



Bus Rapid Transit Development around the World as Transit Option



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Institute for Transportation and Development Policy (ITDP)

Promoting environmentally sustainable and equitable transportation worldwide

ITDP is a social profit organization established in 1985 to promote sustainable and equitable transportation around the world

Head Office in New York, ITDP involve in 10 countries and 20 cities around the world, less than 100 staffs in field offices.

ITDP started to work in Indonesia since 1999 for Non-Motorized Transport development. Since then, we have been working in establishing Transjakarta, the first BRT system in SE Asia.



What we do

- Advising city and local government in promoting sustainable transport
- Technical design and Engineering Design
- Advocacy and campaign for sustainable transport program
- Pushing the agenda on sustainable transportation worldwide

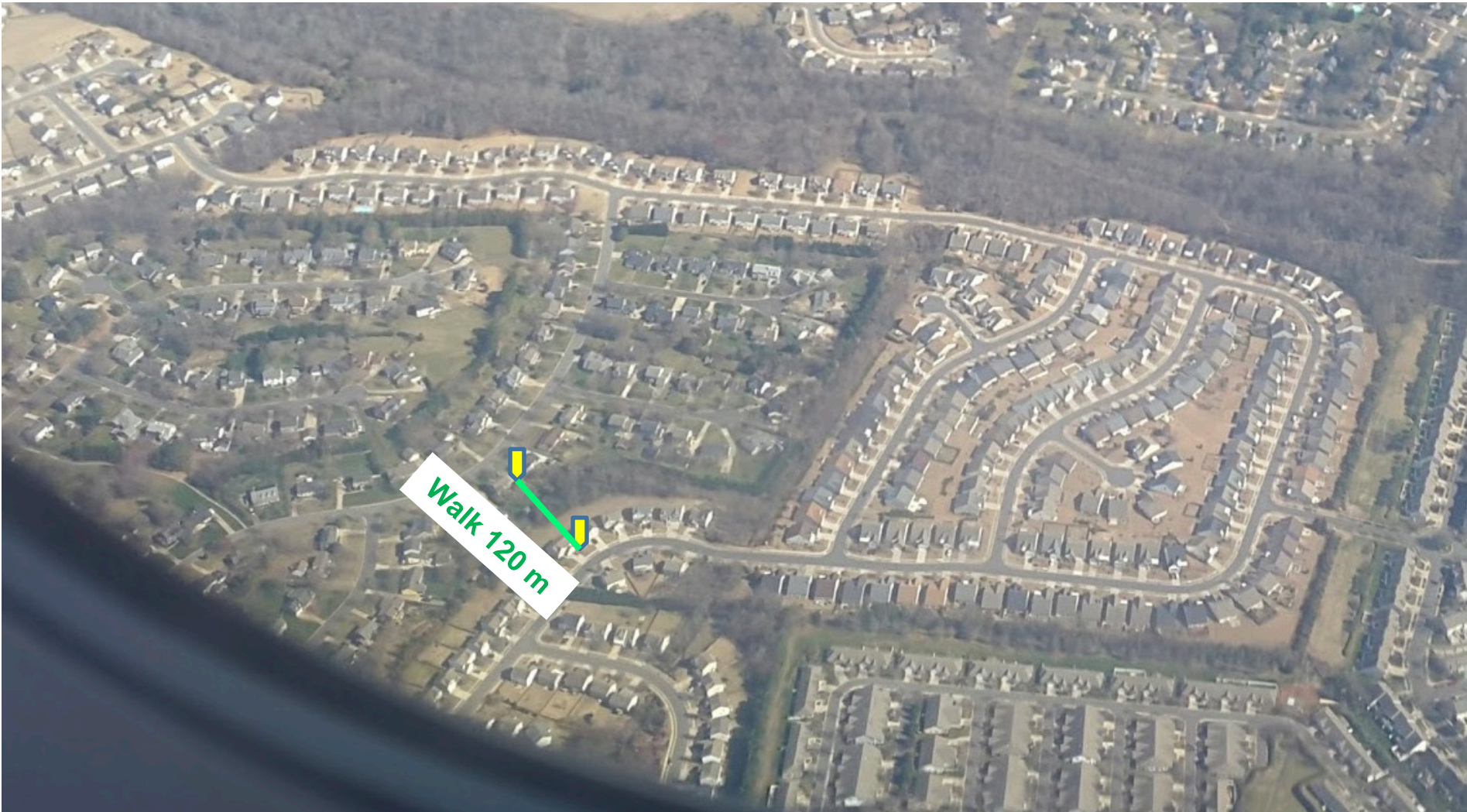


Low Density Car-oriented Development





Cars change the way we move...





Short trip 120 meters to 2.5 km
by car



Vehicle Oriented Development







Pedestrian do not have rights in the road space

Road Users



Private car

Pedestrian

Cyclist

Informal business
owner

Public transport
passenger

TOD Standard Principles



Walk

Develop neighborhoods that promote walking

Mix

Plan for mixed use/mixed income

Cycle

Develop neighborhoods that promote cycling

Densify

Optimize density and transit capacity

Connect

Create dense networks of streets and paths

Compact

Create regions with short commutes

Transit

Locate development near high-quality public transport

Shift

Increase mobility by regulating parking and road use



LIVE

WORK

PLAY

RECREATE

SHOP

MOVE

ACCESS

TOD STANDARD SCORING



WALK

Principle 1 | 15 points

OBJECTIVE A.
The pedestrian realm is safe, complete, and accessible to all.

Metric 1.A.1 Walkways
Percentage of walkway segments with safe, all-accessible walkways. 3 points

Metric 1.A.2 Crosswalks
Percentage of intersections with safe, all-accessible crosswalks in all directions. 3 points

OBJECTIVE B.
The pedestrian realm is active and vibrant.

Metric 1.B.1 Visually Active Frontage
Percentage of walkway segments with visual connection to interior building activity. 6 points

Metric 1.B.2 Physically Permeable Frontage
Average number of shops, building entrances, and other pedestrian access per 100 meters of block frontage. 2 points

OBJECTIVE C.
The pedestrian realm is temperate and comfortable.

Metric 1.C.1 Shade and Shelter
Percentage of walkway segments that incorporate adequate shade or shelter elements. 1 point

CYCLE

Principle 2 | 5 points

OBJECTIVE A.
The cycling network is safe and complete.

Metric 2.A.1 Cycle Network
Access to a safe cycling street and path network. 2 points

OBJECTIVE B.
Cycle parking and storage are ample and secure.

Metric 2.B.1 Cycle Parking at Transit Stations
Ample, secure, multi-space cycle parking facilities are provided at all transit stations. 1 point

Metric 2.B.2 Cycle Parking at Buildings
Percentage of buildings that provide ample, secure cycle parking. 1 point

Metric 2.B.3 Cycle Access in Buildings
Buildings allow interior access and storage within tenant-controlled spaces for cycles. 1 point

CONNECT

Principle 3 | 15 points

OBJECTIVE A.
Walking and cycling routes are short, direct and varied

Metric 3.A.1 Small Blocks
Length of longest pedestrian block. 10 points

OBJECTIVE B.
Walking and cycling routes are shorter than motor vehicle routes

Metric 3.B.1 Prioritized Connectivity
Ratio of pedestrian intersections to motor vehicle intersections. 5 points

TRANSIT

Principle 4 | 15 points

OBJECTIVE A.
High quality transit is accessible by foot.

Metric 4.A.1 Walking Distance to Transit
Walking distance to the nearest transit station.

MIX

Principle 5 | 25 points

OBJECTIVE A.
Opportunities and services are within a short walking distance of where people live and work, and the public space is activated over extended hours.

Metric 5.A.1 Complementary Uses
Residential and nonresidential uses within same or adjacent blocks. 8 points

Metric 5.A.2 Access to Local Services
Percentage of buildings that are within walking distance of an elementary or primary school, a healthcare service or pharmacy, and a source of fresh food. 3 points

Metric 5.A.3 Access to Parks and Playgrounds
Percentage of buildings located within a 500-meter walking distance of a park or playground. 1 point

OBJECTIVE B.
Diverse demographics and income ranges are included among local residents.

Metric 5.B.1 Affordable Housing
Percentage of total residential units provided as affordable housing. 8 points

Metric 5.B.2 Housing Preservation
Percentage of households living on site before the project that are maintained or relocated within walking distance. 3 points

Metric 5.B.3 Business and Services Preservation
Percentage of pre-existing local resident-serving businesses and services on the project site that are maintained on site or relocated within walking distance. 2 points

DENSIFY

Principle 6 | 15 points

OBJECTIVE A.
High residential and job densities support high-quality transit, local services, and public space activity.

Metric 6.A.1 Nonresidential Density
Nonresidential density in comparison with best practice in similar projects and station catchment areas. 7 points

Metric 6.A.2 Residential Density
Residential density in comparison with best practice in similar projects and station catchment areas. 8 points

COMPACT

Principle 7 | 10 points

OBJECTIVE A.
The development is in, or next to, an existing urban area.

Metric 7.A.1 Urban Site
Number of sides of the development that adjoin existing built-up sites. 8 points

OBJECTIVE B.
Traveling through the city is convenient.

Metric 7.B.1 Transit Options
Number of different transit options that are accessible within walking distance. 2 points

SHIFT

Principle 8 | 15 points

OBJECTIVE A.
The land occupied by motor vehicles is minimized.

Metric 8.A.1 Off-Street Parking
Total off-street area dedicated to parking as a percentage of the development area. 8 points

Metric 8.A.2 Driveway Density
Average number of driveways per 100 meters of block frontage. 1 point

Metric 8.A.3 Roadway Area
Total road bed area used for motor vehicle travel and on-street parking as percentage of total development area. 6 points



Principle 1: WALK

- Seluruh ruas jalan di dalam area TOD mendukung berjalan kaki
- Muka bangunan yang aktif dan permeabel
- Terlindungi dari panas matahari dan hujan
- Pembukaan akses antargedung





Change Priorities in City Development

**Car-oriented
Development**



**People-oriented
Development**



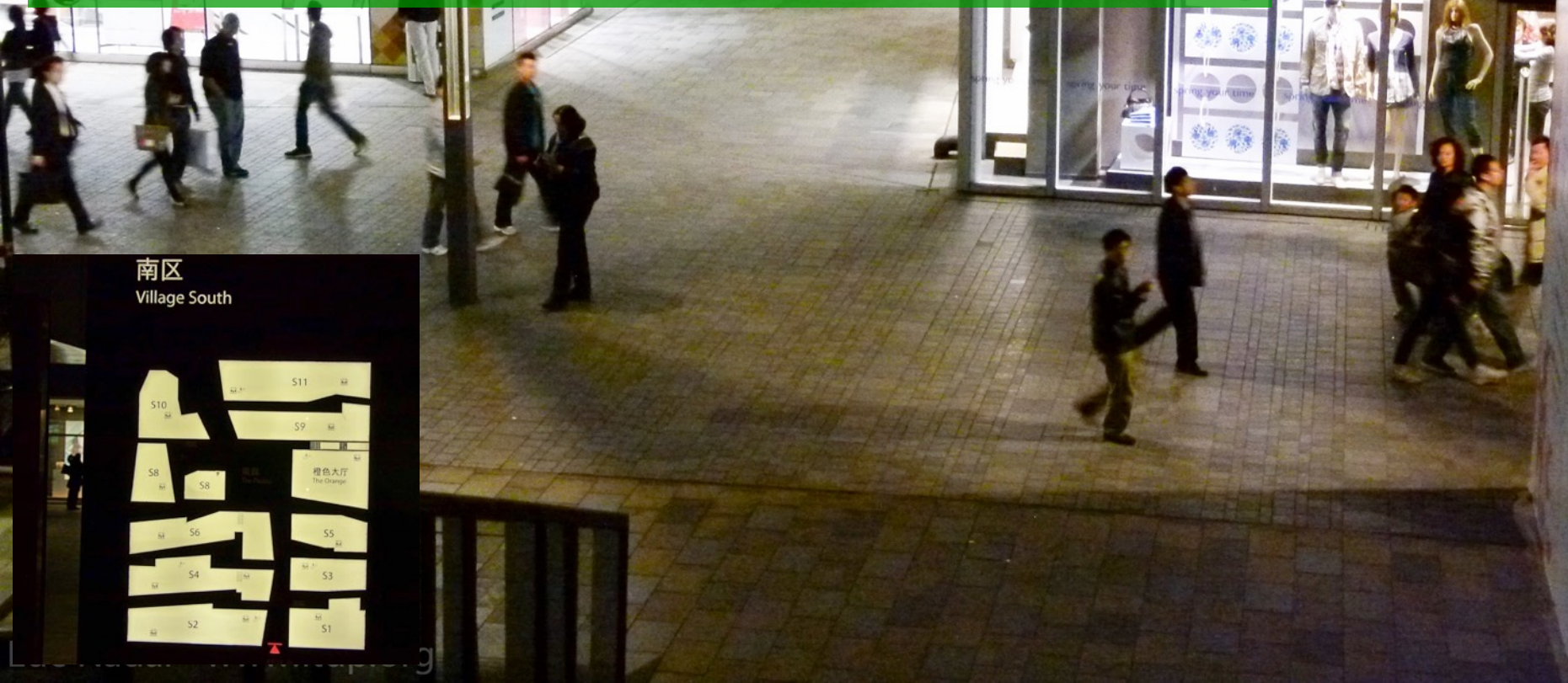
Principle 2: **CYCLE**

- Jalur sepeda terproteksi dari kendaraan bermotor
- Parkir sepeda di stasiun angkutan umum
- Akses sepeda pada bangunan



Principle 3: CONNECT

- Panjang blok ideal 110-190 meter
- Penambahan akses khusus pejalan kaki dan pesepeda
- Peniadaan pagar dan perimeter wall



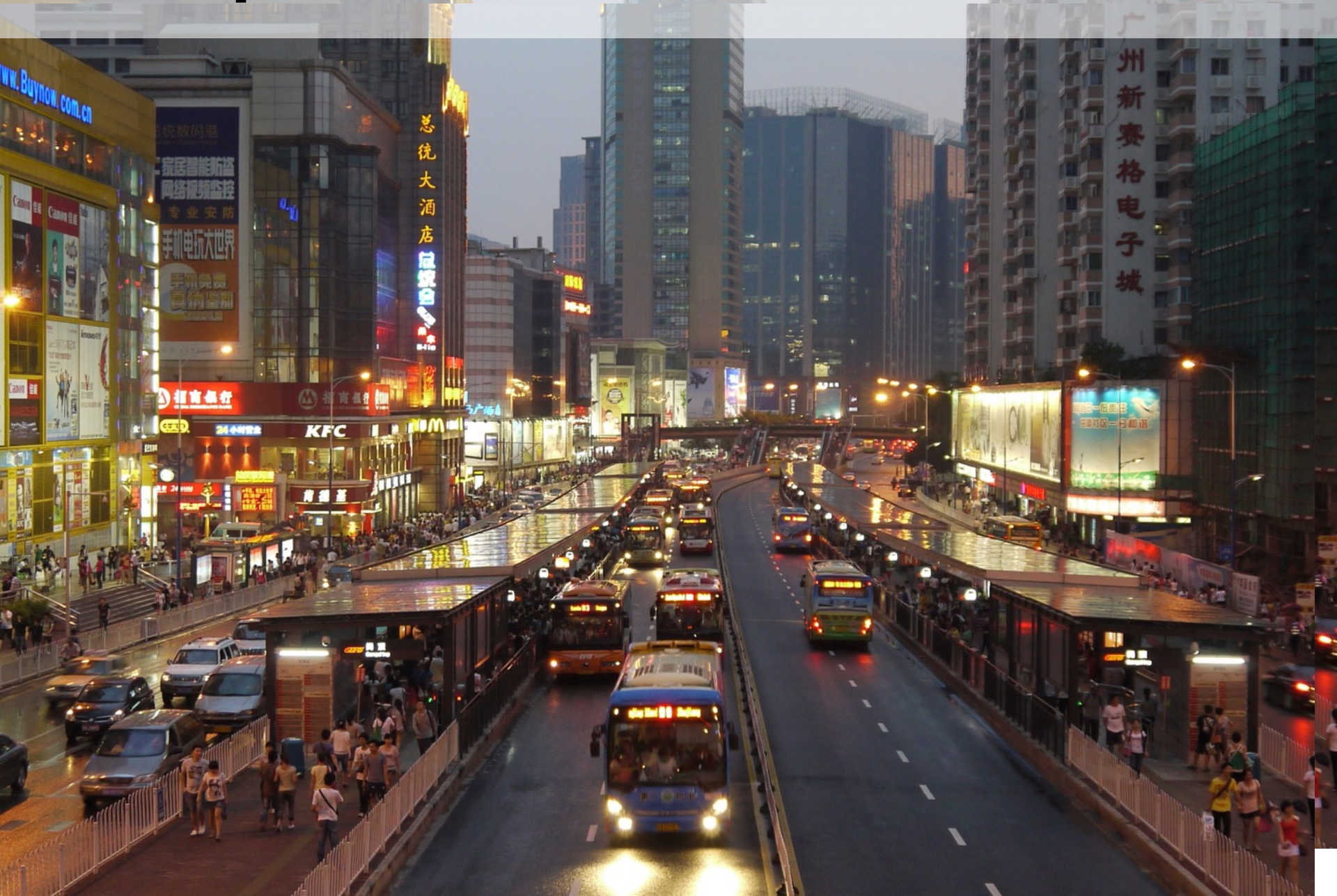
Principle 4: TRANSIT

- Stasiun angkutan umum massal dalam jangkauan berjalan kaki

Kyoto Metro Station



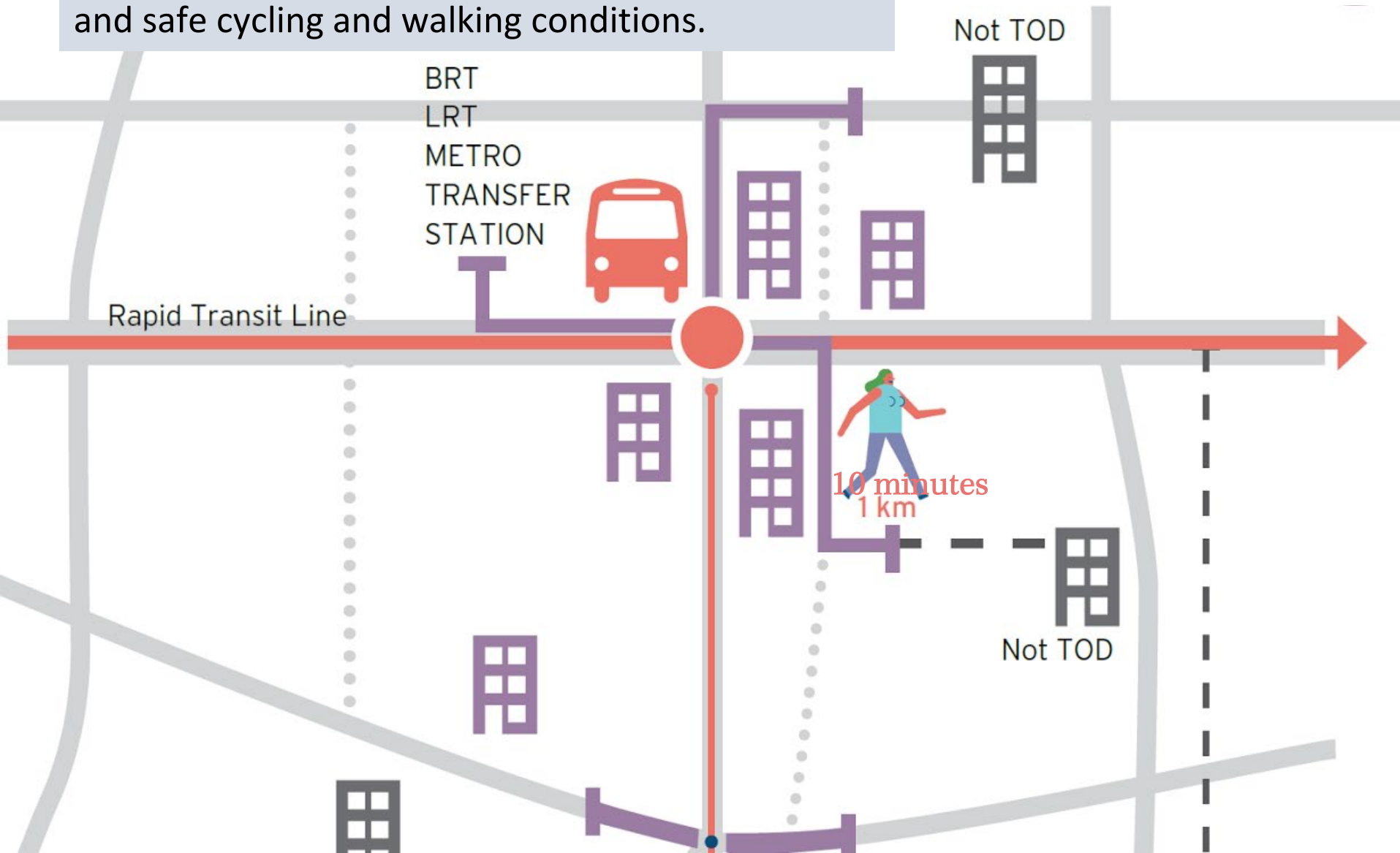
Principle 4: TRANSIT



Transit-Oriented Development



Dense, mixed-use development oriented around public transport with vibrant pedestrian realm and safe cycling and walking conditions.



Principle 5: **MIX**

- Tata guna lahan mixed use
- Form-based code, bukan lagi sekedar zoning code
- Lingkungan sosial yang mixed income

Chelsea, New York, USA

Principle 6: **DENSIFY**

- **Densify** merupakan prinsip TOD yang mendukung pemanfaatan mass transit dan service lainnya secara luas.
- Angka KLB dan KDB yang lebih tinggi dari daerah non-TOD
- Peniadaan GSB

New York, USA

Principle 7: **COMPACT**

London, UK



- Tidak ada lahan kosong/tidur dalam area TOD
- Fokus pembangunan pada area yang telah terbangun, bukan daerah pinggiran
- Lebih banyak rute angkutan umum melayani area TOD

Principle 8: **SHIFT**

- Lebih sedikit luas jalan diperuntukan bagi kendaraan bermotor
- Lebih sedikit luas lahan diperuntukan bagi parkir kendaraan bermotor
- Relokasi driveway dari jalan utama
- Pelarangan setback parking dan pembatasan garasi pribadi

SHIFT

Towards a car-free / car-light lifestyles

How BRT Can help city development





You can see where the BRT corridor is in the city by the level of investment clustered around the corridor

Curitiba, Brazil



The city wanted to encourage higher density development so as part of developing BRT, they changed the zoning regulations.





Bogotá, Colombia- the next big revolution in BRT design. This is the system in the downtown transit mall that integrates well with the built environment.



BRT in Bogota—transit mall in the city center, with BRT, pedestrians & bicycles only



BRT Stations along the high density urban corridor in Guangzhou





Curitiba BRT triggered higher density development along the corridor



Jakarta's first BRT corridor generates more development along the corridor



Benefit of BRT

- Increase public transport travel speed
- Passenger time savings
- (In Guangzhou the bus average speed during the peak hour increased from 11 km/h to 19 km/h after BRT)
- BRT buses can operate inside and outside the BRT corridor, allowing rapid citywide coverage
- Improve public transport conditions
- Affordable by city government. Until 2018, DKI Government has only spent less than Rp 20 trillion to build and subsidize Transjakarta for 15 years to carry more than 1,2 billion passengers

(As comparison, LRT will cost Rp 16 Trillion only to build)



The economics of mass transit

BRT: \$1-10 million/km



Metro: \$40-220 m / km



Planning and construction time



BRT : 18 - 24 months



Metro: 3 – 30 years

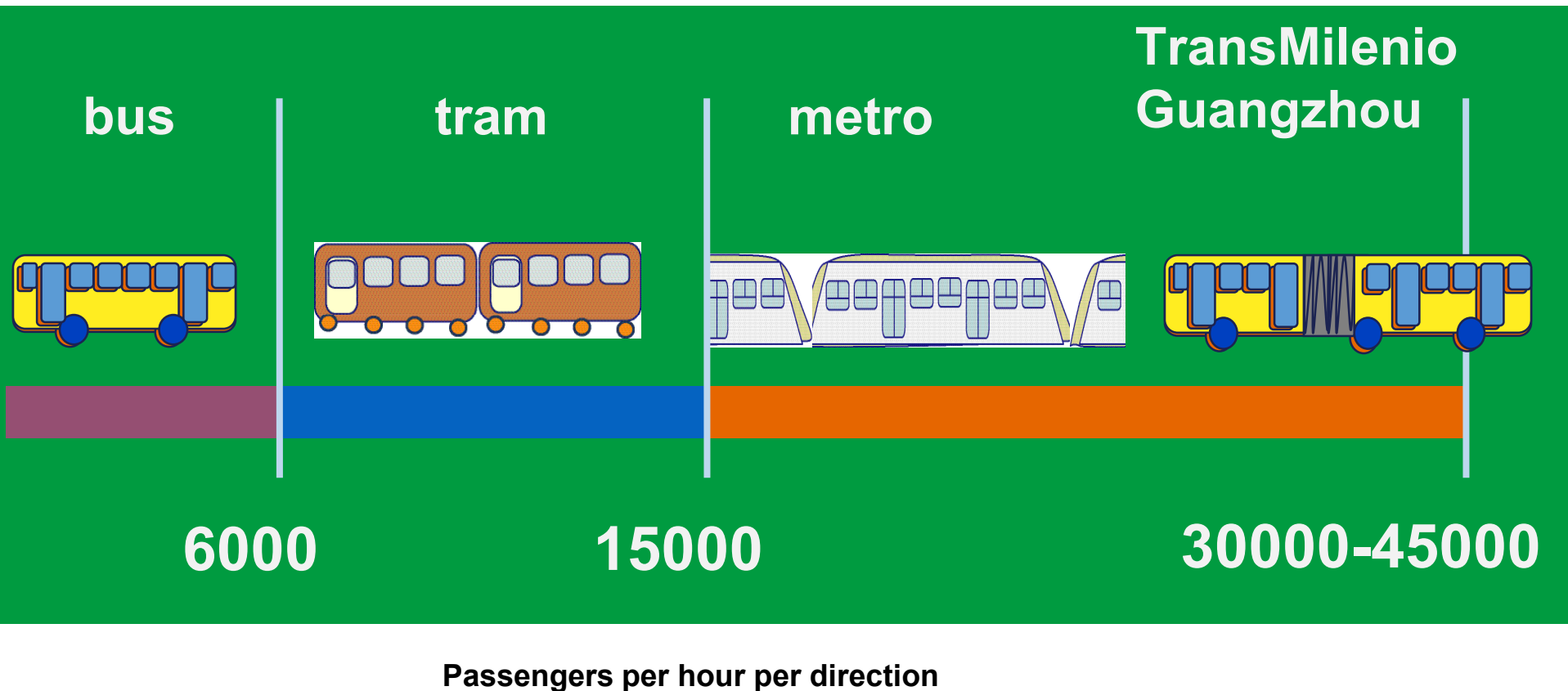


Passenger travel time savings are the main benefit of BRT Project





High capacity BRT systems in Bogota and Guangzhou not only carry more than most metro systems worldwide

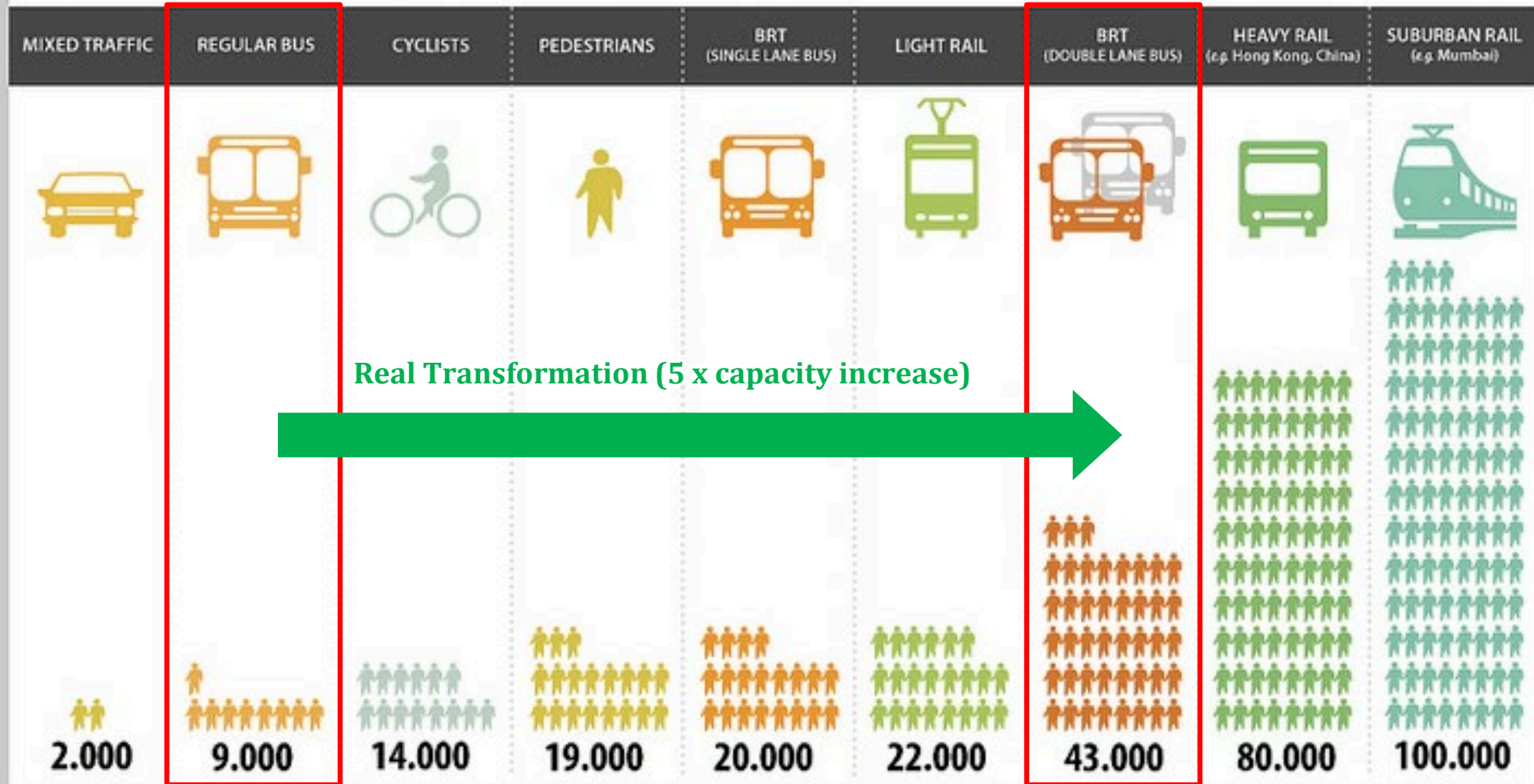


Different Mass Transit corridor Capacity

MAKING THE MOST OUT OF SCARCE ROAD SPACE

people per hour on 3.5-meter wide lane in the city

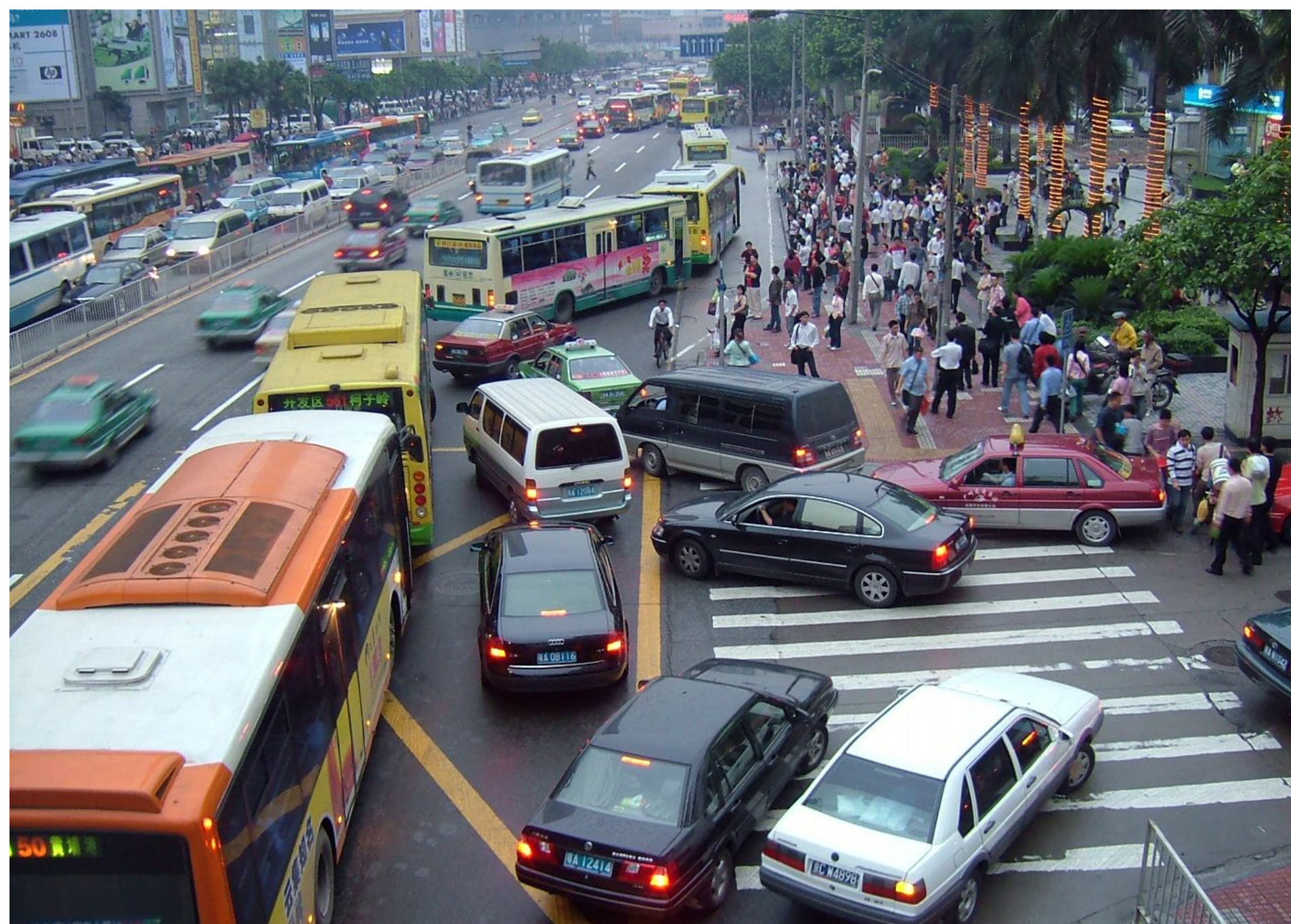
Depending on vehicle size, occupancy or loading, and speed, the use of space can vary greatly for different modes of travel - potential passenger volumes vary greatly by mode along a corridor. The car is the most spatially inefficient mode. Dense urban centers cannot effectively be served by cars, since not enough people can be delivered to the center.





Changes before after BRT



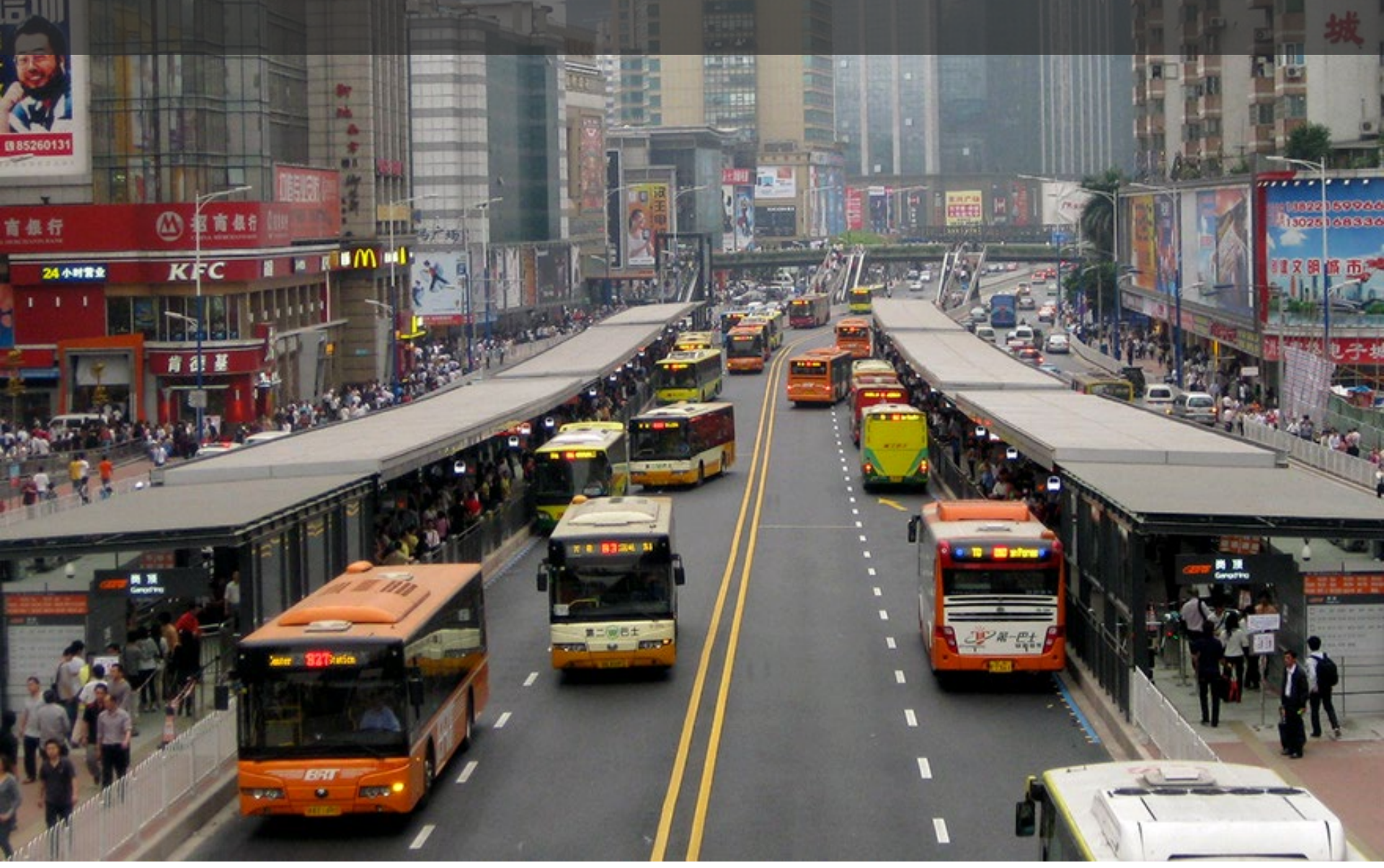


Before BRT, in the BRT corridor. Bus stop congestion bad for all modes





Guangzhou BRT is now the highest capacity BRT in Asia, carrying up to 1 million passengers



Tianhe Gongyuan before the BRT



Tianhe Gongyuan before the BRT





Tianhe Gongyuan after the BRT implementation



BRT in Bogota





BRT in Bogota- highest throughput point in the system: only 36m wall-to-wall





Why should we keep building BRT?

- Quick decision making process (finance less complicated, technology available)
- Faster time of construction
- Road infrastructure supports the system
- Flexibility in determining the bus route
- Suitable infrastructure for transition before the implementation of bigger system such as Subway
- Efficient usage of road space
- Success stories in other cities in the world



BRT Concepts & Principles



BRT Passenger Throughput

Peak throughput (passengers/hr/direction)

Bogota	37,700	Nth of Calle 76 stn, S-N, PM peak 21-Jan-13. AM N-S 35,160 (Jul-13)
Guangzhou	27,400	3-Jun-11, east of Shidajida station, AM peak east-west (Sep-14)
Istanbul	18,900	East of Gevlibağ station, W-E, AM peak, 6-Jul-12 (Jul-12)
Lima	13,950	South of Uni, N-S, AM peak, 2011.6.24. PM peak 9,700 Uni Stn S-N (Jul-11)
Cali	11,100	24-Jun-2013, east of San Pascual, PM peak, W-E (Jul-13)
Xiamen	8,360	West of Wolong Xiaocheng, east-west, AM peak, 10-May-12 (May-12)
Brisbane	7,700	South of Buranda, north-south, 4-Feb-2014, PM peak (Feb-14)
Mexico City	7,550	18-Jan-13 south of Insurgentes Stn, AM peak, N-S (Jul-13)
Zhengzhou	7,230	Zhongzhou Ave, Hongzhuanlu, N-S, AM peak, 22 Aug 2014 (Apr-15)
Urumqi	6,950	North-south, AM peak, 24-Sept-2012 north of Hongshan Stn (Jan-13)
Chengdu	6,650	31-Jul-2013, N-S, AM peak, south of Hongpailouxi Stn (Oct-14)
Lanzhou	6,550	West of Xingfuxiang, E-W, PM peak, 19-Mar-2013 (Oct-13)
Dalian	6,430	South of Cunliu station, into city, AM peak, 24 Feb 2014 (Mar-14)
Hangzhou	6,300	10-Aug-11 AM peak Wulin Guangchang Bei, E-W (Apr-15)
Quito	6,000	In corridor 3. Corridors 1 and 2: 3,500 (October 2008) (Oct-08)
Johannesburg	4,510	West of Mavumbi Station 4-Jul-2012 AM Peak (Jul-12)
Hefei	3,600	20-Mar-11 AM peak, west-east, east of Feifengjie (Mar-13)
Yinchuan	3,600	West of Shangcheng station, W-E, AM peak, 25-Sep-2012 (Sep-12)
Jakarta	3,400	15 May 2012, south of Tosari station (line 1), N-S (Mar-13)
Beijing	2,750	South of Tiantan, N-S, PM peak, 24-Jan-13. Corr. 2-4 1,000-1,500 (Feb-13)
Changzhou	2,650	North of Huaide Qiao, AM peak S-N, 2013.6.20 (Jul-13)
Jinan	2,050	East of Lishan Lu station, 16-Jul-2014, east-west, PM peak (Jul-14)
Leon	1,950	East of Industrial Station, PM peak, east-west, 2013.6.14 (Jun-13)
Lianyungang	1,650	North of Longhe Guangchang, N-S, PM peak, 22 Jan 2013 (Jan-13)
Zaozhuang	1,400	East of Guishan park, W-E, AM peak, 4 Mar 2014 (Mar-14)
Yancheng	1,300	South of Daqing Lu station, PM peak, south-north, 4-Aug-2011 (Aug-11)
Ahmedabad	1,200	Juna Vadaj BRT station, 7-Sep-12, PM peak (Sep-12)
Bangkok	1,200	18-Oct-11, PM peak, north-south, south of Arkan Songkroh (Oct-11)
Nantes	1,200	South of Cite International des Congress, S-N, AM peak 24-Jun-10 (Jul-11)



City Centre bus frequency (bus/hour/direction)

Guangzhou	350	Shidajida station, multiple surveys (Sep-14)
Bogota	312	25-Jun-13, Calle 76 station, AM peak, N-S (Jul-13)
Brisbane	247	Buranda north-south, PM peak, 4-Feb-2014 (Feb-14)
Cali	164	24-Jun-2013, San Pascual station, AM peak, E-W (Jul-13)
Istanbul	137	Cevizlibağ station, W-E, AM peak, 6-Jul-12 (Jul-12)
Zhengzhou	129	Zhongzhou Ave, Hongzhuanlu, N-S, AM peak, 22 Aug 2014 (Apr-15)
Xiamen	104	Wolong Xiaocheng, east-west, AM peak, 10-May-12 (May-12)
Lima	101	24-Jun-11 N-S AM peak, south of Uni Station. PM peak 84 S-N (Jul-11)
Lanzhou	89	Xingfuxiang, E-W, PM peak, 29-May-2015 (Jun-15)
Urumqi	87	North-south, AM peak, 24-Sep-12 north of Hongshan Stn (Jan-13)
Dalian	86	Gunliu station, into city, AM peak, 24 Feb 2014 (Mar-14)
Hangzhou	80	AM peak east-west, 10-Aug-11 (Apr-15)
Chengdu	64	31-Jul-2013, N-S, AM, south of Hongpailouxi Stn (Oct-14)
Johannesburg	64	Mavumbi Station 4-Jul-2012 AM Peak (Jul-12)
Yinchuan	63	Nanmen BRT station, Nanxundongjie, W-E, AM peak, 26-Sep-2012 (Sep-12)
Quito	60	In corridor 3; around 30 in corridors 1 and 2 (Oct-08)
Mexico City	56	18-Jan-13 south of Insurgentes Stn, AM peak, N-S (Jul-13)
Hefei	55	PM peak, 5-Aug-11 (Mar-13)
Jinan	49	Lishan Lu station, 3-Mar-2014 & 16-Jul-2014, east-west, PM peak (Jul-14)
Zhoushan	47	Haiyunxueyuan, E-W, AM peak, 6 Mar 2014 (Mar-14)
Changzhou	41	Huaide Qiao station, AM peak, E-W, 2013.6.20 (Jul-13)
Jakarta	40	4 and 5-May-2011, Line 1, north to south (Mar-13)
Beijing	30	Tiantan, N-S, PM peak, 11-Jun-15 (Jun-15)
Yancheng	30	AM & PM peak surveys, 4-5 August 2011 (Aug-11)
Zhongshan	28	Nongshangyinhang Dongquzhihang stn, E-W, PM peak, 18-Apr-2014 (Apr-15)
Changde	27	Huangmuguan station, S-N, PM peak, 21-Mar-2013 (Mar-13)
Lianyungang	25	Surveys Jan 2013 (Jan-13)
Zaozhuang	23	Guishan park, W-E, AM peak, 4 Mar 2014 (Mar-14)
Ahmedabad	20	(Sep-12)
Leon	20	Industrial Station, PM peak, east-west, 2013.6.14 (Jun-13)

1 bus less than
every 15 seconds



BRT Concept Design

High Capacity

- articulated bus
- high frequency
- passing lane at stations

High Speed

- exclusive lane
- level-platform

Even more..

- wide network
- route flexibility
- high accessibility
- low capital

Think Rail, Use Bus

Think rail, use buses





Principle of BRT Design



BRT Key Design Components





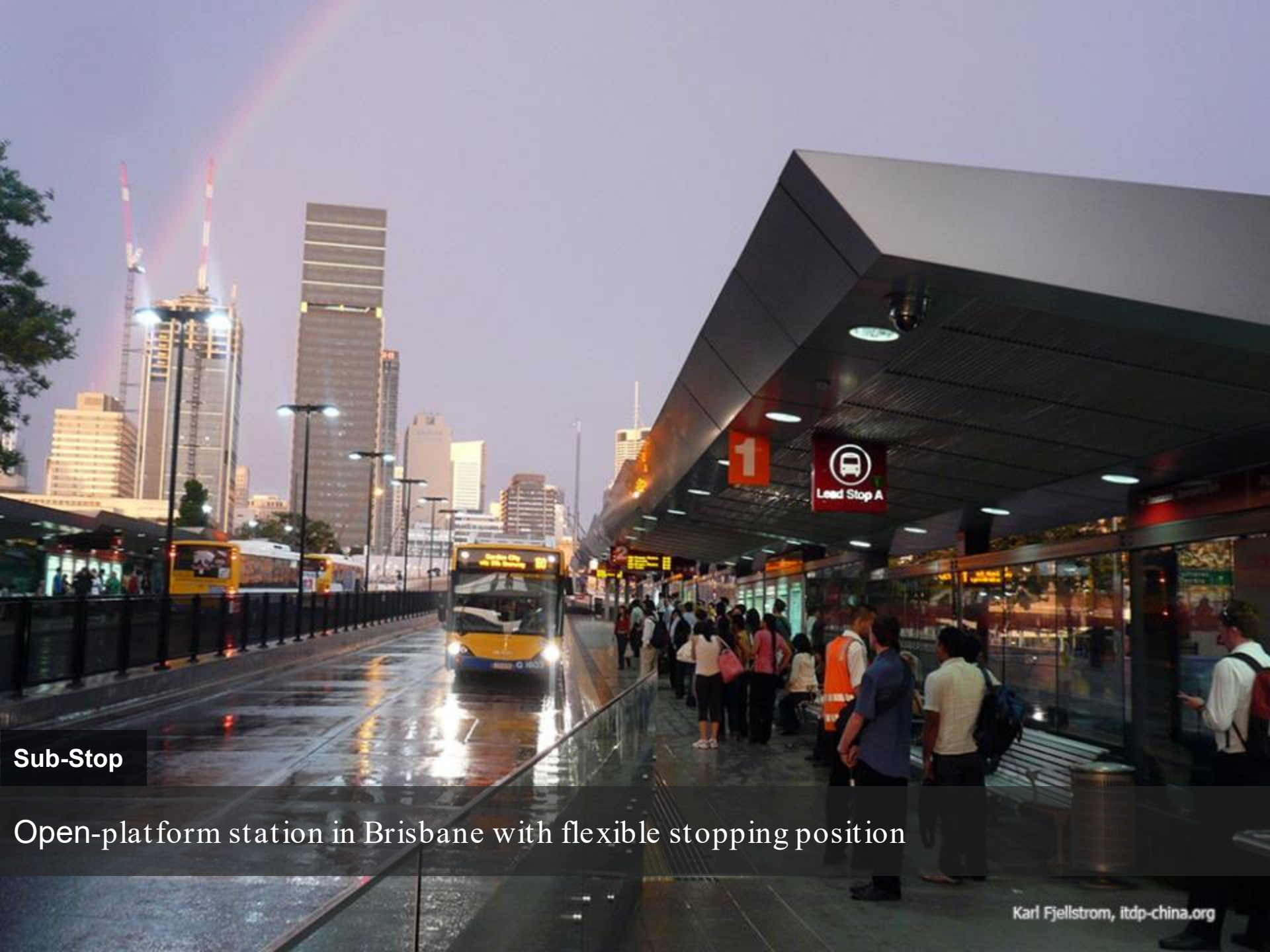
Sub-Stop

Sub-stop and multiple stopping bays allow more than 2 buses stopping at the same time, and increase corridor capacity



Sub-Stop

Application of sub-stop in Bogota, showing each substop work as independent stop



Sub-Stop

Open-platform station in Brisbane with flexible stopping position



Level boarding

Bogota, Colombia- Level boarding with multiple wide doors



Level boarding

Same level platform boarding is very important in BRT design to ensure quick boarding and alighting



Off-board Fare Collection

BRTBasics:Off board fare collection – Mexico City, Mexico



Off-board Fare Collection

Automatic barrier installed in Bangkok BRT



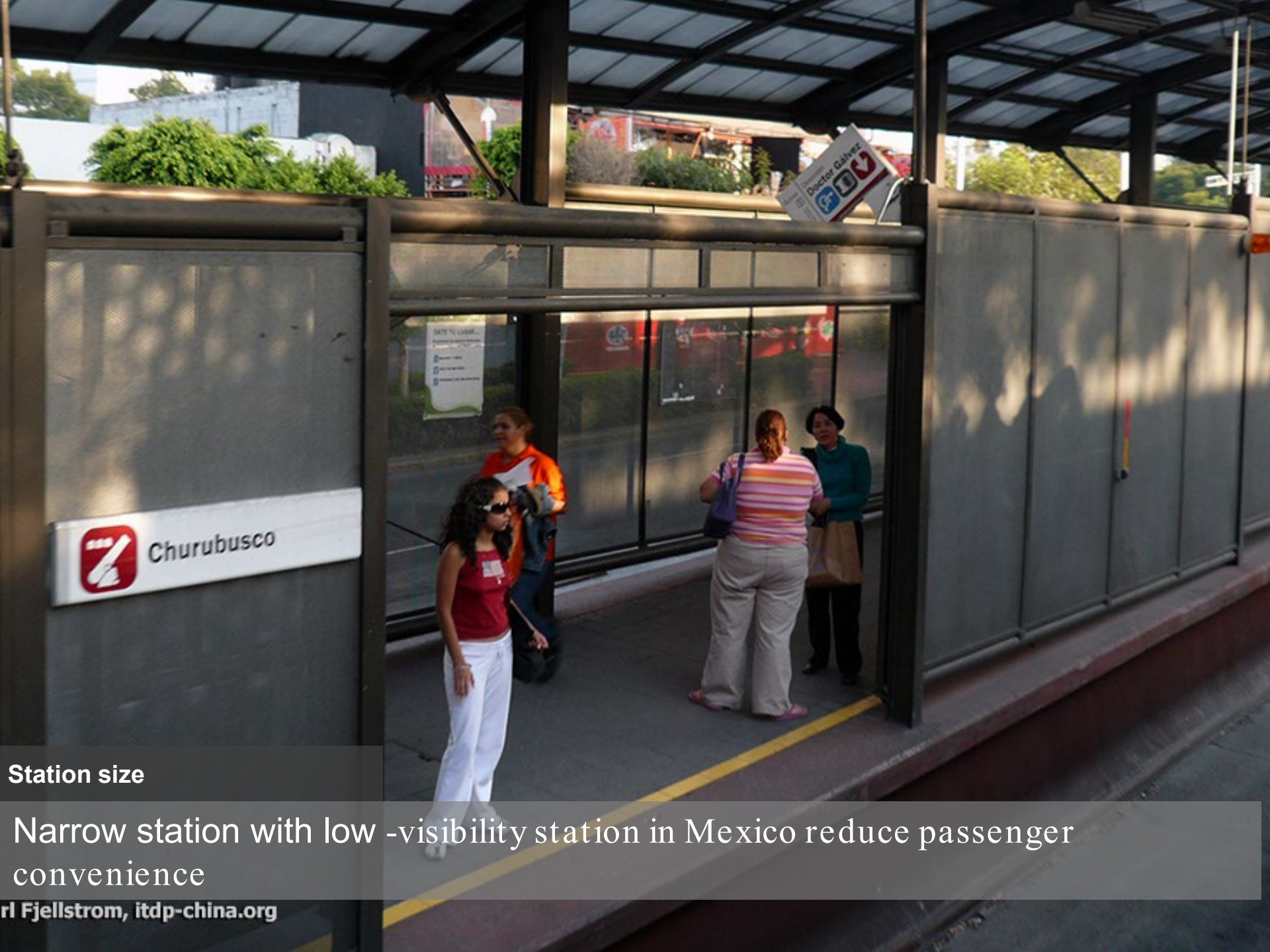
Off-board Fare Collection

Off board fare collection in urumqi



Station size

Long and wide BRT station in Johannesburg to anticipate future growth



Station size

Narrow station with low -visibility station in Mexico reduce passenger convenience

rl Fjellstrom, itdp-china.org



Station size

Jakarta has overcrowding in the station, mainly due to poor bus operation and Route planning



Station location

BRT built on elevated road will restrict flexibility in operation with limited access to station



Station location

In Xiamen elevated BRT, the system failed to capture the highest demand who are mostly “on the ground”



Station design

BRT Station at Curitiba (Brazil), the birthplace of BRT



Station design

The iconic BRT Station Brazil is now a symbol of the city



Station design

BRT Station in Johannesburg is designed with local art touch
different at every station



Station design

Outstanding BRT station design in Cape Town promotes the BRT brand



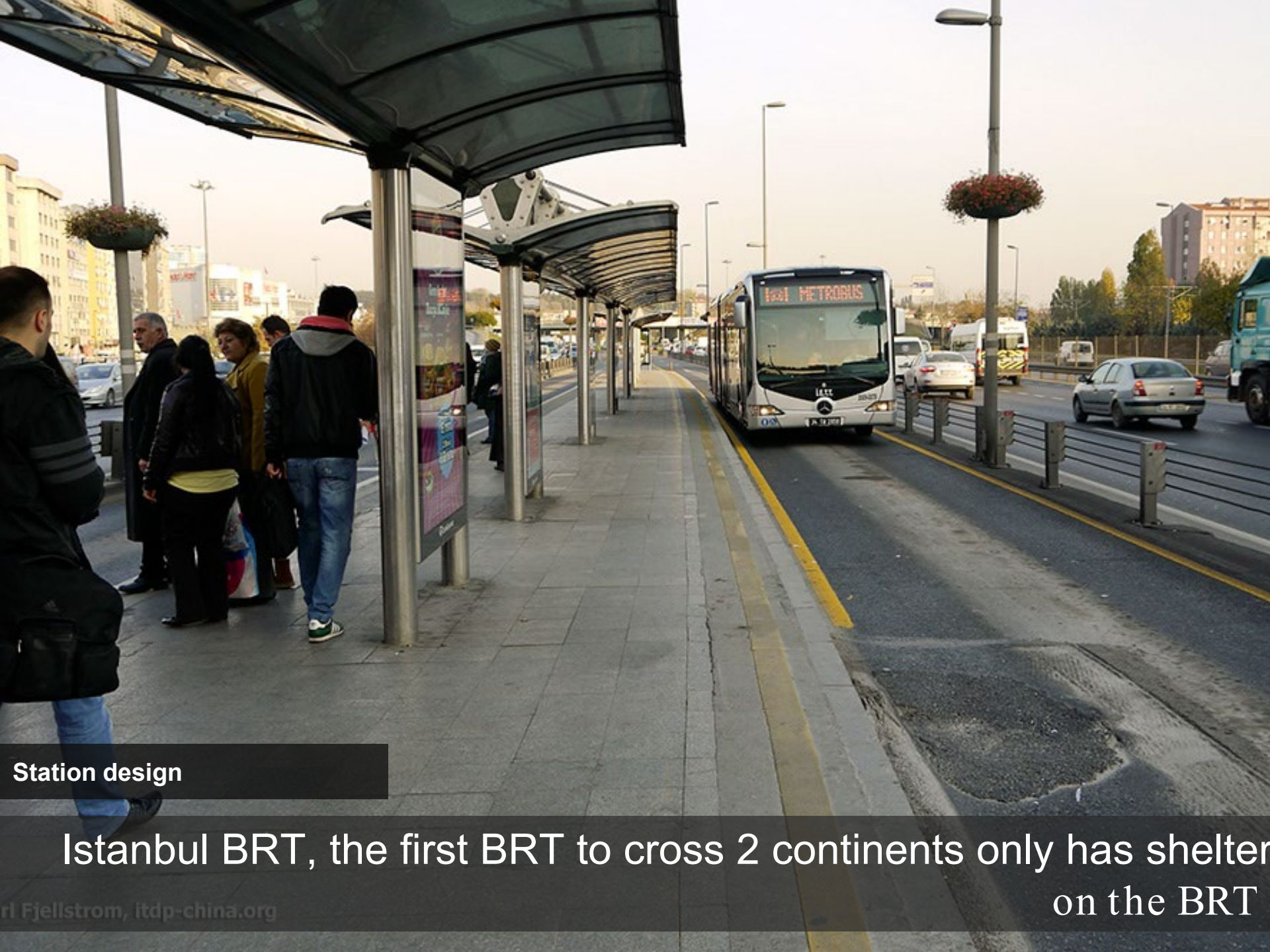
Station design

BRT Station design in Guadalajara
Macrobus is the winning design of station competition held by the city



Station design

In Urumqi, the BRT logo and station has become the icon of the city



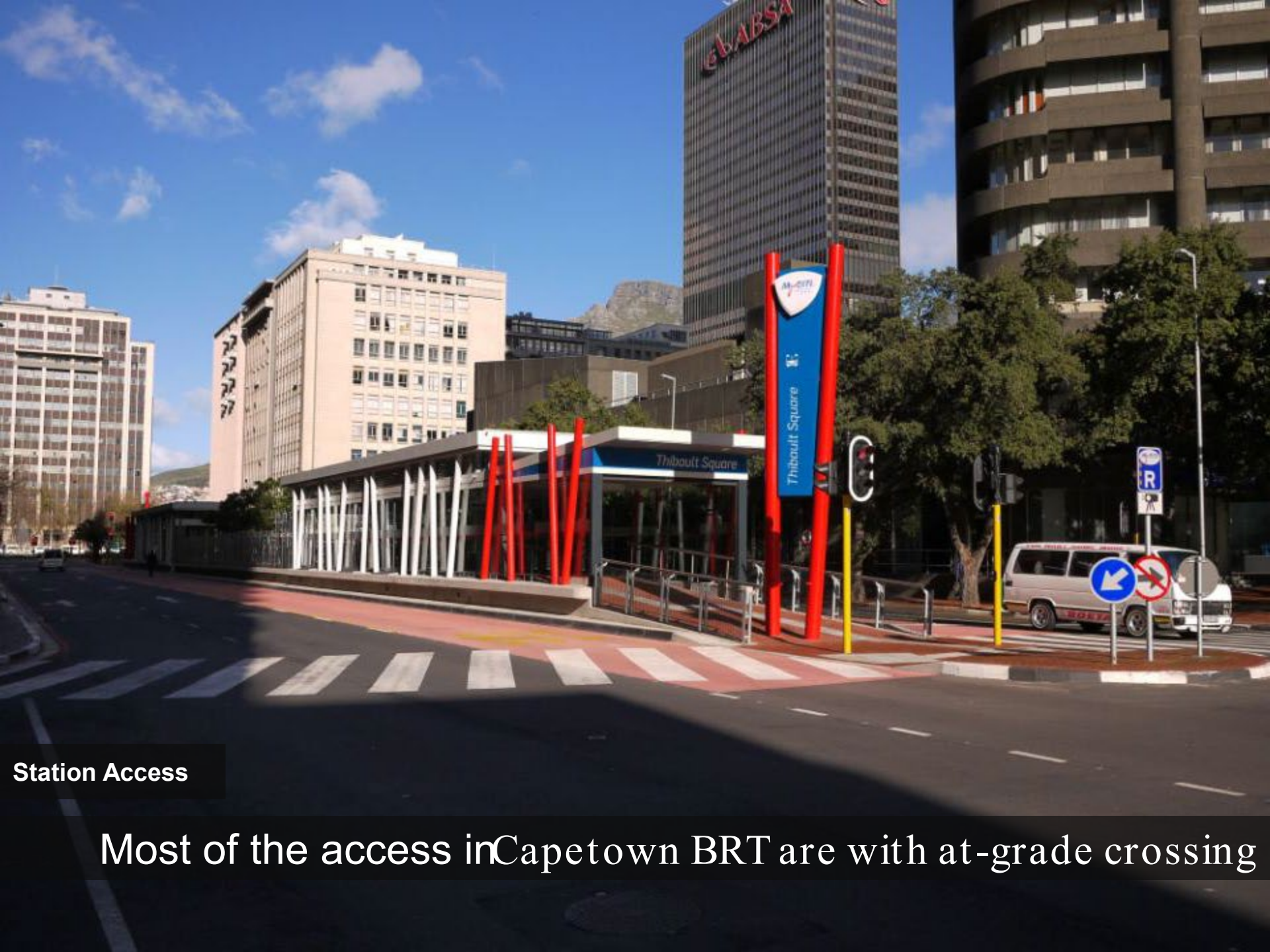
Station design

Istanbul BRT, the first BRT to cross 2 continents only has shelter
on the BRT



Station Access

Quick and easy access to station is one of the best features shown in Lanzhou BR



Station Access

Most of the access in Cape Town BRT are with at-grade crossing



Station Access

At-grade station access works well to accommodate high demand passengers in Guangzhou BRT

Station access

Long pedestrian bridge in Bogota BRT is overcrowded during peak hour





Station Configuration

Istanbul BRT uses central-platform model station, but with no passing lane, limiting the system capacity



Station configuration

Without central -platform station, Lahore BRT takes more space for BRT right of way



Station configuration

Lanzhou BRT uses 'split-offset' station, which save 1 lane for passing lane



Station Configuration

Quito BRT also uses 'split-offset' station, but with no clear direction separation



Passenger information

In Guangzhou BRT, clear passenger information system is important to inform passenger on the next bus arrival and the door allocation





Control System

Centralized control system like in Guangzhou BRT enable quick coordination between BRT management and the bus operator





Operator offices







Depot Facility

Modern bus Depot and workshop will support the bus lifetime, like in Bogota, where after 10 years contract, the contract was extended due to still perfectly good fleet



Fleet

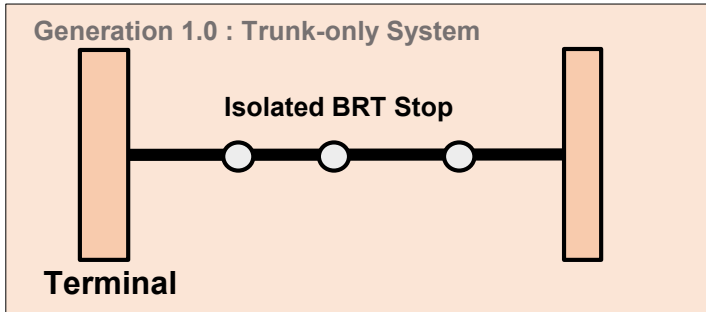
BRT fleet is design with high capacity, from 12 meter, 18 meter and 24 meter. The latter has capacity of 24 passengers.

BRT Operation

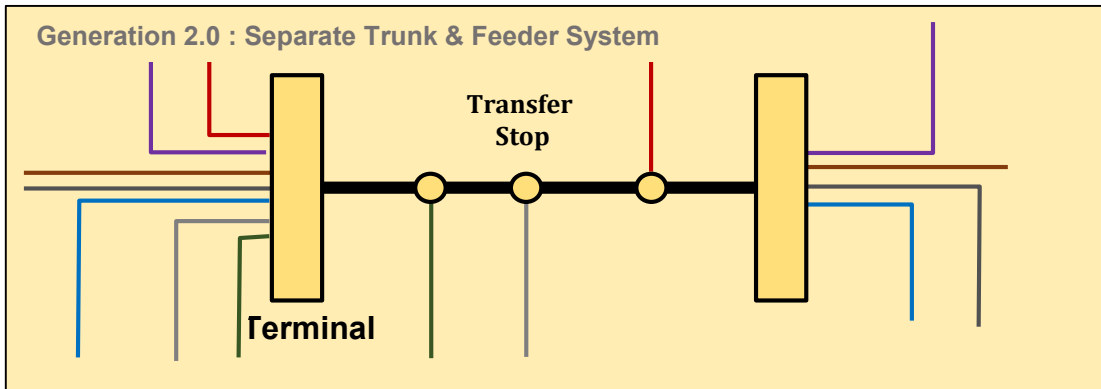




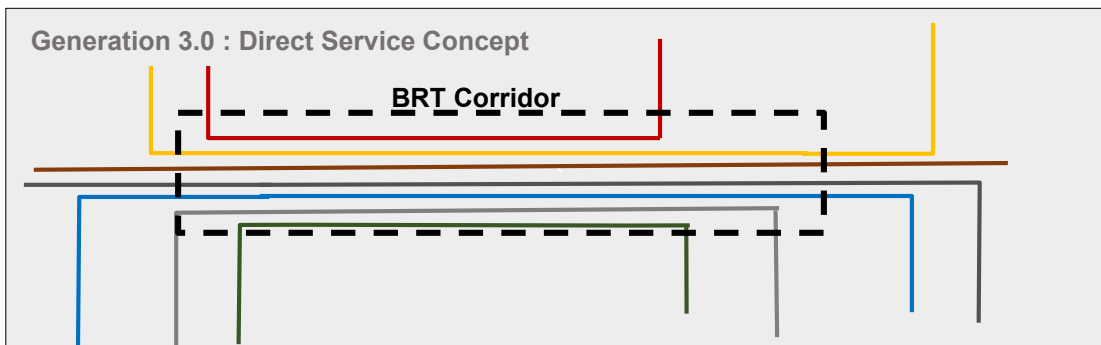
Different types of BRT Operation



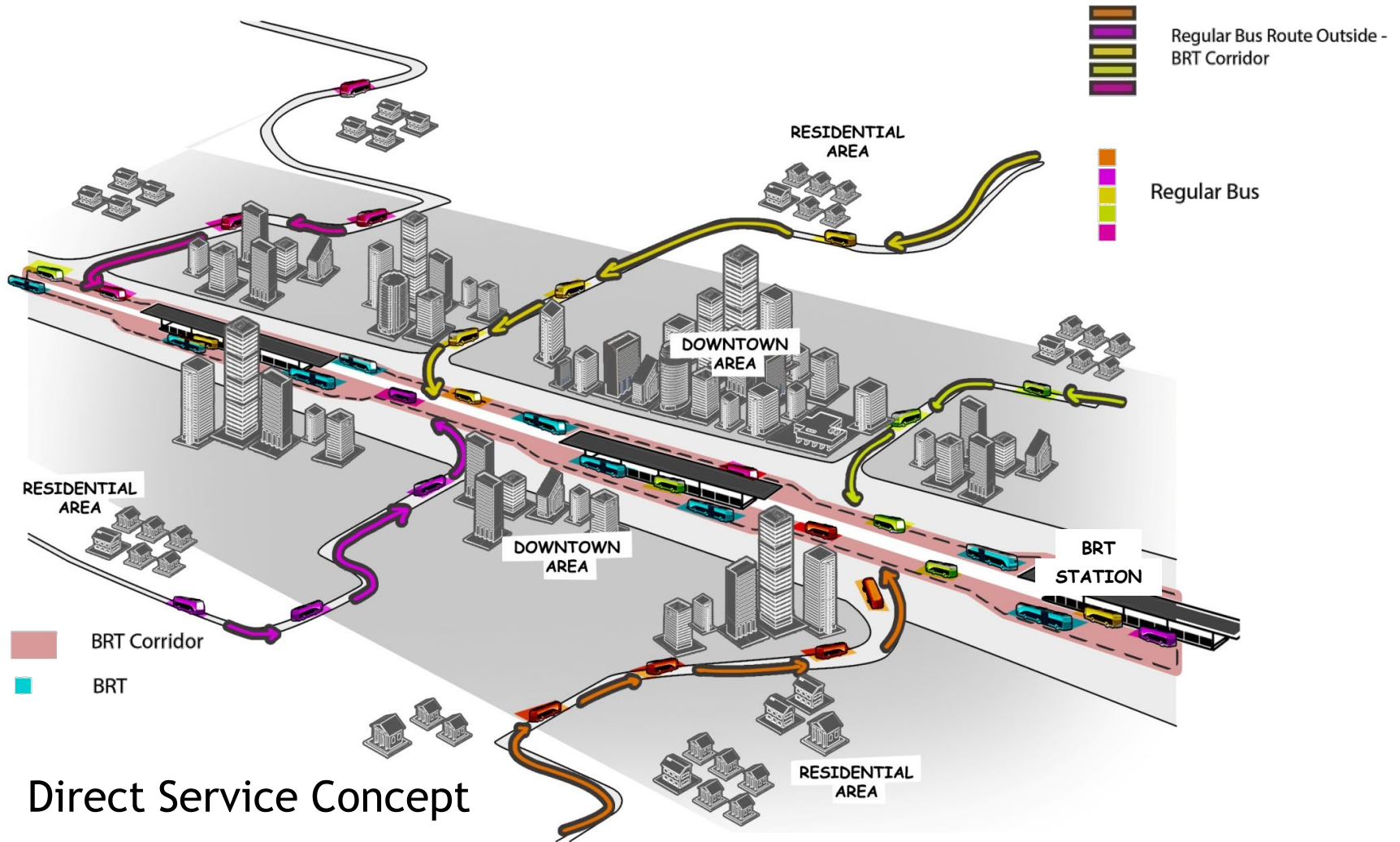
- **Trunk-only system** is the first generation of BRT
- Many have failed due to highly inflexible system, unable to grow and expand
- Should be avoided for future BRT system introduced



- **Trunk & Feeder system** requires passengers to transfer
- Transfers have a large cost, even at well-design transfer location
- Access to terminals requires additional time for vehicle and passenger circulation



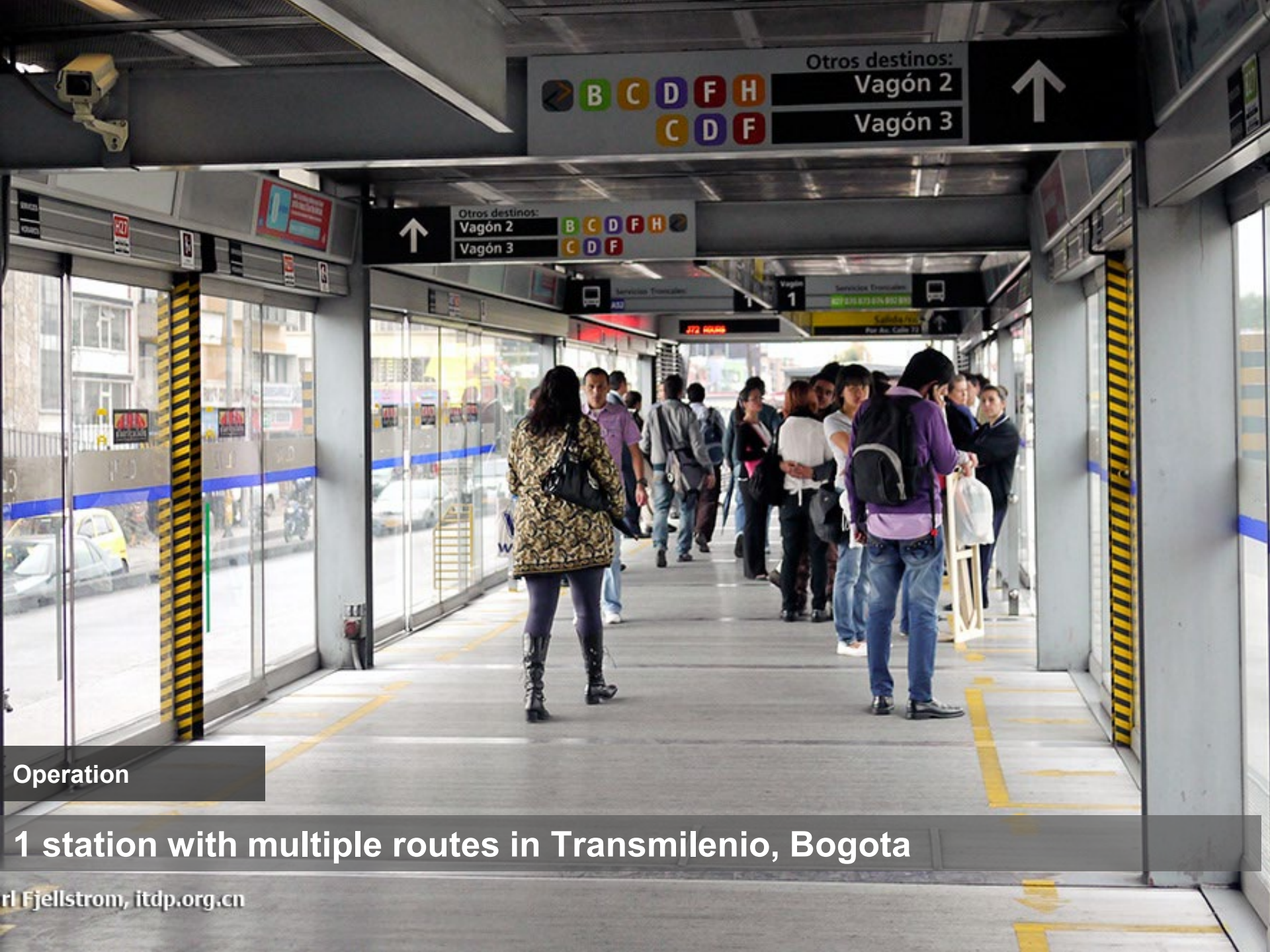
- **Direct service system** minimizes passenger transfers
- Frequency on the BRT lane increases, as many more routes are included in the BRT
- Route service for the BRT service will also be greatly expanded throughout the city



Direct Service Concept

With 'Direct-Service' operation, buses can travel both on and off the BRT corridor.

This eliminates many transfers, minimizes waiting time for passengers, and means that transfer terminals and interchange stations are not needed.



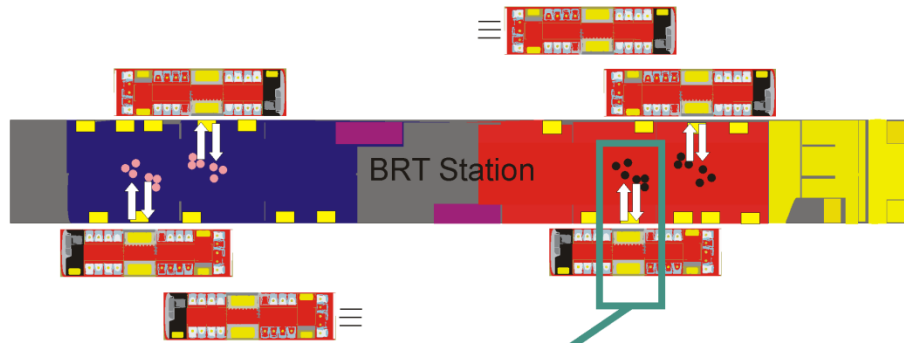
Operation

1 station with multiple routes in Transmilenio, Bogota



Direct Service Operational Model

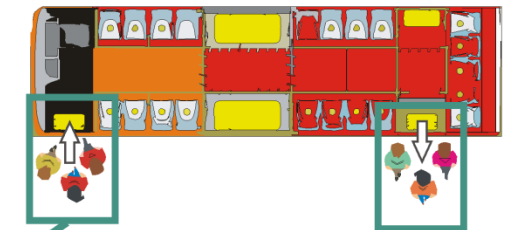
BRT Segment



Access for BRT Station

- No additional fare for passenger
- Free transfer between direct service to other routes within BRT Station

Off BRT Segment



ENTRANCE

EXIT

- Same fare between BRT and direct service routes
- Payment On Board (farebox or by guard)
- Revenue handling by BRT regulator
- Smart Card Ticket



Intersection improvement in Guangzhou after BRT



In Guangzhou, most intersection with BRT is changed from 4-phase (before BRT) to 2-phase (with BRT)



Changed to a 2-phase intersection and combined with at-grade BRT station access. Previously a major traffic blackspot, now operates smoothly

An aerial perspective of a modern BRT station. The station features a large, white, arched roof structure supported by a network of steel trusses. A yellow BRT bus is stopped at the platform, which is enclosed by a glass and metal barrier. The road is marked with yellow lines and the letters 'BRT' in large yellow characters. A blue car is visible in the adjacent lane. In the background, there are various urban buildings, including a tall skyscraper with a 'TOWER' sign and a blue building with a clock tower. The sky is blue with scattered white clouds.

ITDP BRT Projects & Designs



Johor Baru, Malaysia



Kuala Lumpur, Malaysia



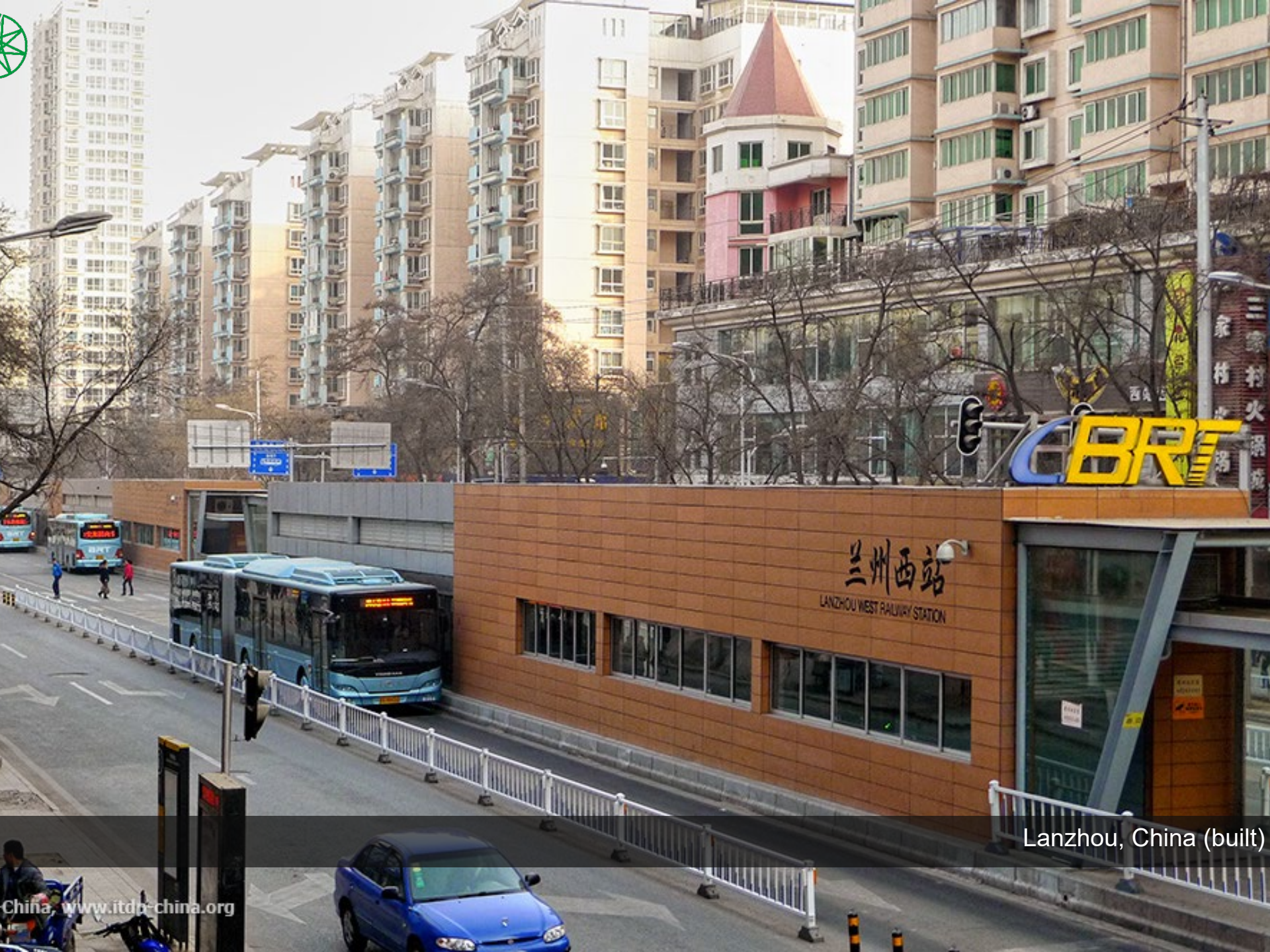
Vientiane, Lao PDR



Vientiane, Lao PDR



Jakarta, Indonesia



兰州西站

LANZHOU WEST RAILWAY STATION

Lanzhou, China (built)



Guangzhou, China(built)



Yichang, China (during construction)



Yichang, China (recently opened)



Thank You!

