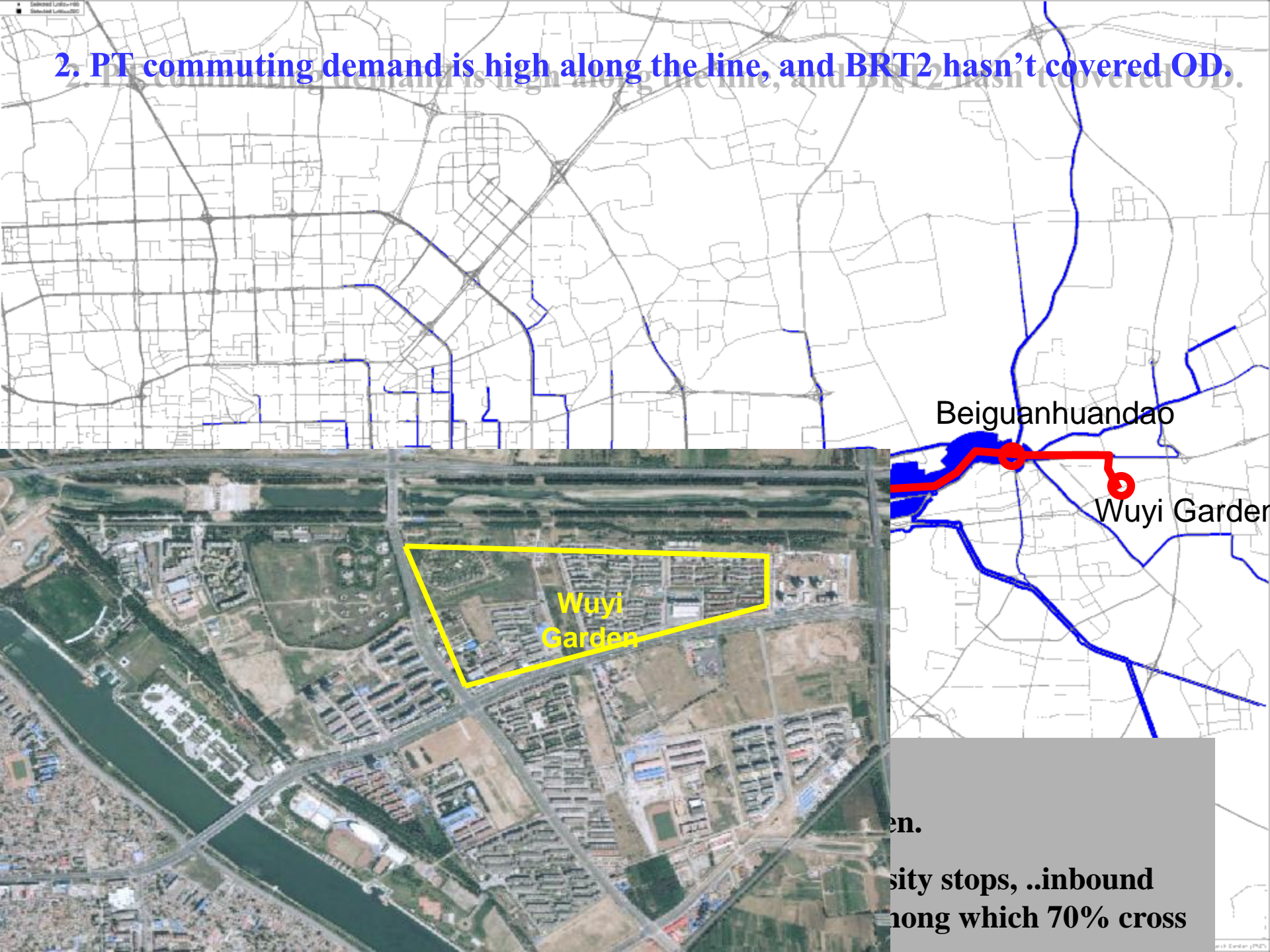
Major Problems

Major causes that affect BRT's speed

- Distance between traffic lights is short(450 meters), and there's no PT priority traffic signal, and the special lane's advantages cannot be seen.
- There is no PT special lane at the entrance of the main road at the crossings below the bridges in peak-hour traffic congested areas such as Ciyunsi and Hujialou.
- The PT special lane is occupied by cars, which affects the PT speed.
- The road construction between the 4th and 5th ring roads makes the special lane discontinuous.



2. PT commuting demand is high along the line, and BRT2 hasn't covered OD.



Beiguanhuandao

Wuyi Garden

Wuyi Garden

en.

city stops, ..inbound
among which 70% cross

Preliminary plan for Chaoyang Road PT lines' adjustment

Optimization goals:

- Enlarge service scale and passenger flow the PT system serves
- Optimize the PT lines
- Quicken the running speed
- Improve service quality

Preliminary plan for Chaoyang Road PT lines' adjustment

Enlarge service scale and passenger flow the PT system serves

- Extend BRT2 to Tongzhou's Wuyi Garden, and cover major passenger flow areas in Tongzhou. The lengthen of the extended section is 26 km.



Preliminary plan for Chaoyang Road PT lines' adjustment

Enlarge service scale and passenger flow the PT system serves

- After BRT2's extension to Wuyi Garden, such paralleled long-distance lines as Bus No. 342, 382, 488, 846, 855 should add fast buses which only stop at selected big stops, as BRT2's supporting lines' system, so that a BCTN system can be built on Chaoyang Road.



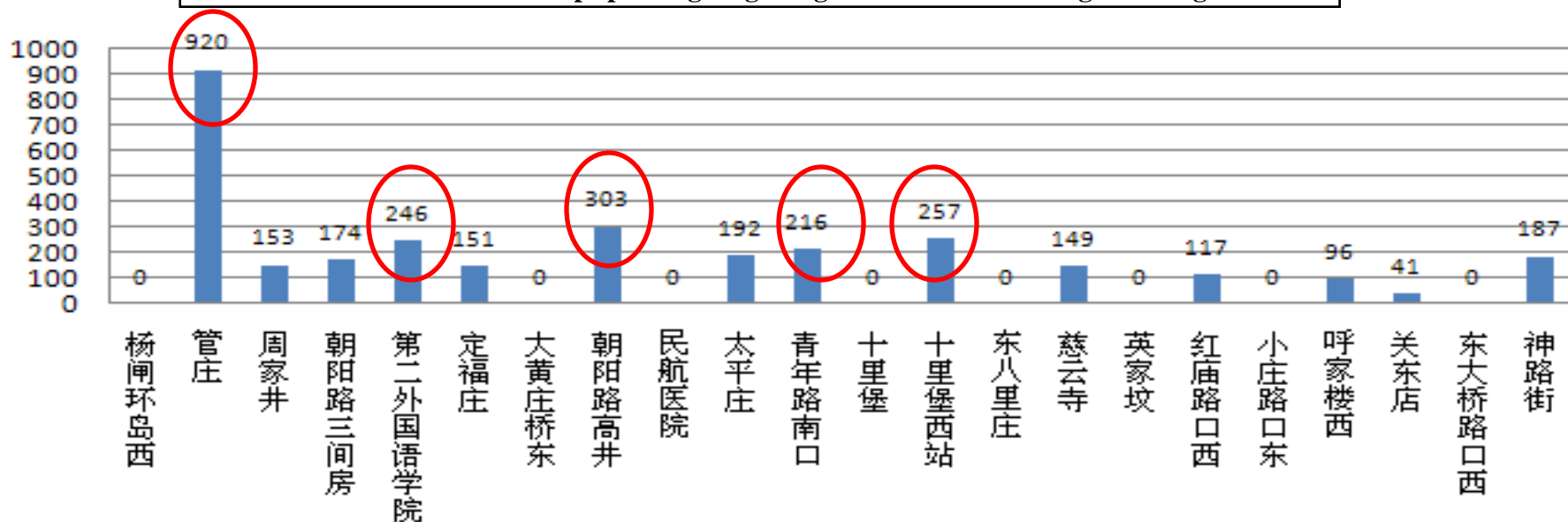
Preliminary plan for Chaoyang Road PT lines' adjustment

Quicken the running speed

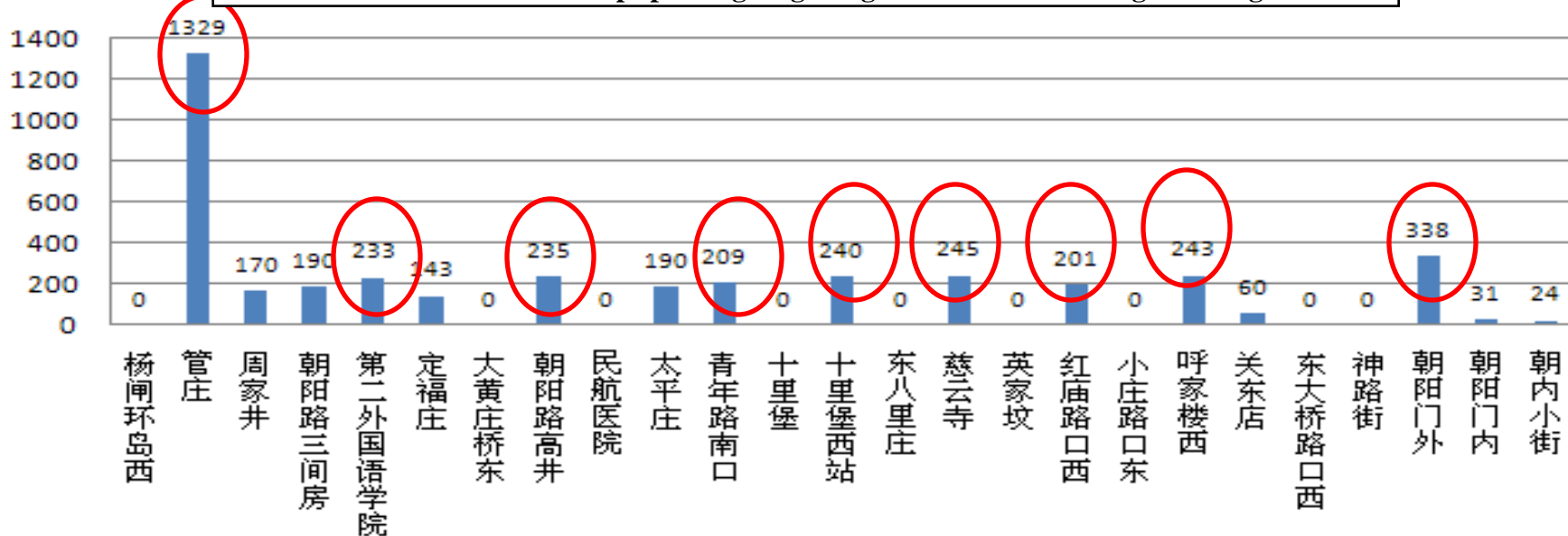
- **The fast buses should stop at major passenger flow collector-distributor points such as Tongzhoubeiguan, Yangzha, Gaojing, Hongmiaolukou, Hujialou and Chaoyangmen.**
- **The fast buses should enter BRT2's special lane to share same platforms for transfer.**
- **Analyze the passengers of Bus No.855 and 846, who get on in the east of Yangzha and get off in the west of Yangzha, and make reference to the setting of stops for the fast buses in the east of Yangzha.**



Bus 855: Statistics on which stops passengers getting on in the east of Yangzha will get off



Bus 846: Statistics on which stops passengers getting on in the east of Yangzha will get off



Preliminary plan for Chaoyang Road PT lines' adjustment

Quicken the running speed

- Take further PT priority measures

- Extend the BRT special lane to the crossing under Ciyunsi and Hujialou Bridges.

- At crossings with traffic lights, BRT priority control plan or green wave coordination control should be implemented.

- Pedestrian traffic lights close to the BRT stops should be under coordinated control with the stops.

- Strengthen supervision of the PT special lane and avoid cars' entrance to the lane to slow down the PT running speed.

Preliminary plan for Chaoyang Road PT lines' adjustment

Improve service quality

- Establish BCTN system along Chaoyang Road based on BRT2
- Differentiate the buses of express lines and conventional lines, to make the express lines easier to be identified
- Different express lines share same transfer stations to improve the transfer system
- Add a forecast of arrival buses for the express lines

Preliminary plan for Chaoyang Road PT lines' adjustment

Expectations:

- Build a Chaoyang Road's BCTN system with BRT2 supported by several other express lines.
- Form a BCTN corridor between Tongzhou district and the city center by the links between BRT2, subway Line 1, Batong Line and subway's Loop Line & Line 10.



Preliminary plan for Chaoyang Road PT lines' adjustment

Expectations:

- Passenger flow of the BCTN is estimated to increase to 100 thousand travels per day
- The speed of the fast buses in the corridor will be increased to over 20 km/hr

THANKS!