Bus Rapid Transit Developments in China

Perspectives from Research, Meetings, and Site Visits in April 2006

Final Report: July 2006
Project Number: FTA-FL-26-7104.02

U.S. Department of Transportation
Federal Transit Administration (FTA)
Office of Research, Demonstration and Innovation (TRI)

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METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in)	=	2.5 centimeters (cm)
1 foot (ft)	=	30 centimeters (cm)
1 yard (yd)	=	0.9 meter (m)
1 mile (mi)	=	1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2)	=	6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2)	=	0.09 square meter (m^2)
1 square yard (sq yd, yd^2)	=	0.8 square meter (m^2)
1 square mile (sq mi, mi^2)	=	2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he)	=	4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz)	=	28 grams (gm)
1 pound (lb)	=	0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb)	=	0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp)	=	5 milliliters (ml)
1 tablespoon (tbsp)	=	15 milliliters (ml)
1 fluid ounce (fl oz)	=	30 milliliters (ml)
1 cup (c)	=	0.24 liter (l)
1 pint (pt)	=	0.47 liter (l)
1 quart (qt)	=	0.96 liter (l)
1 gallon (gal)	=	3.8 liters (l)
1 cubic foot (cu ft, ft^3)	=	0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3)	=	0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm)	=	0.04 inch (in)
1 centimeter (cm)	=	0.4 inch (in)
1 meter (m)	=	3.3 feet (ft)
1 meter (m)	=	1.1 yards (yd)
1 kilometer (km)	=	0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2)	=	0.16 square inch (sq in, in^2)
1 square meter (m^2)	=	1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2)	=	0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2)	=	1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm)	=	0.036 ounce (oz)
1 kilogram (kg)	=	2.2 pounds (lb)
1 tonne (t)	=	1,000 kilograms (kg)
	=	1.1 short tons

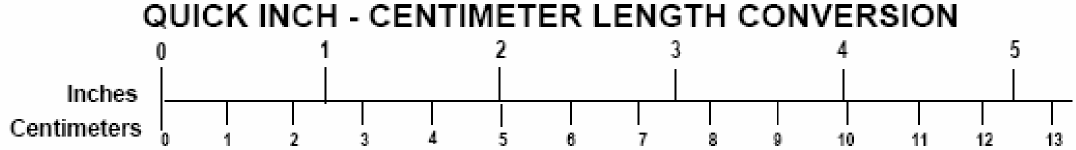
VOLUME (APPROXIMATE)

1 milliliter (ml)	=	0.03 fluid ounce (fl oz)
1 liter (l)	=	2.1 pints (pt)
1 liter (l)	=	1.06 quarts (qt)
1 liter (l)	=	0.26 gallon (gal)
1 cubic meter (m^3)	=	36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3)	=	1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH - CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSION

°F	-40°	-22°	-4°	14°	32°	50°	68°	86°	104°	122°	140°	158°	176°	194°	212°
°C	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°

For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures.
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Executive Summary

China is the most populous country in the world and has been experiencing remarkable economic growth in recent decades. With rising income levels, Chinese cities have also experienced a massive rural migration and rapid motorization with a profound effect on urban mobility and public transportation. With over 100 cities of more than 1 million in population, the urban public transportation market in China is very large. As many Chinese cities continue to grow, the problems of traffic congestion, air pollution, and road accidents have worsened. Like the United States, China also worries about meeting the need for transportation infrastructure and on energy resources.

The National Bus Rapid Transit Institute (NBRTI), representing the Federal Transit Administration's Office of Research, Demonstration and Innovation, participated in a public transportation mission in April 2006 to better understand the urban transportation problems and solutions in China. The purpose of NBRTI's participation was primarily to visit BRT systems and meet with organizations engaged in BRT planning or operation in various Chinese cities. By establishing initial contact with such organizations, a channel of communications has been opened to exchange information and allow for future cooperation on common problems and programs. Specifically, it is hoped that data from BRT systems in China can be included in the update of the FTA publication, "Characteristics of Bus Rapid Transit for Decision Making" by NBRTI. This would expand the understanding of viable BRT systems and the range of possible cost and benefits to improve the allocation of limited transit resources.

Although the BRT market in China is in a nascent state, it has the potential to revolutionize urban public transportation within a decade's time. There is already significant BRT activity in more than a dozen Chinese cities, which are good laboratories for research because of the diversity of approaches, compressed development time, and expected ridership growth. The ten-day visit included meetings with a number of government, academic, and non-governmental organizations in the following five Chinese cities:

- Beijing – the national capital with a population of approximately 13 million in the north of the country opened its first BRT line in 2005 and plans to open 3 others by 2008 when it will host the Olympic Games.
- Shanghai – the eastern provincial capital and bustling coastal city of about 15 million residents is planning to implement BRT elements incrementally (such as transit signal priority and passenger information systems) while continuing to expand the metro network in anticipation of the 2010 World Expo.
- Nanjing – the eastern provincial capital and ancient capital of China with about 5 million residents plans to implement BRT elements incrementally to complement an ambitious 30-year metro expansion program.
- Hangzhou – the eastern provincial capital of about 5 million people is an ancient city that attracts many visitors. It started operating the initial 10 km of its first BRT line in April 2006 and plans to expand its program.
- Kunming – a provincial capital of about 4 million people in the interior of the country launched the first modern busway in China in 1999 with international assistance and is looking to upgrade its 40km network with additional BRT elements.

The present report summarizes BRT developments in these and other Chinese cities and synthesizes the relevant background on China's institutions, policies, economic growth, and demographic change. It concludes with observations and recommendations for future research cooperation and information exchange of mutual benefit to the United States and China.

1. Purpose and Objectives

This report briefly summarizes the information related to Bus Rapid Transit (BRT) developments in China collected through research and a visit to China during the FTA Public Transportation Trade Mission from April 17-26, 2006. The National Bus Rapid Transit Institute (NBRTI) participated in this mission as a representative of the FTA Office of Research, Demonstration and Innovation. The main purpose for NBRTI's participation was to visit operational BRT systems and to meet with organizations engaged in BRT planning or operations in China. By establishing initial contact with such organizations, a channel of communications has been opened to exchange information and allow for future cooperation on common problems or programs. Specifically, it is hoped that data from BRT systems in China can be included in the future update of the FTA publication, "Characteristics of Bus Rapid Transit for Decision Making,"[1] by NBRTI. This work will expand the understanding of viable systems and the range of possible performance, cost and benefits to improve the allocation of limited transit resources.

This report also synthesizes the relevant background on China's institutions, demographic and economic growth, policies and initial data on BRT systems in China in operations and planning. It concludes with observations and recommendations for future cooperation in areas of common interest.

1.1. Meetings and Organizations

Appendix A presents an itinerary of the meetings and visits associated with the trip to China in April 2006. The itinerary includes additional meetings related to BRT research not associated with the FTA Public Transportation Trade Mission, such as the visit to Kunming. Appendix B includes a list of organizations and research contacts made during these meetings. Appendix C and D are two presentations (given in English or translated) by planning organizations in China about their BRT developments.

The ten-day visit included meetings with a number of organizations in the following five Chinese cities:

- Beijing: April 17-18, 2006
    - Chinese Ministry of Construction (MOC), Division of Transit/Transport
    - China Urban Public Transport Association (CUPTA)
    - Beijing Municipal Committee of Communications
    - China Academy of Urban Planning and Design (CAUPD), Urban Transportation Institute
    - Beijing Transportation Research Center
    - Beijing Bus Company and BRT Operator
    - Beijing University of Technology
    - Energy Foundation/China Sustainable Transportation Center (CSTC)
- Nanjing: April 18-20, 2006
    - Institute of City Transport Planning, Southeast University
    - Nanjing Municipal Construction Committee
    - Nanjing Bus and Metro Companies
- Shanghai: April 20-22, 2006
    - Shanghai Municipal Urban Transport Bureau
    - Shanghai Municipal Construction and Transportation Commission
    - One of Shanghai's Bus Company
- Kunming: April 22-23, 2006
    - Kunming Urban Transport Institute
- Hangzhou: April 23-26, 2006
    - Hangzhou Municipal Communications Bureau and Construction Commission
    - Hangzhou Transportation Research Center
    - Hangzhou BRT Operator

[1] Available for download at: http://www.fta.dot.gov/documents/CBRT.pdf

The cities range in size from large (e.g., Nanjing, Kunming, and Hangzhou each with a population of over 3 million) to very large (e.g., Beijing and Shanghai each with a population of over 10 million). Although they represent several different provinces in the country, four out of five cities are in the wealthier coastal regions of the northeast and eastern parts of the country. Exhibit 1 is a map of China showing the location of each city.

Exhibit 1: Map of China and its Major Cities
(N.B. cities visited are circled and underlined)

1.2. Institutional Structure and Roles

Although the government of the People's Republic of China (i.e., China) has traditionally been highly centralized, the past three decades of economic reform have devolved many functions and the responsibility for 70% of public expenditures to the provincial level (Cherry, 2005). Chinese institutions at the national or provincial level are not typically organized into departments of transportation as is the case in the United States. Transportation policy is a shared responsibility of the Ministries of Construction, Communication, Rail and Public Security within the central government. Most of the urban transportation planning and implementation is done at the local level by municipal government organizations such as an Urban Planning Bureau or Institute (e.g., Shanghai, Nanjing, and Kunming) or Transportation Research Center (e.g., Beijing and Hangzhou). These organizations typically fall under a Municipal Construction Bureau. Other municipal agencies may control other transportation functions such as management, operations and maintenance. The generic organizational chart in Exhibit 2 is a reflection of this structure. This institutional structure has been cited as a contributing factor for the general lack of regional transportation planning and interagency coordination in China.

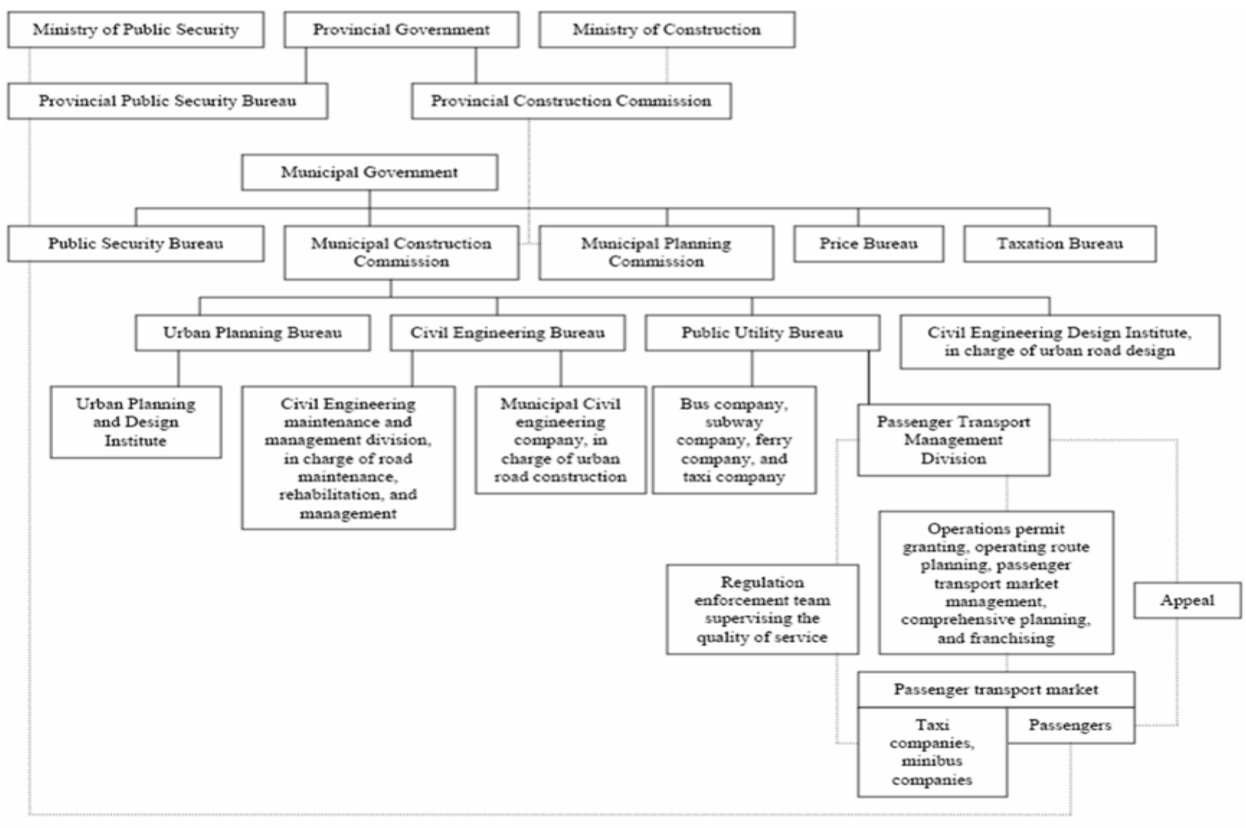
Cherry (2005) states that much of the urban transportation infrastructure is built by the Ministry of Construction using funds from leasing new land and land use rights. The government has also been encouraging the financing of transportation infrastructure using public-private partnerships and "Design-Build" arrangement to share risk and develop capital infrastructure in areas of underserved demand.

Some international development banks such as the World Bank and the Asian Development Bank are also evaluating and funding urban transportation projects in China.

The closest counterpart to the FTA for urban transit administration is the Chinese Ministry of Construction (MOC), particularly the Division of Transport and Public Transportation. A Ministry of Railways is also responsible for intercity passenger and rail transportation. Within the MOC, the Urban Transportation Institute of the China Academy of Urban Planning and Design (CAUPD) is perhaps the closest counterpart to the FTA's Research Offices and supporting organizations such as the National BRT Institute. It employs highly qualified staff for research, documentation of best practices, and providing technical assistance to local agencies. A transit industry association similar to APTA, the China Urban Public Transportation Association (CUPTA), also exists as part of the MOC.

Several non-governmental organizations, such as the Energy Foundation/CSTC, Institute for Transportation and Development Policy (ITDP), and World Resources Institute (WRI)/Embarq, are actively advising and supporting local government agencies in urban transportation policy and planning with support from international foundations. CSTC is monitoring and supporting the development of BRT plans in several cities together with the dissemination of best practices via their web site and printed documents.[2] In Gangzhou, ITDP has pursued a Memorandum of Understanding with the Municipal Construction Commission and has been helping create a 2010 BRT plan.[3] WRI/Embarq has also advised officials in Shanghai on BRT development.[4]

Exhibit 2: Typical Institutional Structure for Urban Transportation in China (Wu et al. 1996, as cited in Cherry 2005)



[2] http://www.chinastc.org
[3] http://www.itdp.org/read/BRT%20Recs%20for%20GZ%2010May05.pdf
[4] http://embarq.wri.org/en/ProjectCitiesDetail.aspx?id=4

2. Background on China

2.1. Economic Growth

China has been experiencing remarkable economic growth and demographic changes profoundly affecting urban and public transportation. According to the World Bank, growth of GDP per capita, an indicator of personal income, in the past decade has averaged almost 9% per annum in China and is expected to continue. The Central Government projects GDP to grow at an annual rate of 8% during the period of the 11th Five-Year Plan (2006-10). In 2004, the US GDP totaled $12.6 trillion and was the largest in the world. That same year, China reported a GDP of nearly $2 trillion, which makes it the sixth largest economy in the world. At the rate of growth projected, China may become the second largest economy in the world by the year 2030. The currency exchange rate remains relatively stable at US$1 equaling about 8 Yuan (also known as the RMB). International economists cite the exchange rate as one reason for record trade imbalances between the United States and China in favor of the latter.

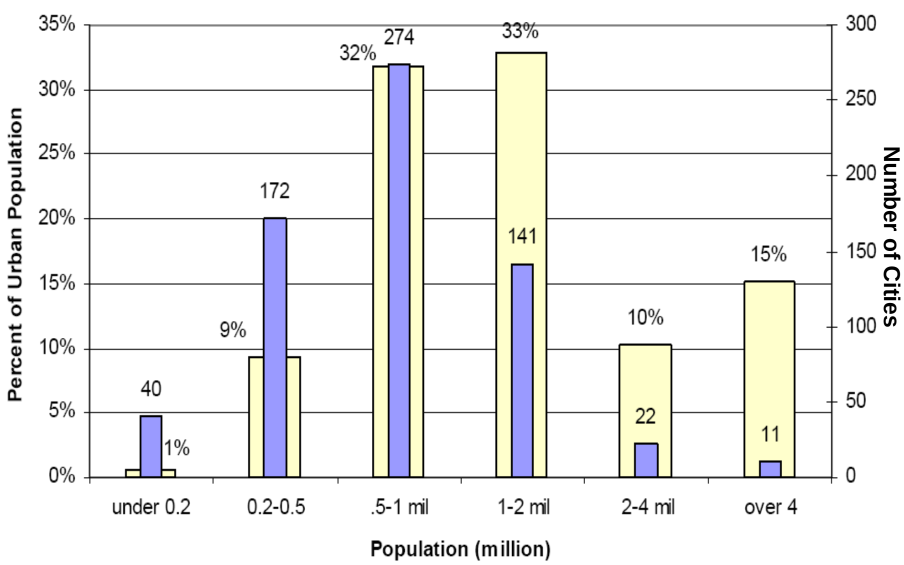
2.2. Demographic Changes

China is the most populous country in the world and, in the last few decades, has been experiencing perhaps the largest rural migration in history. This migration is fueling the rapid urbanization of the country. As a result, many Chinese cities have swelled in population in recent years and continue to grow. China's urban population is currently about 600 million or 40% of the total population of about 1.5 billion people (Cherry, 2005). About two-thirds of urban dwellers in China live in cities between 0.5 and 2 million people. As shown in Exhibit 3, there are an estimated 150 Chinese cities with current populations of more than 1 million (Cherry, 2005). Among them were the five cities visited, as evidenced by their most recent population estimates:

- Shanghai: 15 million
- Beijing: 13 million
- Nanjing: 5 million
- Hangzhou: 5 million
- Kunming: 4 million

By comparison, the US urban and suburban population is about 240 million or 80% of the total population of about 300 million people. About 50 US metropolitan areas have a population of 1 million or more according to 2004 Census data.

Exhibit 3: Distribution of Chinese Cities by Population (Cherry, 2005)



At the same time Chinese cities are urbanizing, many are also experiencing urban spatial decentralization characterized by the growth of suburbs (Gakenheimer, 2004). Chinese cities are some of the densest in the world but are decentralizing as the government pursues a policy of creating more manageable satellite cities. The rapid increase in personal income levels as a result of the expanding economy is also driving the demand for land consumption.

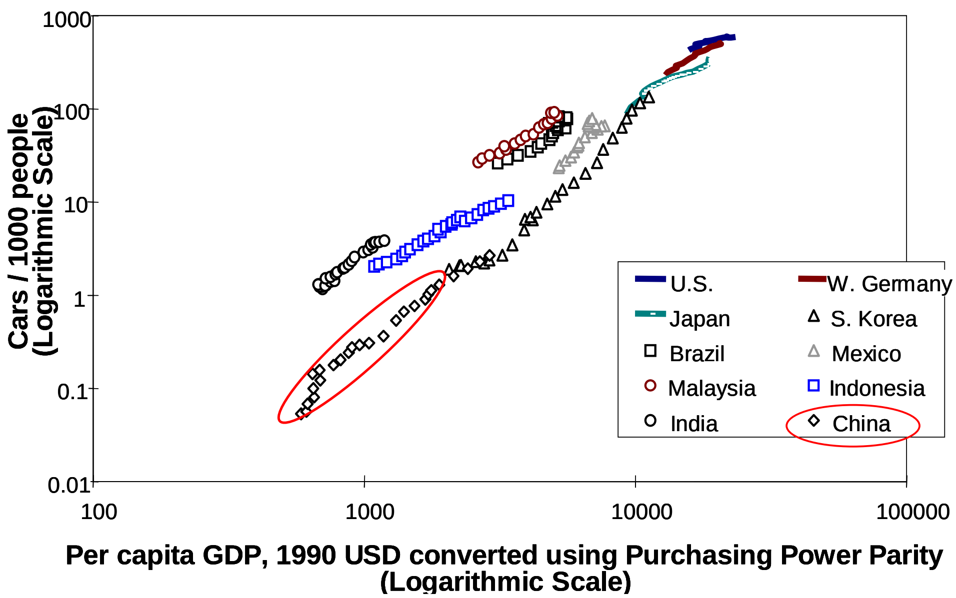
2.3. Mobility Trends

Urban income growth is associated with rapid growth in the number of vehicles (i.e., motorization) and much slower growth in the length of the urban road network, thereby tending to worsen urban congestion (NRC-CAE, 2003). At present, China has relatively few private motor vehicles per capita. In 2001 China had 18 million vehicles, of which 5 million were cars. If the number of motor vehicles per capita in China were comparable to the world average, its fleet would total 160 million, with 10 million new and replacement vehicles acquired each year. (NRC-CAE, 2003)

The combination of economic and demographic phenomena is also driving a significant increase in demand for transit services and other changes in personal mobility. Public transportation carries about 50% of all trips in Chinese cities, and buses carry the vast majority of all motorized trips (MOC, 2006) (Schipper and Ng, 2005). The MOC estimates that 93% of 661 cities in China have bus and trolley operations with about 280,000 vehicles. Buses currently carry over 40 billion trips per year in China and this figure continues to grow (MOC, 2006). Decentralization is also causing an increase in the average trip length, which in turn discourages walking and bike trips in favor of motorized modes including public transportation.

Chinese cities are experiencing rapid motorization not only due to rising incomes, but also from increased domestic automobile production (which lowers prices) and perhaps even the increased traffic congestion associated with urbanization (Gakenheimer, 2004). Many observers expect that the Chinese automobile market is far from reaching saturation as evidenced by the motorization trends shown in Exhibit 4. For instance, Schipper and Ng (2005) state that China's motorization in 2003 is comparable to the U.S. in 1907 on a per capita basis, though China's adjusted per capita GDP in 2003 was only half of U.S. levels in 1907.

Exhibit 4: Motorization Trends in Select Countries in Relation to Income (Schipper, 2004)



In China's most motorized city, Beijing, there are currently 2 million private vehicles (roughly 150 vehicles per 1,000 residents). This level of motorization was achieved in a very short time as 1,000 new private vehicles are presently added every day (MOC, 2006). By comparison, the US has reached about 750 vehicles per 1000 residents over a period of about 60 to 70 years.

The inevitable motorization of Chinese cities is compounded by a trend of increasing private vehicle use in terms of kilometers driven and trips (currently averaging around 2 trips per person per day). The combined effect will mean greater traffic congestion despite the rapid expansion of urban roadway networks on the periphery of Chinese cities.

2.4. Urban Transportation Problems and Policies

A 2003 joint study on "Personal Cars and China" by the U.S. National Research Council and the Chinese Academy of Engineering looked at the impact of rapid motorization on Chinese cities and economy. It recommended that government provide both the necessary road infrastructure to accommodate the increasing number of cars while also "providing public transportation that is convenient, comfortable, sufficiently widespread, safe, and affordable." It recognized that the fraction of the population that will own personal cars will be small for many years and China must maintain a balance between public transportation, non-motorized vehicles, and private cars.

The list of urban transportation issues in China is similar to the U.S., but the problems are becoming more acute and at a faster rate.

- Traffic congestion, and the associated delays and productivity losses, are already a very serious problem in many Chinese cities. The average speed of traffic in central Beijing and Shanghai decreased by 50% in past 10 years to less than 10 km/hr (Zhong-Ren Peng, 2005). Bus operating speeds are decreasing in most urban areas as a result.
- Air quality in many Chinese cities is seriously threatened by air pollution. Motor vehicles are now the largest source of urban air pollution in China's big cities (Gallagher, 2004). The industrialization and demographic changes previously described are also creating additional pressure on the environment in China. The Chinese government is trying to catch up by harmonizing vehicle emission standards with EURO III, lagging several years behind Europe and the US. The Chinese government is investing in alternative fuel vehicles, including CNG, hybrid electric, and fuel cell buses, particularly in the larger cities.
- There are significant issues of energy security and resource availability in China's booming cities. China is already the second biggest consumer of petroleum in the world after the US (IEA, 2004). It is aggressively expanding fossil fuel production and international agreements to secure further supplies. The expected growth in energy consumption from both the building and transportation sectors threatens the government's goals for energy independence and emissions of harmful pollutants and greenhouse gases.
- Road safety has been an increasing issue in the rapidly expanding cities. A policy of separating motorized and non-motorized modes in some cities has been used to justify the restriction of bicycles on arterial streets, particularly in large cities like Shanghai.
- A growing issue in China is accessibility and meeting the mobility needs of the poor, elderly, and disabled.

There is optimism that the benefits of using the latest, most cost-effective transportation technologies (i.e., leap-frogging generations of technologies) will compensate for some of the tremendous growth in demand in Chinese cities. Most importantly, the existing fleet of motorized vehicles is relatively small for a country of China's size but is expanding very quickly. This means that the penetration rate of new technology is high and, therefore, even small changes in fuel efficiency or tailpipe emissions standards can have a significant aggregate impact over time.

The recent policies of the central government have been to give priority to urban public transport. In 2004, the Chinese government made the development of urban public transport a key strategic objective. In "Recommendations on Prioritizing the Development of Urban Public Transport" (No. 38 of 2004), the

Ministry of Construction states its objective to strengthen the position of urban public transport in five years. Beijing and Shanghai have the most comprehensive public transportation plans in anticipation of the 2008 Olympics Games and the 2010 World Expo, respectively.

The central government allows metro systems to be developed in cities with populations greater than 3 million. At least 15 such cities have developed preliminary metro plans or are operating metros (Zhang, 2003 as cited in Cherry, 2005). Several cities also have very ambitious rail expansion plans and hope to attract private investment. Still, some of these cities and others are pursuing BRT as a complementary strategy. In fact, BRT-type projects are encouraged as a lower-cost rapid transit solution for intermediate to large corridors. At least 12 Chinese cities are actively planning or expanding BRT systems with varying approaches—from a full-fledged BRT system line by line to an incremental implementation of BRT elements over an existing bus network.

BRT systems also may be well-suited for many other Chinese cities. In fact, the Chinese government is beginning to recognize that BRT may be one of the most cost-effective strategies to combat the impending rise in private vehicle modes in urban areas and the decrease in operating bus speeds. Some observers have likened BRT development in China today to the early 20th century when major cities in the US where forming large commuter communities and suburbs on the basis of street car services (Gakenheimer, 2004). BRT is typically a less costly alternative to the transit operator and the rider, but can be as safe, clean and dependable as other motorized modes.

The State Council Office Decree 46 issued in September 2005 in a joint document by six departments of the central government guides the development of transit systems but leaves the detailed planning and implementation primarily to local governments. The policy is primarily aimed at increasing transit mode share by absorbing formerly non-motorized trips and new induced trips before becoming motorized. The policy is ultimately intended to lessen the impact of present and future congestion in urban areas by attracting a "choice" ridership that is increasingly buying private vehicles. To this end, the central government will finance more initial urban transportation construction and speed up reform of the urban public transport sector to attract private investors, but local government will likely continue to finance most of the initial capital cost of projects.

A description of how urban transportation projects are financed in China and recommendations are documented in an ITDP report by Hook et al. (2006) entitled "Options for Financing Bus Rapid Transit in China." This report states that the infrastructure of all BRT projects currently being implemented in China are financed from public sources. Typically, a municipally-owned corporation under the City Government is responsible for raising the necessary funds. This report also questions the economic viability so some urban transport projects and recommends ways to involve private investment into certain components of a BRT project, such as vehicles and operations, to encourage financial self-sustainability.

3. BRT Plans and Systems

The following sections describe the plans being implemented or systems in operations in several Chinese cities. Additional photographs of these systems and graphics of their current plans are provided in the presentations included in Appendix C and D. Exhibit 5 summarizes the primary characteristics of the 3 BRT-type systems in operation and observed during the visit.

Exhibit 5: Summary of BRT Systems in Operation in China

	Beijing (Southern Axis BRT Line 1)	Kunming Busway Network	Hangzhou BRT (Line B1)
Length in Operation	16.5 km, one corridor	40 km, six corridors	28 km, one corridor
Infrastructure Cost per Mile (Approx., in US Dollars)	$6.5 million per mile (excluding vehicles)	$0.5 to 0.8 million per mile (excluding vehicles)	$0.8 to 1 million per mile (excluding vehicles)
Bus lane position	Center, with barriers, with passing lanes at stations	Center, 5 cm solid separator, no passing lanes	Right-side, limited low barriers, with passing lanes at stations
Bus lane width	3.5 meters	3.2 meters	3.5 meters
Stations	Semi-enclosed	Open	Semi-enclosed
Vehicles	18 meter low-floor	9-12 meter high-floor	18 meter low-floor
Transit signal priority	Yes	No	SCATS (coordinated traffic signal system)
Real-time passenger information	Yes	No, but currently implementing	Yes
Fare collection	Pre-payment	On-board	Pre-payment, smartcard
Operation	Closed busway; New BRT company	Open busway; Existing organization and operators	Dedicated busway; Existing organization and operators
Development pattern	Secondary passenger corridors for city with TOD	Network of key urban corridors	Connects the city center and suburbs
Ownership and Financing	Shared government and BRT company	Operator responsible for maintenance, signals and stations	Government-- including construction, vehicles, ITS

3.1. Beijing

The first BRT line of its kind in Beijing and perhaps in China, known as Southern Axis BRT Line 1, began full revenue operations on December 30, 2005. BRT Line 1 is a 16.5 km (13 km of which is exclusive busway) with 19 stations linking 200,000 residents in eight residential areas and four commercial areas in the city's southern districts. It currently averages around 85,000 passengers per day, and has reportedly already carried as many as 150,000 passengers during holidays.

Beijing BRT Line 1 Articulated Vehicle and Station Infrastructure (courtesy of CSTC)

The center lane exclusive busway has some elevated intersections and a reported operating speed of 22-26 km/hr, which reduces the previous one-hour journey to 37 minutes. Level boarding platforms and multiple doors facilitate boarding and lighting at stations. Fare collection is off-board at stations that have no fare gates, but have one or more attendants controlling ticket sales and entrance. The BRT line charges a premium fare of 2 RMB (US$0.25) per trip, but 75 percent of riders use monthly passes with a discounted fare of 45 RMB (US$5.63) for a monthly pass. By comparison, the regular bus fare is 1 RMB, air-conditioned bus fare is 2 RMB while the metro is 3 RMB. A contactless smartcard system is also available.

Beijing BRT Line 1 Station at Arterial Overpass

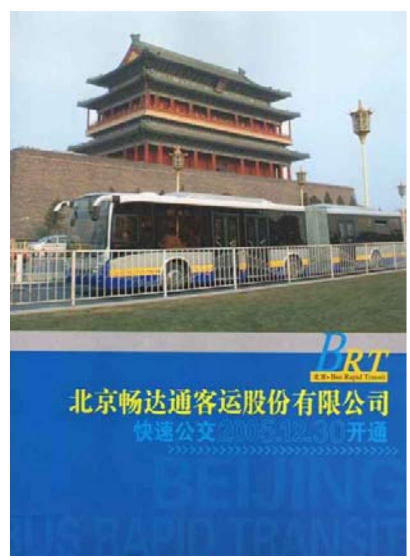
The infrastructure, including the 50 BRT vehicles associated with the project cost, about US$5 million per km. In comparison with the other BRT-type projects in China, the Beijing BRT Line 1 was more expensive per mile because of the significant roadway infrastructure and stations included (see pictures of running way and stations). According to communications with project consultants, the government funded the roadway infrastructure while the BRT operator invested in the buses, station and depots.

The new articulated BRT vehicles are from a joint IVECO-Chinese venture. Each 18-meter, low-floor bus costs about US$250,000 and includes automatic stop announcements, three double left-side doors, and air conditioning. The BRT system also includes AVL technology, transit signal priority, and video surveillance. The BRT marketing program includes brochures and signs at stations describing the operations and various systems.

Beijing BRT Line 1 Running Way and Station (courtesy of CSTC)

A new operations and management company, the Beijing BRT Company, Ltd., was formed and is owned by the state-owned Beijing General Bus Company and two private bus companies under the Beijing Transit Group (BTG). The BRT planning and implementation was completed in 18 months. Limited operations and trials began on December 25, 2004 on 5.5 km of the busway to train drivers and test system design elements such as ITS, stops, signal priority schemes and buses. The entire 16.5 km corridor started revenue service one year later.

The operator of regular bus services had planned to rationalize routes in the corridor with the opening of the BRT Line 1. Three regular bus routes were discontinued, two routes were shortened to serve as the feeder lines for the BRT service, and two routes were realigned (maintaining a terminus or stop at a BRT station) to provide bus services for adjacent areas where there were no bus services. As a result, the BRT project eliminated 300 standard buses per direction per hour in the corridor, which the operator claims was a significant savings in energy use and environment impact. However, according to ITDP (2006), there were initial problems with overcrowding in vehicles and stations during the peak hours. Because of the high ridership and lack of BRT vehicles for operations, BTG decided to restore a parallel regular bus route to reduce the demand for the BRT services and added 25 regular



Cover of Beijing BRT Informational Brochure buses (with doors on the right side) during the peak hours. According to the operator, the initial BRT ridership of 100,000 per day was reduced to an average of 85,000 per day with a peak hour rideship of about 7,500 per direction. In April 2006, 20 new BRT buses were delivered and currently 60 BRT buses are in daily operation. It is expected that the BRT corridor will serve 150,000 passengers per day by 2007.

A second BRT line, the Chaoyanglu Line, is currently under construction in Beijing's eastern districts, and two more lines cutting across the north and the west are in the planning stages to help serve the future Olympic Park area. All three lines are scheduled for completion in time for the 2008 Beijing Summer Olympics, and will extend the BRT network to about 100 kilometers. Also by 2008, the metro network will extend 186 km. By 2010, ten lines of BRT totaling 184 km are planned.

3.2. Shanghai

Shanghai's current five-year plan (2005-2010) calls for 11 lines of metro bringing the total length of its network to 400 km in anticipation of the 2010 World Expo. Even if this impressive expansion is realized, the majority passenger trips are still expected to be made by bus and taxi.

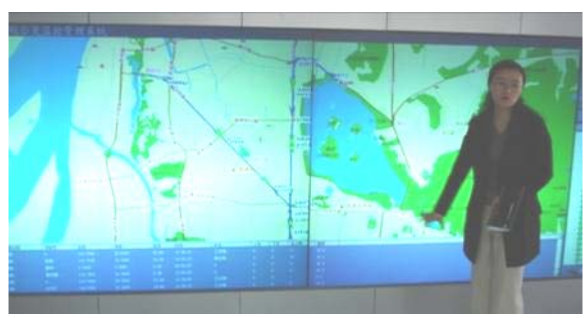
Peak Hour Bus Lanes in Shanghai

In 2002-2005, Shanghai transportation officials conducted feasibility studies and plans for BRT routes. A 250 km BRT network was proposed to connect with satellite cities and intermodal terminals. The current plan calls for 300 km of bus lanes connecting with metro stations and the implementation of other BRT elements incrementally (such as transit signal priority and passenger information systems) as they continue to expand the existing metro network.

Road space is believed to be too constrained for exclusive bus lanes in the central city. However, 26 km of peak hour bus lanes were installed in downtown in 2005. Officials reported that they increased bus speeds by 8-10%. An AVL system currently operates on 1,500 buses in some routes. A multimodal contactless smartcard is used on the metro, ferries, taxis, and most buses.

3.3. Nanjing

Nanjing transportation officials are also implementing elements of BRT incrementally to complement an ambitious 20-30 year metro expansion program. The first line of the metro recently began operating. They are currently testing AVL/CAD and passenger info systems on more than 300 buses operating on 3 routes. They are also considering upgrades to stations and intersections (i.e. transit signal priority) to increase the efficiency and capacity of bus services. Improvements to vehicles are also being made to install stop announcement systems and to replace older, diesel buses with cleaner vehicles.



Large Screen Display of Real-Time Bus Location System Being Tested in Nanjing

3.4. Kunming

Kunming launched the first modern busway in China in 1999 with technical support through a Kunming-Zurich Sister City partnership. A "Public Transport Master Plan" was also developed with Swiss assistance. The average operating speed on demonstration line increased 68% to 15 km/hr while the average passenger wait time decreased by 59%. Ridership on demonstration line increased 13% at its opening because of the improved service. The operating company was also able to reduce its fleet size by nearly half on the demonstration line.

Kunming currently has a 40 km network of 6 centerline, at-grade open busways with several private operators and low or no physical separation for most of the alignment. This network currently carries 1.2 million passengers per day and is purported to cover 75% of city center assuming a reasonable walking distance. The capital cost has average around US$0.5-0.8 million per mile because few other BRT feature has been implemented.

Kunming Busway, Station, and Typcial Vehicles

Kunming transportation officials are incrementally implementing other BRT elements to maximize the benefits of the exisiting busway network while planning to expand the network beyond the city center and into the suburbs. The plan is to upgrade facilities and modernize operations with more passenger information displays at stations and ITS.

The biggest problem according to the Kunming Urban Transport Institute is expanding the busway capacity beyond 8,000 passengers per hour per direction without increasing the already high frequency of service. The right-of-way is currently constrained by a lack of space to overtake at stations and by delays at intersections (see pictures at right). Planners are considering transit signal priority and cleaner, higher capacity vehicles to replace the regular diesel 12-meter buses in operations.

Kunming Busway Constrained Along Center of Arterial

The second biggest problem is improving the quality of services and integration with the bus network in a financially-sustainable fashion. The plan to implement a zone-based fare structure using contactless smart cards, passenger terminals, and allowing free transfers has encountered great resistance from the bus operators holding concessions to operate on the busway. Any change to the status quo is seen as a threat to the profitable business they currently operate.

3.5. Hangzhou

Hangzhou is implementing its first BRT line (B1) with 28 km of at-grade bus lanes. The first 10 kilometer, 16 station segment of line B1 began trial passenger service in late April 2006 after 16 months of planning and construction. The buses operate on a dedicated right lane of major arterial with minimal physical separation from mixed traffic only near station areas (see picture at right). The low level of segragation from the arterial roadway and the minimal road construction involved kept the capital cost of the project relatively low. The stations are located approximately 150 meters from the intersection to minimize the impact on right turning traffic. Adjacent to the bus lane and to the right of the stations are bicycle lanes. Ridership is expected to increase rapidly as the city diverts existing bus routes off the corridor used by Line B1.

BRT Vehicle and Station in Hangzhou

The service is currently operating at 3 to 4 minutes headways in the peak, although it is designed to ultimately operate at 2 minute headways in the peak. Passengers pay a premium fare for the BRT service, 4 RMB (US$0.50), which is double the fare of the regular bus. Passengers pre-pay the fare at the stations using contactless smartcards. According to project consultants, the smart card users can purchase a monthly pass to receive effectively a 50 percent discount (2 RMB or US$0.25 per trip). Regular smart car users receive a 9 percent discount for each trip. Students can purchase a monthly pass to receive a 75 percent discount (1 RMB or US$0.13 per trip). Senior citizens (60 years old or above) and disabled riders use the service without charge.

As part of the first phase of the Hangzhou BRT program, 48 new articulated buses were purchased from a Neoplan/Chinese joint venture. The 18 meter BRT bus is painted a distinct red color and is able to carry up to 160 passengers. On board the bus are video screens and passenger information signs. An AVL/CAD system enables a simple route map on-board the bus to display the location of the bus along the route (pictured at right). Hangzhou has already implemented electronic signs at 450 stops throughout the city center, 200 of which display real-time passenger information.

On-Board Route Map and Bus Location Display in Hangzhou

The government funded all infrastructure and vehicles for the first BRT line. As part of a multi-billion dollar transportation investment program, Hangzhou is currently constructing 2 additional BRT lines with 27 km of exclusive rights-of-way in some sections and traffic signal priority in other sections. By 2010 and 2020, respectively, Hangzhou plans to have 9 BRT lines (142 km network) and 11 BRT lines (165 km network). The funding of this BRT program is expected to have private sector participation although it has been publicly funded thus far. Hangzhou is also constructing a subway by 2010.

3.6. Other Cities in China

Several other cities are beginning to plan or implement BRT systems:

- **Jinan** – This city of about 3 million people is undertaking a BRT plan, which includes 6 BRT lines (135 km network) by 2010 and 12 BRT lines (208 km network) by 2020. A bus lane has been implemented while BRT is under currently construction in two major arterial corridors. (CAUPD, 2006)
- **Guangzhou** – This city of about 5 million people has been evaluating BRT corridors. ITDP has a memorandum of understanding with the Guangzhou Construction Commission to develop a detailed conceptual plan and evaluate various corridor alternatives.
- **Shenzhen** – This city of about 2 million people approved BRT plans in May 2006 according to ITDP. The first corridor, 24 km from Laojie to Xili via Sungang Road, is expected to be under construction by the end of 2006 and will be completed in 18 months. Current plans indicate that it will be a closed system with 28 stations (including 3 terminals) featuring pre-board fare collection and level boarding and alighting using 40 specialized BRT buses.

Cities in China Currently Planning or Operating BRT (Courtesy CSTC)

- **Chengdu** – This city of about 3 million people changed its original design for 28 km of elevated expressway into a full BRT in the second ring road. The proposed design includes 30 stations with two bus lanes. (S.K.J. Chang, 2005)
- **Chongqing** -- This city of over 5 million people has a preliminary plan for 15km of BRT. (S.K.J. Chang, 2005)
- **Shenyang** – This city of 5 million people has a BRT plan that includes two lines of 16 km for the first phase. (S.K.J. Chang, 2005)
- **Tianjin** -- This city of over 5 million people plans a BRT network of 145 km.
- **Xi'an** – This city of over 3 million people plans a BRT network of 48 km and is undertaking preliminary designs. (S.K.J. Chang, 2005)

According to CAUPD (2006), BRT is also planned or proposed in:

- Fuzhou
- Hefei
- Qingdao
- Shijiazhuang
- Suzhou
- Wuhan
- Zhengzhou

4. Key Findings

The BRT market in China is in a nascent state but has the potential to revolutionize urban public transportation in many Chinese cities within a decade's time. There is already significant BRT activity in more than a dozen Chinese cities, which are good laboratories for research for several reasons:

- Transit ridership is likely to grow quickly and many investments in BRT are planned. According to CAUPD, as of 2006 about 969 km of BRT in all are planned, of which 137 km are under construction now and another 39 km will be under construction soon.
- Because of the local nature of BRT planning, there are a variety of approaches being pursued in China which have similarities to the approaches in American cities:
    - The approach in certain cities has been to develop BRT elements incrementally by enhancing existing bus services (e.g., Nanjing, Shanghai) even as rail infrastructure is expanded.
    - In Kunming, where light rail was deemed too expensive, an low-cost, open network of BRT is operating and there are plans to upgrade the technology and vehicles to increase capacity.
    - Other cities have implemented new BRT lines as a closed system including several elements (running ways, stations, vehicles, ITS, fare collection, and service plans) and a goal of achieving most of the benefits upfront. In Beijing and Hangzhou, the planned BRT lines are intended to complement expanding rail networks.
    - The approach to BRT planning in the US is similar with respect to an integrated system of elements, each with different performance and benefits and no one solution appropriate for every corridor. Moreover, BRT terminology is being harmonized into a common language as Chinese transportation planners gain familiarity with US and international guidance documents and emerging standards for BRT. Interestingly, the English term "BRT" appears to have been adopted in several cities including Beijing and Hangzhou.
- Chinese cities face similar urban transportation problems to the US, albeit at different levels of intensity and with slightly different causes resulting in differing priorities and responses. Among the problems are traffic congestion, poor air quality, and energy efficiency and security. Like in the US, BRT systems in the largest cities are viewed as complementary to urban rail transportation plans. Being mindful of the significant differences in the decision-making processes and what is considered standard practice, there are also similar challenges to BRT development in the US and China. According to CSTS, the challenges to BRT development in China include:
    - Political will
    - Requires significant interaction
    - New approaches to organizational structure
    - New skills and training
    - Focus on desired outcomes
- The development time for BRT and its impacts in Chinese cities is compressed. For a variety of reasons, the typical implementation of BRT from planning to opening is less than 2 years. Moreover, the impacts of BRT projects on land use, economic development, and environmental quality may be observable over a much shorter time period compared to the US because of the remarkable economic growth and demographic changes taking place in many Chinese cities.

As a result, it may be an opportune time to pursue the formal or informal exchange of data and knowledge consistent with high-level policy efforts for greater cooperation between the countries. At a more practical level, there is the possibility of greatly enhancing the BRT data set for the purpose of creating or updating future guidance documents, such as the "Characteristics of Bus Rapid Transit for Decision-Making (CBRT)," using:

- Ongoing communications with Chinese researchers and planner
- Future meetings and workshops
- Before/after BRT studies planned by CAUPD in Beijing and other cities
- Common research programs, such as Energy Foundation's China Sustainable Energy Program (CSEP) alternative fuels program

5. Recommended Next Steps

The recommendations for next steps are of three types: opportunities for data and knowledge exchange, areas of potential contribution, and agreements for further collaboration.

5.1. Exchange of Data and Knowledge

The type of BRT-related data that may be sought from Chinese cities includes performance, costs and benefits as defined in the CBRT. The following are observations about the availability and suitability of each type of data for the update of CBRT:

- Performance
  - Travel time (savings and reliability) – some data readily available from Beijing, Kunming, Hangzhou and other cities as more BRT systems come on line
  - Identity and image (customer satisfaction, awareness surveys) – wide survey data may not be available
  - Safety and security (accidents and incidents) – wide survey data may not be available
  - System capacity – some data readily available from Beijing, Kunming, Hangzhou and other cities as more BRT systems come on line
- Project Costs and Benefits
  - Ridership – some data readily available from Beijing, Kunming, Hangzhou although it is still stabilizing for the newer BRT systems
  - Capital cost effectiveness – detailed cost data may be difficult to collect, some studies have already publish basic cost data (e.g., Hook et al., 2006)
  - Operating cost efficiency – detailed cost data may be difficult to collect
- External Benefits
  - Environmental quality – may be possible to collect data on emissions savings and improvements to air quality at the city or corridor level
  - Transit-supportive land use and economic development – may be possible to collect data at the BRT corridor level

There are additional topics and questions that are worth further investigation, for example:

- The integration of BRT services with other modes — Of particular interest is the compatibility of BRT with non-motorized modes. Bicycles trips still account for a large share of passenger transport in China and in some cases have to share road space with other modes.
- The development and implementation time for BRT systems — The existing systems in China suggest that faster implementation may be possible, however, a number of significant process differences must be considered when comparing this performance with the US.
- Closed versus open BRT systems with feeder services — There are advantages and disadvantages with both types of systems that tradeoff cost and flexibility of services.
- The location of stations along a corridor and in relation to intersections— US and Chinese cities have adopted a number of different approaches that may be driven by local traffic and design considerations.
- Vehicle design choices — Several Chinese cities have chosen low-floor buses (e.g., Beijing and Hangzhou) over higher capacity, high-floor buses (e.g., Curitiba) with the associated level station platforms. The decision may consider cost, accessibility and capacity considerations.
- Other reasons for differences in BRT planning approaches (i.e., rail-BRT-bus investment and operations mix) as seen in Chinese cities –- Cherry (2005) hypothesizes that “a case-based comparison offers an opportunity to sort through factors leading to different policy strategies in different Chinese cities – such as fiscal constraints, political rationales, unforeseen opportunities, or local technical capacities.”
- Emerging standards – There may be opportunities to share development costs, and lower production costs for BRT systems.

5.2. Areas of Potential Contribution

There are also research areas where the US may be able to make contributions to its counterparts in China and vice versa. These may include:

- Federal funding processes and innovative financing options—These may include selection and administration of funds (e.g. New Starts, Small Starts) and Public-Private Partnerships and Design-Build arrangements. According to Hook et al. (2006), “most major municipalities [in China] have highly qualified transportation planning and/or urban design institutes, and BRT planning can be done as part of their normal duties or as a special project.” They argue that the project cost from the government’s point of view is nominal and the use of private financing for BRT is more helpful because of the international experience in designing viable projects.
- Coordination of transportation agencies and regional planning – The United States has had decades of experience in increasing the coordination of regional and metropolitan agencies with overlapping jurisdictions.
- Technology and standards acceptance – Several organizations in the United States are working on development frameworks and standards for technologies that may impact BRT. These include effort in Vehicle Assist and Automation (VAA) technologies (for narrow lanes and shoulders, etc.), Vehicle Infrastructure Integration (VII) for mobility and safety, accessibility requirements (e.g. federal ADA requirements), and other emerging standards for BRT systems and elements.
- Network optimization – Experience in the United States is building in the use of Intelligent Transportation Systems (ITS) as applied to transit to improve capacity and operations (e.g., Transit Signal Priority). There are also technologies to improve the integration of bus, rail and BRT modes to minimize transfers and improve services.
- Demand-oriented planning – One criticism of current Chinese policy is that it favors supply-oriented transportation development strategies that overlook fundamental modes such as bus, biking, and walking (Zhang et al., 2003 as cited in Cherry 2005). Many cities in the US have significant experience planning transit services for low-demand environments and for socially desirable services to urban poor and disabled.

5.3. Agreements for Further Cooperation

Several agreements already exist between US and Chinese organizations to facilitate cooperation in research. New agreements are also being developed related to transportation and transit research. The following is a brief, non-exhaustive summary of some of these cooperative agreements:

- The organizations representing the transit industry in the US and China respectively, the American Public Transportation Association (APTA) and China Urban Public Transport Association (CUPTA), signed an agreement in April 2006 that will facilitate cooperation between the organizations. In particular, CUPTA is forming new committees on ITS and BRT by the end of 2006. The formation of these committees presents an opportunity for cooperation with American counterparts within APTA and other organizations.
- As of May 2006, FTA was negotiating an agreement with Chinese Ministry of Construction to facilitate cooperation through joint meetings, research programs, and staff training. The FTA is already aware that China has an ambitious goal of putting 20,000 fuel cell buses in operation by 2020 in the largest ten cities. The Chinese Ministry of Science and Technology (MOST) is the agency responsible for the advanced vehicle technology research and development, including hybrid electric, hydrogen and fuel cell buses. As of April 2006, MOST and the FTA are discussing collaboration on research programs. China also has great interest in hydrogen internal combustion engine technology including hydrogen-CNG blends. Tsinghua University in Beijing leads research efforts in fuel cell buses. China also received UNDP-GEF funds to implement fuel cell buses in Shanghai for the 2010 World Expo. There are also opportunities for

demonstration and deployment of clean and energy efficient buses for the 2008 Olympics in Beijing.[5]

- USF-CUTR is moving forward with a contractual agreement with Veolia Transportation regarding a package of activities that will include management training for Veolia transportation managers, technical support activities, and sponsorship of Chinese students to train at USF.
- A 2004 agreement between the State Environmental Protection Administration of the People's Republic of China and the U.S. Environmental Protection Agency has resulted in a Strategy for Clean Air and Energy Cooperation.[6] This agreement serves as the framework for joint objectives and activities in the areas of air quality management, public health, clean energy and transportation.
- Memoranda of understanding may also be used to facilitate cooperation and joint research. For example, a 2003 study on "Personal Cars and China" was the outcome of collaboration between the U.S. National Research Council and the Chinese Academy of Engineering, which had signed a Memorandum of Understanding in 1999 to facilitate cooperation and joint research.[7]
- Both the US and China are also parties to the Asia-Pacific Partnership on Clean Development and Climate which includes joint research into advanced transportation technologies (e.g. vehicles, ITS) and alternative fuels.[8]

[5] Based on personal communications with the FTA project manager in April 2006.
[6] For more information, the reader is referred to: http://www.epa.gov/oia/regions/Asia/china/2004_sca_eng.pdf
[7] For more information, the reader is referred to: http://darwin.nap.edu/books/030908492X/html/219.html
[8] For more information, the reader is referred to: http://www.state.gov/g/oes/rls/fs/50314.htm

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- Energy Foundation and China Sustainable Transportation Center (CSTC) staff in the San Francisco and Beijing offices
- WRI/Embarq staff in Washington, DC
- Breakthrough Technologies staff in Washington, DC
- CUTR/National BRT Institute staff in Tampa, FL

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7. References

Chang, S.K.J. “BRT Developments in China: Presentation to the Pre-Conference Workshop”, Environment 2005 Conference on Sustainable Transport and Cities: Improving Transit Systems, January 29, 2005.

Cherry, Chris. “China’s Urban Transportation System: Issues and Policies Facing Cities” UC Berkeley Center for Future Urban Transport, Working Paper, April 2005.

China Academy of Urban Planning and Design. “BRT Development in China,” Presentation given on April 18, 2006.

Jin, Fan (China Sustainable Transportation Center). “Bus Rapid Transit (BRT) Development in China’s Cities,” Presentation given on April 18, 2006.

Fjellstrom, Karl. “BRT in Hangzhou and Beijing.” ITDP Sustainable Transport e-Update, April 2006.

Fjellstrom, Karl. “BRT Poised for Take-off in China.” ITDP *Sustainable Transport* Magazine, Winter 2005.

Gakenheimer, Ralph. “Motorization and Urban Decentralization in China.” Presentation given at the Embarq Conference on Transforming Transportation: New Visions in China, January 13, 2004.

Gallagher, K. “Car Wreck? Reconciling Economic Development, Environmental Quality, and Oil Security in China.” Presentation given at the Embarq Conference on Transforming Transportation: New Visions in China, January 13, 2004.

International Energy Agency (IEA), “World Energy Outlook.” 2004.

Hook, Walter, Karl Fjellstrom and Oscar Diaz. “Options for Financing Bus Rapid Transit in China,” ITDP, May 2006.

Kunming Urban Transport Institute, “Practice, Review, and Strategy BRT Development in Kunming,” Presentation given on April 22, 2006.

Ministry of Construction (MOC) of China. Presentation to the FTA Public Transportation Trade Mission, April 17, 2006.

Ministry of Construction (MOC) of China. "Recommendations on Prioritizing the Development of Urban Public Transport" (No. 38), 2004.

U.S. National Research Council (NRC) and the Chinese Academy of Engineering (CAE). “Personal Cars and China,” 2003.

Schipper, Lee and Wei-Shiuen Ng. “China Motorization Trends: Policy Options in a World of Transport Challenges.” Chapter 4 of *Growing in the Greenhouse: Policies and Measures for Sustainable Development while Protecting the Climate,* 2005.

Schipper, Lee. “Opening Remarks to Transforming Transportation: New Visions in China”, Presentation, January 13, 2004.

Zhong-Ren Peng, “Urban Transportation Development Strategies in China and Their Impacts on the Poor,” June 2005, Presentation downloaded from: http://mit.edu/dusp/chinaplanning/cpn2005/presentations/pdf/Zhongren%20Peng.pdf

Appendices

A. Itinerary of Visit and Meetings in China in April 2006

B. Organizations and Contacts in China

C. China Academy of Urban Planning and Design. “BRT Development in China,” Presentation given on April 18, 2006 (originally in Chinese)

D. Kunming Urban Transport Institute, “Practice, Review, and Strategy BRT Development in Kunming,” Presentation by given on April 22, 2006

Appendix A: Itinerary of Visit and Meetings in China in April 2006

April 17, 2006: Beijing

- Meeting with US Commercial Service Officers
- Meeting with Chinese Ministry of Construction and Signing of APTA-CUPTA Memorandum of Understanding
- Meeting with Beijing Municipal Committee of Communications
- Site visit to BRT Line 1, city Light Rail #13, and control and dispatch center
- Reception which included informal meetings with university researchers and municipal planners

April 18, 2006: Beijing

- Meeting at Energy Foundation and China Sustainable Transportation Center (CSTC)
- Meeting at China Academy of Urban Planning and Design (CAUPD), Urban Transportation Institute
- Travel to Nanjiing

April 19, 2006: Nanjing

- Meeting with US Commercial Service Officers
- Site visit to Nanjing Metro, Bus, Headquarters and Automated Operations and Control Center
- Site visit to 2nd Nanjing Yangtze River Bridge Administration Center
- Meeting with Nanjing Municipal Construction Committee
- Reception which included informal meetings with university researchers and municipal planners

April 20, 2006: Shanghai

- Travel to Shanghai
- Meeting with US Commercial and Foreign Service Officers
- Meeting with Shanghai Municipal Urban Transport Bureau and Municipal Construction and Transportation Commission
- Site visit to Long Distance Bus Company Control Center

April 21, 2006: Shanghai

- Site visit to Shanghai Maglev Train
- Site visit to Shanghai downtown bus facilities
- Reception which included informal meetings with university researchers and municipal planners

April 22-23, 2006: Shanghai and Kunming

- Travel to Kunming
- Meeting and presentations with Kunming Urban Transport Institute
- Site visit of Kunming Busway Network
- Reception with municipal BRT planners
- Travel to Hangzhou

April 24-25, 2006: Hangzhou

- Meeting with US Commercial Service Officers
- Meetings with Hangzhou Municipal Communications Bureau and Construction Commission, Hangzhou BRT Operator, and Hangzhou Transportation Research Center
- Site visit to Hangzhou BRT Line B1

April 26, 2006: Return to United States

Appendix B: Organizations and Contacts in China

Organizations	Persons Met	Primary Contact or For More Information
Chinese Ministry of Construction (MOC), Division of Transit/Transport	Ms. Lan Rong, Director and Senior Engineer Division of Transport/Transit Department of Urban Development	
China Urban Public Transport Association (CUPTA) in Beijing	Mr. Zhu Ying, Secretary General	Mr. He Qing, Foreign Affairs Liaison Office Director qhe@sohu.com
Beijing Municipal Committee of Communications	Mr. Li Xiaosong, Vice Director	
China Academy of Urban Planning and Design (CAUPD), Urban Transportation Institute in Beijing	Mr. Zhao Jie, Vice Director, Professor, Senior Engineer Mr. Sheng Zhiqian, Master Engineer	Ms. Ye Min, Engineer yem@caupd.com http://www.chinautc.com
Beijing Transportation Research Center	Mr. Guo Jifu, Deputy Director and Professor	guojf@bjtrc.org.cn http://www.bjtrc.org.cn
Beijing Public Transport Holdings, Ltd.	Wang Xinsheng, Vice General Manager	http://www.bjbus.com
Beijing University of Technology	Mr. Xiao Kuan Yang, PhD, Professor	xiaokuan@bjut.edu.cn
Energy Foundation and China Sustainable Transportation Center (CSTC) in Beijing	Mr. Jin Fan, CSTC Executive Director Mr. Dongquan He, PhD, China Sustainable Energy Program Officer for Transportation Mr. Liu Daizong, Senior Engineer Mr. Huiming Gong, Assistant Program Officer	Mr. Jin Fan, fanjin@chinastc.org http://www.chinastc.org http://www.efchina.org
Nanjing Institute of City Transport Planning and Southeast University	Mr. Yang Tao, PhD, Professor and Institute Director Mr. Guo Xiucheng, PhD Mr. Wan Shiu, PhD	yangtao@nictp.com
Nanjing Municipal Construction Committee	Lu Pinggui, Director	
Nanjing Public Transport General Corporation	Li Xun Kang, Vice General Manager	
Shanghai Municipal Urban Transport Bureau	Zhang Lin, Vice Director, Senior Engineer Yin Quia Xian, Sector Chief Researcher, Senior Economic Manager	
Shanghai Municipal Construction and Transportation Commission	Ms. Helen Yang, Program Official	hyyang@jsw.shanghai.gov.cn
Ba-Shi Group of Shanghai	Li Ming, Vice President	

Organizations	Persons Met	Primary Contact or For More Information
Kunming Urban Transport Institute	Mr. Lin Wei, Director, Senior Engineer and Registered Planner Mr. Tang Chong, Deputy Director, Senior Engineer Ms. Zhang Yan, Transport Engineer	kmuti@vip.km169.net
Hangzhou Municipal Communications Bureau	Fan Jian Jun, Vice Chief	
Hangzhou Municipal Construction Commission	Susan Wang, Vice Chief of Planning and Financial Department	wangwenshuo@sohu.com
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Hangzhou Public Transport Group, Ltd.	Jiang Tian Rong, General Manager	Jin Ling, Vice Chief Engineer hzjinling@163.com

Appendix C

中国快速公交发展现状
BRT Development in China

中国城市规划设计研究院
China Academy of Urban Planning and Design
April 2006

Background

- Current transit service needs to be improved to satisfy various, high-quality transportation demand of modern urban residents
- BRT is an environmentally-friendly, cost-effective option to increase public transit ridership and develop desirable mode choice for urban residents based on the constrained funding and limited time framework
- By combining the urban public transit system with the urban land use, the BRT reduces the travel demand, modifies the mode choice, and implements a reasonable urban developing model. It is one of the most important methods to reduce the urban congestion.

Overview

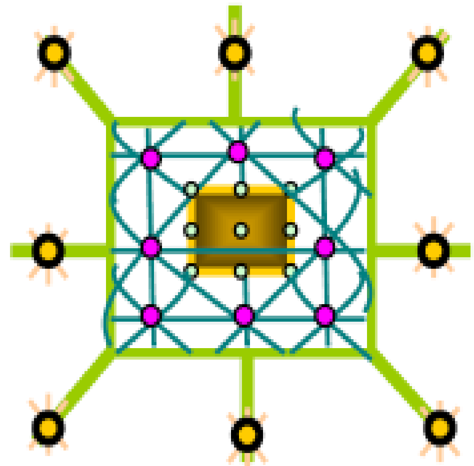
- **Operation Phase**
  - Beijing City-South Axis Road BRT
    - Initially tested and operated in December 2004
    - In full operation since December 2005
- **Construction Phase**
  - Kunming City
    - Cooperated with Zurich, center lane exclusive transit ROW network was established in 1994
    - The network is now being upgraded to BRT system
  - Hangzhou City
    - BRT No. 1 was planned and constructed in January 2005, and scheduled to serve the public in April 2006
  - Jinan City
    - Started to plan and construct first BRT in March 2005
- **Planning Phase**
  - The special study of BRT planning is being conducted in 17 cities including Qingdao, Shenyang, Xiamen, Xi'an, Chongqing, Suzhou, Wuhan, Guangzhou, Shenzhen, Hefei, Tianjin, Taiyuan, Haikou, Fuzhou, Zhengzhou, and Nanjing.
- **Forum and Seminars**
  - Forum and seminars were hosted to discuss the promotion of BRT in China from different perspectives

Beijing BRT

- "Beijing Transportation Development Strategy (2004-2020)"
- BRT Function Definition
  - **Inner central city areas**
    - Focus on the developing of subway and surface public transit system
  - **All other inner central city areas**
    - Focus on the developing of rail and high-speed, high-capacity public transit system
  - **Suburb areas**
    - While the priority will be given to the development of public transit network, a relatively less constrained environment will be provided to private vehicles

Beijing BRT

- Principles of Beijing BRT Network Planning
  - 3-layer hub
  - 2-level corridor
  - Outskirt corridor: Axis-emission
  - Urban area corridor: Construct the network structure around the hubs

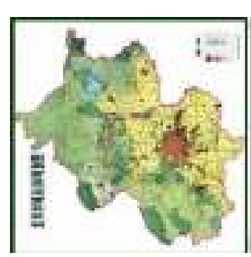


Beijing BRT

Outskirt Corridors

Current Ridership

No.	Transit Lines	Passenger/Hour
1	23	7900
2	24	7500
3	/	/
4	20	4040
5	16	4200
6	15	3100
7	20	9700
8	/	/
9	/	/



Beijing BRT

Urban Area Corridors-Long Term 2020

No.	Length (km)
1	40.7(16.3)
2	19.2
3	15.8
4	15.6
5	16.5
6	32.5
7	25.1
8	10.9
9	17.9
10	14.7
11	13.1
12	14.1
13	37.6
14	8.9
15	14.6
16	12.4
17	6.8
18	6.4
Total: 322.7km	

Beijing BRT

Urban Area Corridors-Short Term 2010

Short-Term 10 Corridors

- South Axis 6.5km
- Chaoyan Road 19.2km
- Anti Road 15.8km
- West Huanpin Road 15.6km
- Fushi Road 16.5km
- Lianguan Road 32.5km
- Zhanlan Road 25.1km
- Wangjing 10.9km
- Shangdi 17.9km
- North Feng Road 14.7km

Total: 184.km

Beijing Southern Axis BRT

- Through three districts
- Total length: 16.5 km
- Total number of stations: 19
- Number of stations in full operation: 17

Beijing BRT System: Proposal 1

- Maximum speed (Fully loaded): 80km/hour
- Engine: clean fuel meeting the EURO2 requirements
- Capacity
  - Single bus: >85 passengers
  - Articulated Bus: >200 passengers
- Characteristics: Serve as role model, fully-equipped

Technical Characteristics-South Axis BRT

- Center Lane: Exclusive Right-of-Way with stations to allow passing
- Vehicles: articulated buses with doors opening on the left side, low-floor passenger deck
- Stations: semi-closed, semi elevated platform, level boarding, tickets sold on surface
- Control: signal priority, intelligent control and dispatch
- Fares: uniform fare, monthly fare pass, no discount for transfer
- Average distance between two stations: 1220m

South Axis BRT:

Pictures of full operation on December 30, 2005 at 4:55 am

Current Situation

- BRT System Components
  - High-capacity vehicles
  - Exclusive ROW
  - Level boarding
  - Signal priority
  - Tickets sold on surface
- Operation
  - Headway: 2 minutes
  - Daily passengers: 100, 000
  - Peak hour passengers: >10, 000
  - Average speed: 22-26km/hour
  - Travel time each round: 38-45 minutes

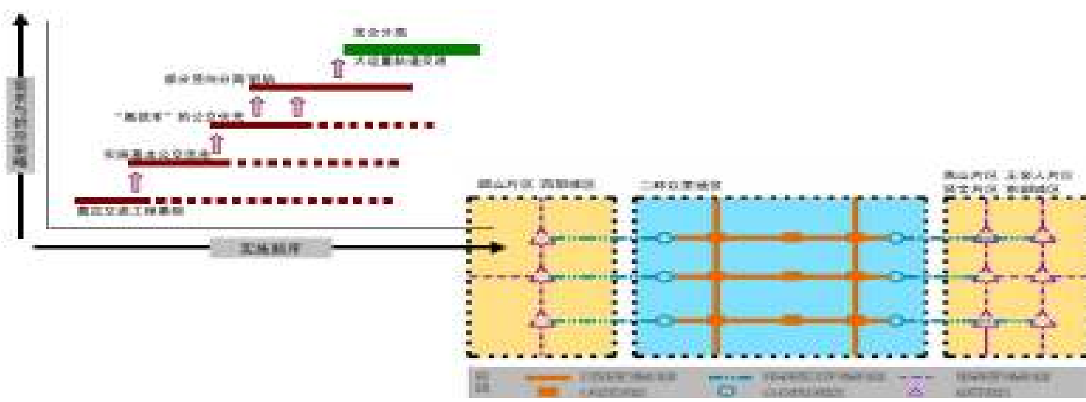
Jinan BRT

- Transportation Development Strategy - BRT positioning in Jinan, Shandong Province
  - Public transit development strategy:
    - Short term: focus on BRT
    - Long term: considering rail transit system
  - BRT network will be ribbon-shaped based on passengers flow corridors, compatible with city pattern
  - Substitution model

Jinan BRT

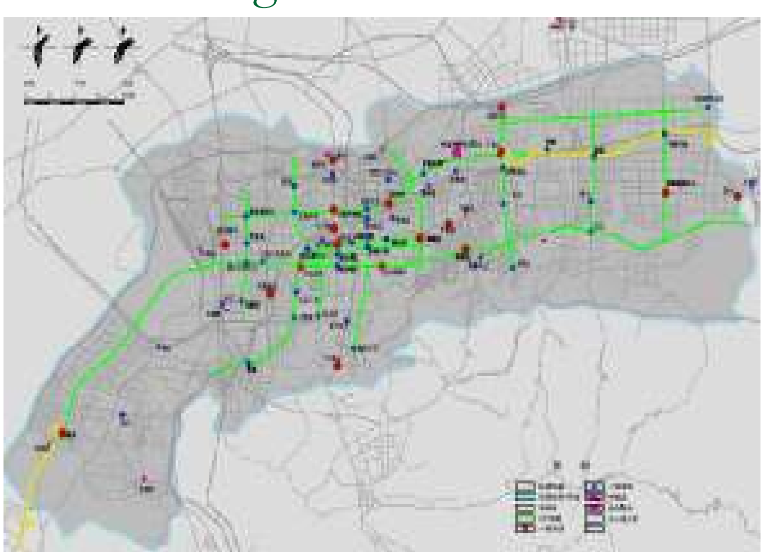
BRT Network Planning Principles

- BRT updating strategy:
  - Two categories of corridors:
    - Supporting passenger flow corridor
    - Leading passenger flow corridor
  - 3-layer hub:
    - old urban area, new urban area, and in-between



Jinan BRT

Long-term Corridors

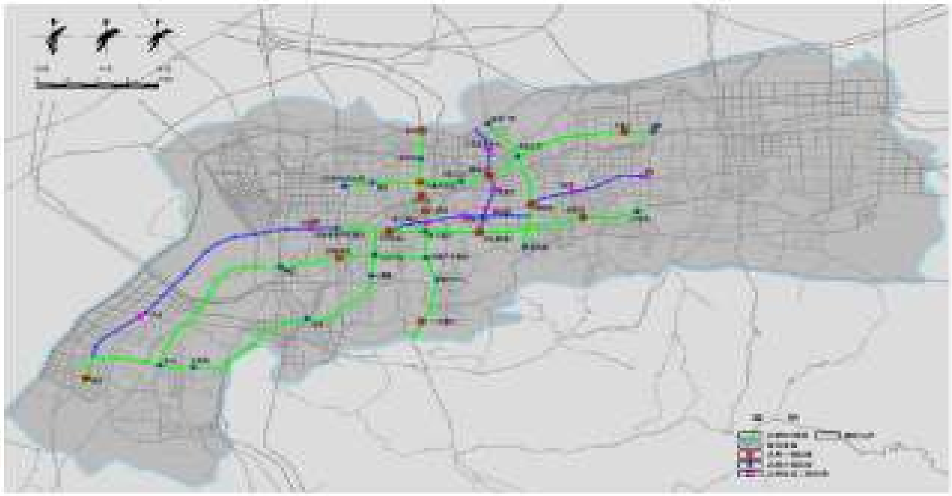


Proposed to build 12 BRT lines by 2020 with total length of 208km

Corridor location	Length (km)
West-East	
Beiyuan Street	27.5
Jinsi Road	22.9
Jinqi Road	10.9
Jinshi Road	62.4
Jinanbeizhan	16.8
Nashan	9.1
Subtotal	140.5
South-North	
Weishie Route	12.1
Xungen Road	6.8
Efandong Road	9.5
Lizhiyuan Road	11.4
Tongzhi	8.3
Dongbu	10
Subtotal	67.2
Total	207.7

Jinan BRT

Short-term Corridors



By 2010, 6 BRT lines are proposed to be built, with a total length of 135km

Beiyuan BRT-Jinan City

Beiyuan Street is the portal of CBD from northern Jinan

Beiyuan BRT is proposed to be 12 km with 20 stations (average distance between two stations of 608m)

No.	Station Location	Station Name	Distance Between 2 stations (Meter)
1	K0+200	XiwanhanDongkou (Transfer)	
2	K0+975	JiqilouXikou (Regular)	775
3	K1+600	HuanganglouXikou (Transfer)	625
4	K2+200	Jiaojuanguihua Road (Regular)	600
5	K2+725	WuyinshanxiluXikou (Regular)	525
6	K3+325	WuyinshanXikou (Regular)	600
7	K3+950	WuyinshandongluXikou (Regular)	625
8	K4+760	JiqilouXikou (Transfer)	810
9	K5+325	DonggongshanXikou (Regular)	565
10	K6+075	SankongqiaoDongkou (Regular)	750
11	K6+725	ShenchanluXikou (Regular)	650
12	K7+175	BeiguanBeilukou (Regular)	450
13	K7+750	ShuitongluXikou (Regular)	575
14	K8+400	LihuanluDongkou (Regular)	650
15	K8+850	Guihua Road (Regular)	450
16	K9+300	LishanluXikou (Transfer)	450
17	K9+925	ChezhanBeijie (Regular)	625
18	K10+450	Guihua Road (Regular)	525
19	K11+150	YaotoudagouDongkou (Regular)	700
20	K11+750	DonwanhuanXikou (Transfer)	600
Total			11550
Average			608

Beiyuan BRT Under Construction: Phase I

• Leadership: the city party committee and government organizations BRT construction Steering Group, located in the Office of Project Construction

• Committee Design Team: Integrated Group, established planning of groups such as the Business Policy Group, Traffic Management Group

Hangzhou BRT

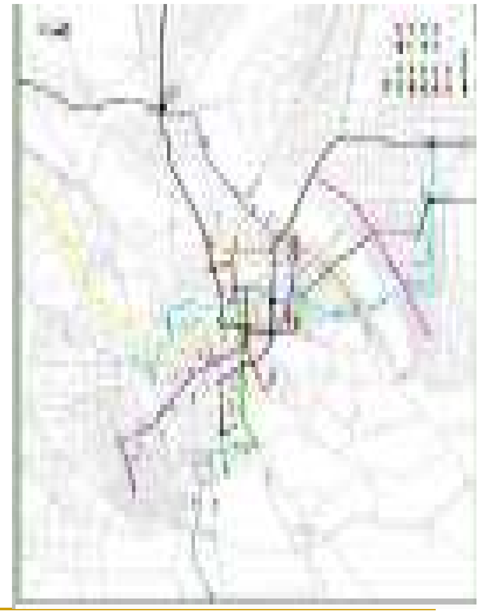
- Hangzhou Transportation Development Strategy - BRT Function Definition
  - Establish public transport priority in urban areas
  - BRT is considered as an effective way to solve urban transportation problems

Hangzhou BRT

- Propose to
  - Build 11 BRT lines by 2020 with total length of 165km
  - Build 9 BRT lines by 2010 with total length of 142km
  - Build 3 BRT lines by 2006 with total length of 55km

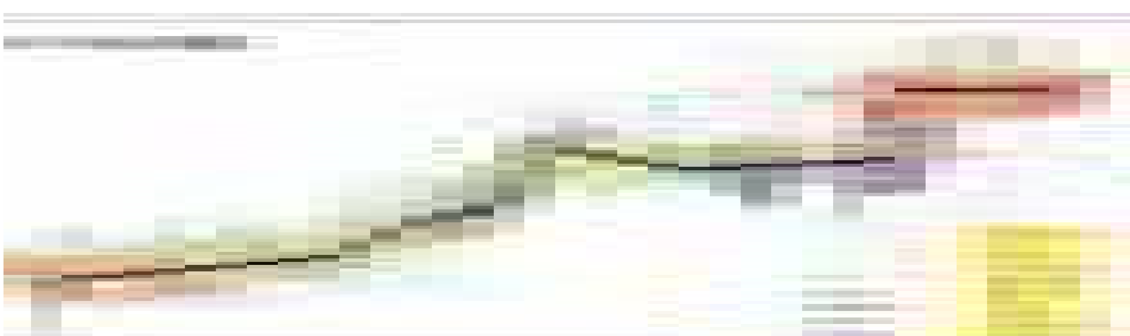
BRT network 2003

BRT network 2010



Hangzhou BRT -Line 1

- Total length: 28km
- Number of stations (proposed): 19



Hangzhou BRT-Line 1

- Besides the starting and end stations, 5 transfer hubs planned to be built

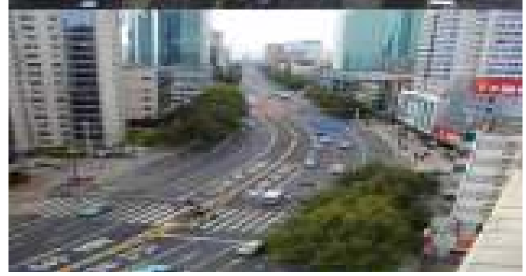
Kunming Bus Way System

- The cooperation with Zurich public transit agency beginning in 1994, established the Kunming urban transportation planning policy of "Public transit priority"
- In 1999, the first bus way was established on Beijing Road
- Kunming bus way system is proposed to be
  - shaped like #
  - with total length of 40km
  - provides high-quality public transportation services for 75% of the urban area
  - four major components:
    - Beijing Road: 5km
    - Rinmin Road: 4.6km
    - Jinbi Road: 9.9km
    - Xichang Road: 3.3km

Kunming Bus Way System

-Technique Characteristics

- Exclusive Busway lanes: Two-way, two-lane; no passing lane; part of the bus way dedicated lanes are separated from other regular traffic lanes by 5cm low solid separator
- Stations: Spacious stations with size of 65m*3.5m; not enclosed;
- Ticketing and fare collection: Inside-vehicle ticketing; coin and IC card accepted; uniform fare; no discount for transfer
- Vehicles: Majority of vehicles are Yangzhou made IVECO (9m or 12m in length), in good condition
- Other characteristics: No integrated network, all other transit bus can use the exclusive lanes; besides the station name plate, no other services or electronic screen reporting equipment in station

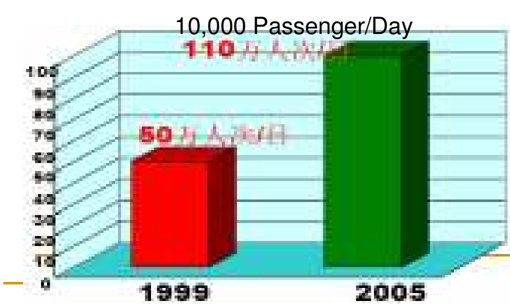


Kuming Bus Way System

-Performance Evaluation

Major Achievements

- The capacity of transit exclusive lane has been increased by around 50%; up to 8000 passenger trip one way per lane per hour
- Traffic speed of transit exclusive lanes increased to 15.2 km/hour from 9.6 km/hour
- Collection time at central area stations has been reduced from 56 seconds to 23 seconds
- Public support ratio increased to 96 % in 2002 from 78% in 1999
- Daily ridership of the urban public transit has increased from 500,000 unlinked passenger trips in 1999 to 1, 100, 000 passenger trips in 2005



Overview of BRT

BRT Development in China Summary

No.	City	Proposed Network (in km)	Under-Construction	Constructed	Comment
1	Beijing	323	87.8	16.5	________
2	Kuming	40		22.8	System updating
3	Jinan	208	21.5		________
4	Hangzhou	165	28		
5	Chengdu	155			
6	Xi'an	78			
Total		969	137.3	39.3	

- BRT is proposed in 12 other cities, include Guangzhou, Qingdao, Shenyang, Xiamen, Chongqing, Suzhou, Shenzhen, Hefei, Tianjin, Taiyuan, Haikou, Fuzhou, Zhengzhou, and Nanjing. Among which Guangzhou is in the phase of expert evaluation

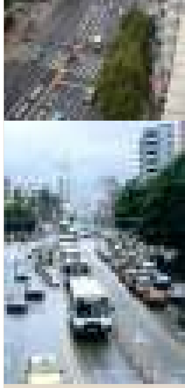
Overview of BRT Technique Characteristics

Characteristics\City	Beijing	Kunming	Jinan	Hangzhou
Location of Bus Way Lanes	Central, separated, passing lanes at station	Central, separated by 5cm solid separator, no passing lanes at stations	Central, separated, passing lanes at stations	Outer, separated, with passing lanes at stations
Width of Bus Way Lanes (meter)	3.5	3.2	3.5	3.5
Vehicle	18m in length, door open at left side, low-deck	9-12m in length, door open at right side with steps	18m in length, door open at left side, low-deck	18m in length, door open at left side, low-deck
Station	Semi-closed, side or island-form	not closed, side-form	semi-closed, side-form	semi-closed, side-form
Signal Priority	Yes	No	Yes	SCATS
Real-time Information Service	Yes	No	Yes	Yes
Fare	Uniform, monthly fare certificate valid	Uniform, monthly fare certificate not valid	Uniform, monthly fare certificate not valid, discount for IC (smartcard) card and transfer	Uniform, monthly fare certificate not valid, discount for IC (smartcard) card
Operation Agency	Newly established BRT Operation Company	Existing transit operation company	Newly established BRT Operation Company-Joint Venture	Existing transit operation company
Rapid Transit Development Model	Urban non-key passenger flow corridors and TOD	Urban key passenger flow corridors	Urban key passenger flow corridors and TOD	Connection between the suburb and CBD
BRT Financing	Government responsible for underground facilities, the operating company for surface facilities	Transit company responsible for surface marks, signal adjustment, and stations	Government responsible for surface and underground construction, the rest (construction and ITS) by the joint venture	100% financed by government including construction, vehicles, and ITS

BRT Development in China-Summary

- Still at the initial exploration stage of promoting BRT systems
- Many positive outcomes have been achieved, including
  - Function definition
  - Technical standard
  - Financing precedents
- Policy orientation is needed for further development

Thank You!



Appendix D

昆 明 快 速 公 交

—— 实践、反思和发展策略

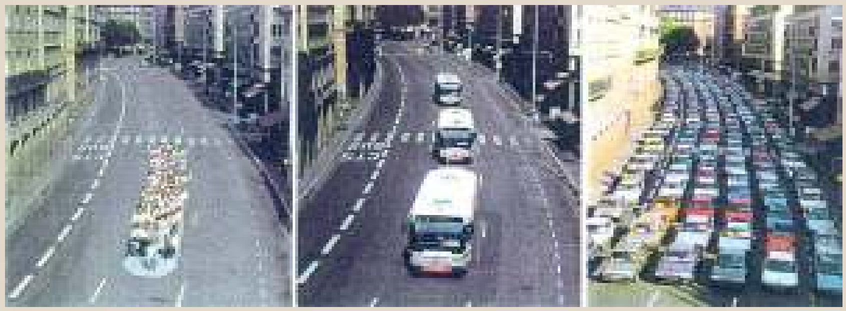
Practice, Review, and Strategy
BRT Development in Kunming

交通拥挤困扰现代大城市，解决交通矛盾已成为城市政府当前的一项首要任务。

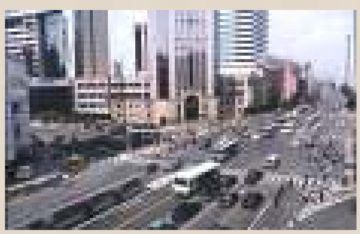
Solving traffic problems is the one of the most arduous tasks for city governments currently.

The Public Transport (PT) Planning Project between Kunming and Zurich started in 1994 and initiated "Public Transport Priority" as a principal policy for urban transport development in Kunming.

1994年开始的昆明与苏黎世公共交通规划合作，奠定了昆明"公交优先"的城市交通发展政策。



北京路/ **Beijing Rd.**



人民路/ **Renmin Rd.**

金碧路/ **Jinbi Rd.**

1999年，昆明开通中国首条现代公交专用道，随后又建成**2**条专用道。

Kunming launched the first modern bus lane in China in 1999 and two additional bus corridors have been built.

可持续城市能源发展国际市长论坛 10-11 Nov.2004, Kunming

公交专用道/**Bus lane**

BRT

BRT是有效解决城市交通矛盾的先进技术

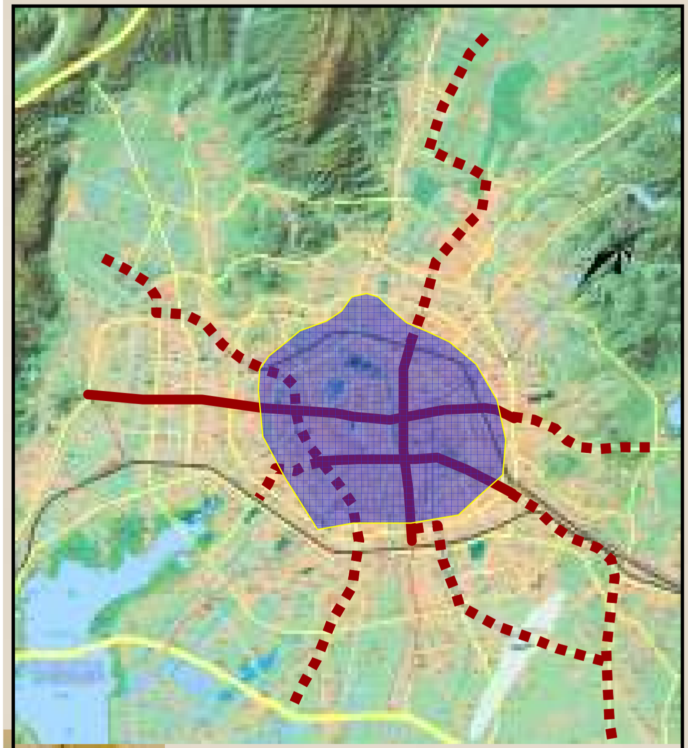
BRT is a new efficient solution to urban transportation issues.

昆明期望通过努力，建设现代**BRT**系统

Kunming hopes to build a demonstration BRT system in China through our concerted efforts.

一、昆明快速BRT的实践

I. BRT in Kunming



1、规划建设情况

❑总长约70KM的“井”字型公交专用道路网规划

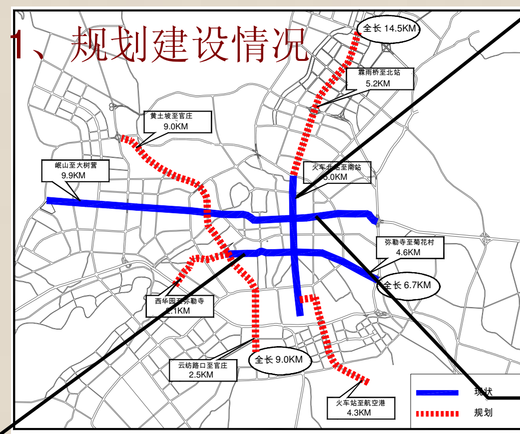
❑ 为城市中心区75%以上地区提供高品质的公共交通服务

1、Planning & Construction of Bus lanes

❑ **40 km of bus lanes planned in # shape.**

❑ **75% service coverage rate of BRT in city center.**

1、规划建设情况



北京路专用道/ **Beijing Road**

长度/ **Length：5km**

建成日期/ **Date：1994.4**

单位造价/ **Unit cost :**

RMB 1,400,000/km

人民路专用道

Renmin Road

长度

Length：9.9km

建成日期

Date：2002.7

单位造价/ **Unit cost :**

RMB 3,950,000/km

金碧路专用道/ **Jinbi Road**

长度/ **Length：4.6km**

建成日期/ **Date：2003.8**

单位造价/ **Unit cost :**

RMB 5,000,000/km

西昌路

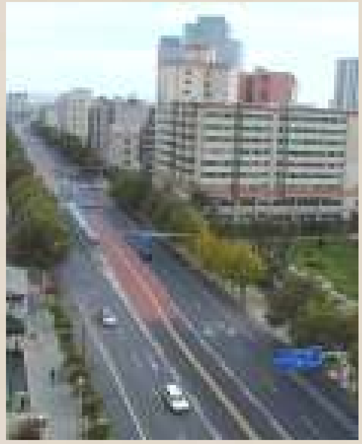
Xichang Road

Length：6.7km

Date：2005

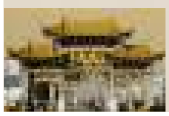
一、昆明快速BRT的实践　　I. BRT in Kunming

1、规划建设情况
Planning and Construction



昆明公交专用道主要技术特点
Main features of bus lane design

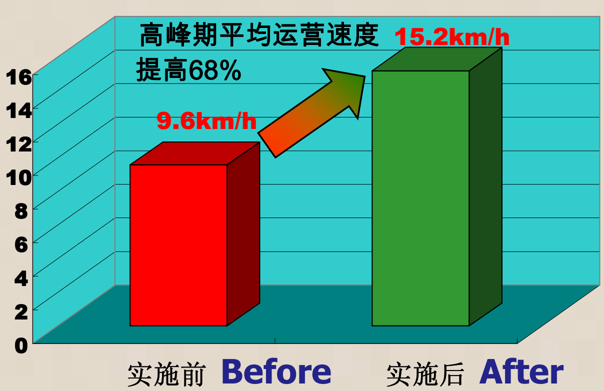
- ❑内侧式公交专用车道
- ❑ **Center bus lanes**
- ❑站台设在交叉口
- ❑ **Bus stops at intersections**
- ❑宽大式站台
- ❑ **Wide platforms**



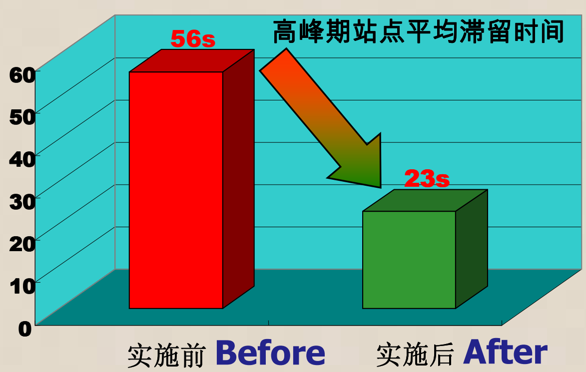
一、昆明快速BRT的实践　　I. BRT in Kunming

2、实施效果　Results

- 中心区公交专用道车速，由9.6KM/h提高到15.2KM/h
- **Bus speed in bus lane improved from 9.6KM/h to 15.2KM/h in downtown area**
- 中心区公交站点停靠时间，由56秒下降到23秒
- **Average wait time in downtown platforms decreased from 56s to 23s**



Average bus speed in peak hours on Beijing Rd.



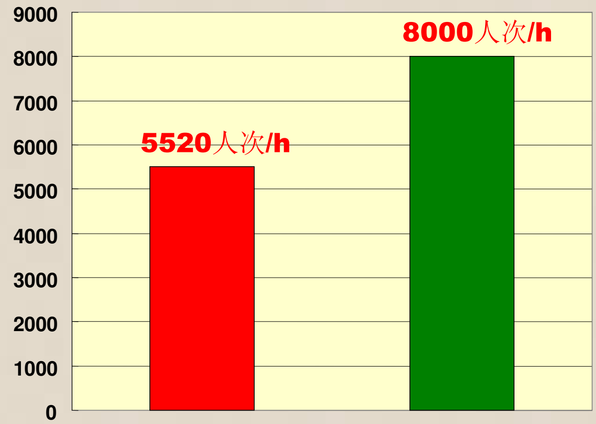
Average wait at downtown platforms

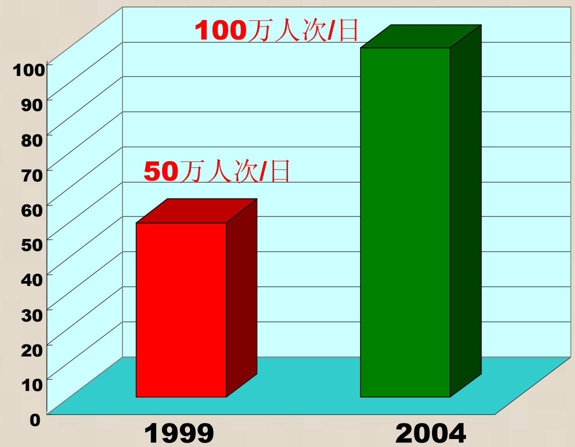
一、昆明快速BRT的实践　　I. BRT in Kunming

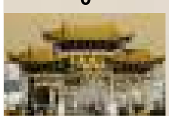
2、实施效果　Results

- 专用道公共交通运力增加近**50%**，达到**8000**人次/小时；
- **Bus lane capacity reached 8000 passengers/h, almost a 50% increase**

- 城市公交日客流量，由**99**年的**50**万人次增加到**2004**年的**100**万人次
- **Passenger volume doubled from 0.5 million in 1999 to 1 million in 2004**







一、昆明快速BRT的实践　　I. BRT in Kunming

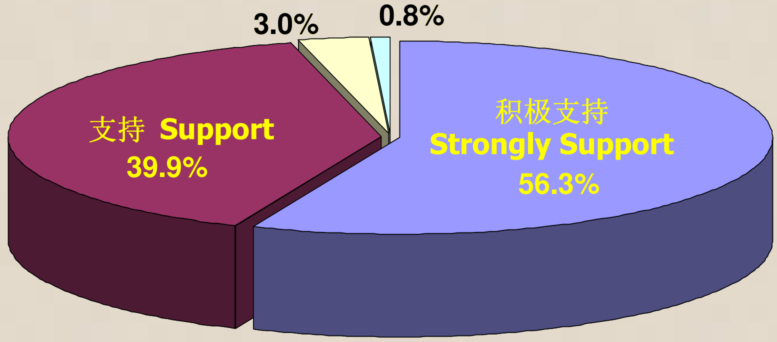
3、公众态度　Public Attitude

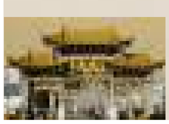
公众支持率 Public Support

78%(1999年)

↓

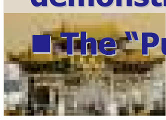
96%(2002年)





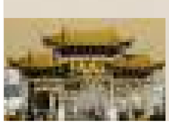
4、综合评价　Appraisal of Kunming's BRT

- 稀缺的城市交通时空资源得以更合理和公正的分配；
- 公共交通运输效率和服务水平明显提高，公交营运成本降低;
- 削减了专用道沿线的车交通量，交通污染降低；
- 改善了公众特别是低收入者的交通出行质量，体现了对人的尊重和关怀；
- 政府的公交优先政策得到各方面的广泛接受。
- **Deficient urban traffic resources i.e. time and space are more reasonably and fairly reassigned.**
- **Efficiency and service quality of public transit have been improved at a lower cost.**
- **Vehicle use decreased, resulting in a decrease in pollutants.**
- **The quality of public transport especially for low income groups has improved, demonstrating respect and concern for the people.**
- **The "Public Transport Priority" policy is widely accepted by the public.**



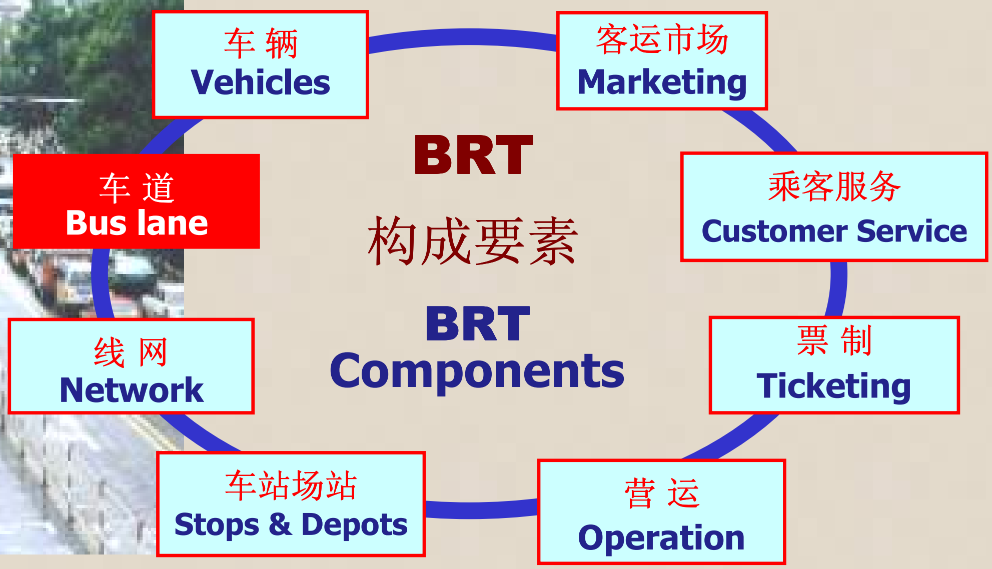
二、昆明快速BRT的反思

II. Review of BRT in Kunming



昆明公交专用道只是现代BRT的雏形

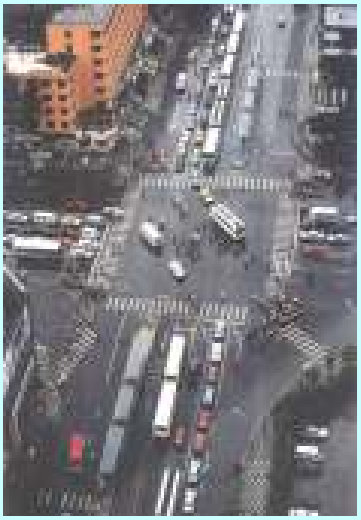
Current bus lanes in Kunming are in their infancy



专用道能否提升形成现代BRT，将对昆明交通发展方向产生重大影响.

If current bus lanes could be upgraded to a modern BRT system, this would substantially affect the direction of urban transport development in Kunming.

1、专用道客运效率未达到理想水平 1 . Capacity is insufficient



昆明/ Kunming
8000人次/h
8000 passengers /h

BRT

20000~30000人次/h

20000~30000 passengers/h

运力不足是昆明**BRT**的核心问题

Insufficient capacity is the main issue for Kunming BRT development.

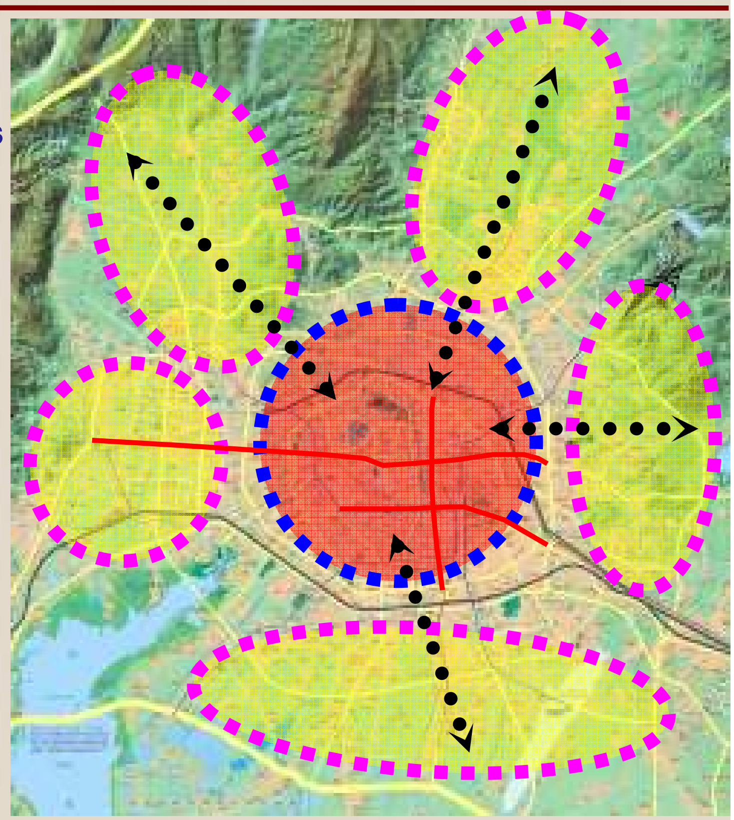
二、昆明快速BRT的反思 II. Review of BRT in Kunming

2、专用道总规模和覆盖率偏低

2. Overall scale and coverage rates are low

特别是联结城市中心区和新区的放射轴线缺乏大运量公交通道

There is a lack of high capacity bus lanes connecting the downtown area to its surrounding areas.



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3、公交服务品质不满足现代生活要求

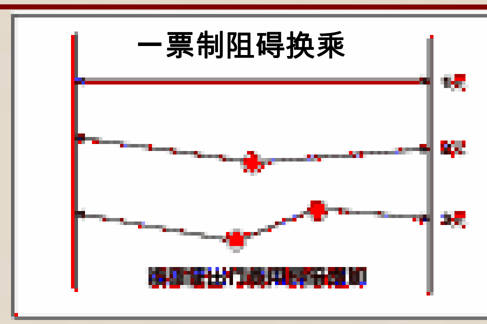
3、The quality of public transit service does not meet modern needs

公交档次低、服务水平不够高，对市民出行缺乏良好的吸引力，不能满足现代出行需求。

Low quality bus vehicles and service level cannot attract ridership and fail to meet modern travel needs.

4、公共交通未整合成一个高效系统

4、Public transport has not been integrated into a highly efficient system



公交线网混乱低效

Poor efficiency bus lines network

- ❑ 缺乏大运量骨干线路
- ❑ Lack of backbone bus lines with high capacity
- ❑ 低水平垃圾线路多
- ❑ Too many low efficiency bus lines
- ❑ 一票制是公交丧失网络效率根本原因
- ❑ One ticket-one bus system hinders the efficiency of the public transport network

线网混乱低效

三、昆明快速BRT的发展策略

III. Development Strategies for BRT in Kunming

建设现代**BRT**是昆明城市交通发展的既定方针

To develop a modern BRT system is the priority for Kunming's urban transportation development.

在美国能源基金会的资助和技术支持下，昆明市已完成《昆明快速公交系统研究》。以此为指导，昆明市将实施"快速**BRT**提升计划"，包括五大措施：

Thanks to the Energy Foundation for their financial and technical support, Kunming has completed the *Kunming BRT System Development Study*. With these guidelines, Kunming will implement a "BRT Upgrade Plan" to include these 5 main measures:

三、昆明快速BRT的发展策略 III. Development Strategies

1、法定公交优先政策 Legislate "Public Priority Policy"

贯彻《建设部关于优先发展城市公共交通的意见》的精神，从立法层面确立"优先发展公共交通"的城市交通发展政策。

Carry out the public transit development policy from Ministry of Construction, and make "Public Transport Priority" the principal for the urban transport development in legislation.

全面研究和落实公交优先的各种措施及政策，为公共交通的优先发展提供良好的环境和支持。

Comprehensively implement "Public Transport Priority" related measures and policies to support the development of public transport.

加强宣传和教育，使全社会理解和支持政府的公交优先政策。

Be more proactive in public education and promoting "Public Transport Priority" to gain stronger public support and increase public awareness.

三、昆明快速BRT的发展策略 III. Development Strategies

2、全面提升BRT设施水平 Upgrade Overall BRT Facility

车辆

Vehicle

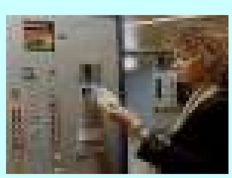
场站

Stops and Depots

车道

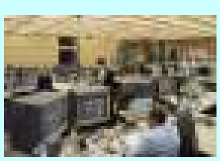
Bus lane

票制



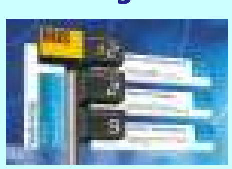
Ticketing

营运调度



Operation

乘客服务



Customer Service

BRT容量 BRT Capacity

■城区内： BRT in City Center

12000~15000人次/h (passengers/h)

■放射线： Radiation BRT

>20000人次/h (passengers/h)

提升品质，成为对小汽车具有竞争力客运系统。

Upgrade service quality to compete with cars.

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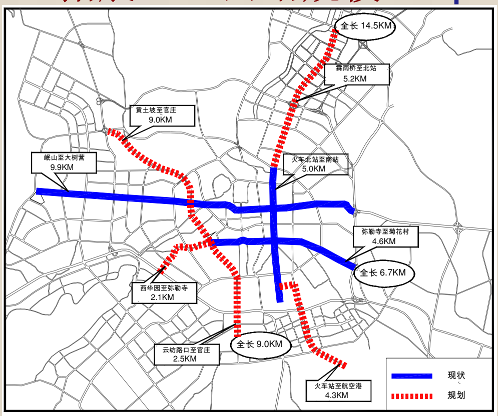
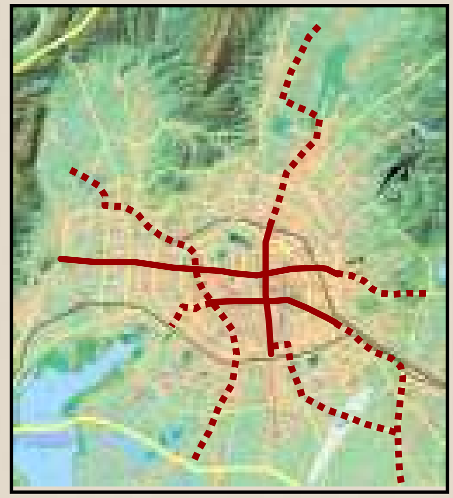
三、昆明快速BRT的发展策略 III. Development Strategies

3、拓展BRT网络规模 Expand the BRT Network





使昆明**BRT**网络总长从目前的**26km**增加到约**70KM**

Expand total length of BRT network from 20KM to 70Km

建立换乘体系，将**BRT**与其它交通方式集成为一个完整的体系

Establish interchange system to integrate BRT and other traffic modes into a complete transport system.

三、昆明快速BRT的发展策略 III. Development Strategies

4、优化公交线网 Optimize Bus Network

形成分级和衔接的高效体系 **Develop a multi-level network**

一级网：大容量骨干网络

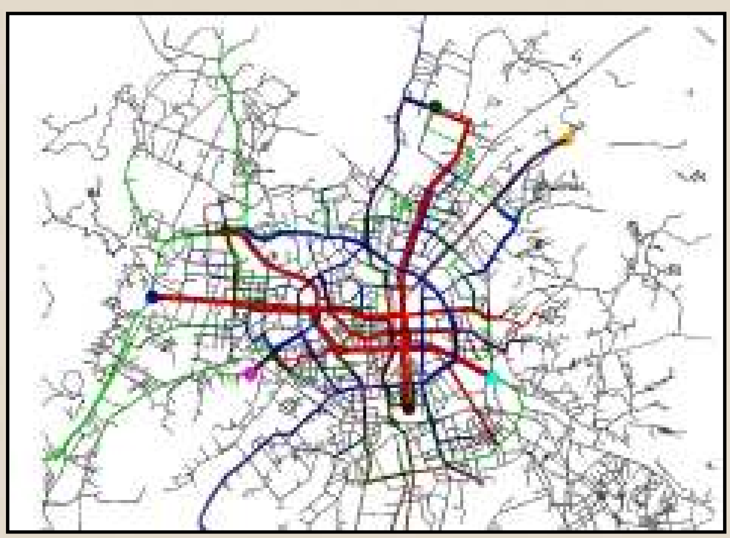
First level: High capacity backbone lines

二级网：补充性干线网

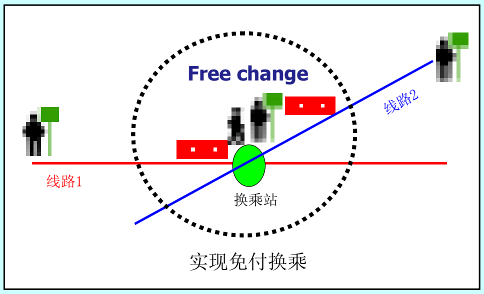
Second Level: Secondary Main lines

三级网：客流收集与疏解系统

Third Level: Feeding routes to gather and disperse passengers



5、建立现代公交票制
Establish a modern ticketing system

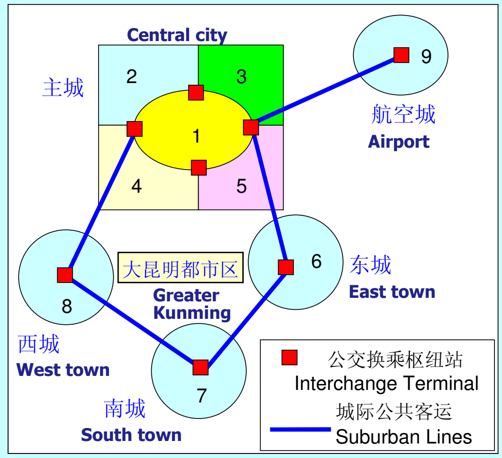


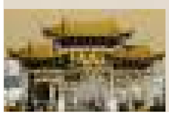
第一阶段：公交IC卡，免付换乘

Phase I: Free ticketing exchange with IC card.

第二阶段：票制分区，多系统、多功能

Phase II: Ticketing zone for multi-modes and functions.





结 束 语

昆明的公交优先实践，使政府和公众看到了解决交通矛盾的曙光。

公交专用道提升形成高品质的现代**BRT**系统,将能找到一种适合发展中城市、经济高效、易于实施和推广的公共交通解决方案。

"Public Transport Priority" practices in Kunming demonstrate an effective way to solve traffic problems for the government and public.

Upgrading bus lanes in Kunming to a high quality modern BRT system will create an economic, effective, and practical transportation solution for cities in developing cities like Kunming.

谢谢 **Thank You**