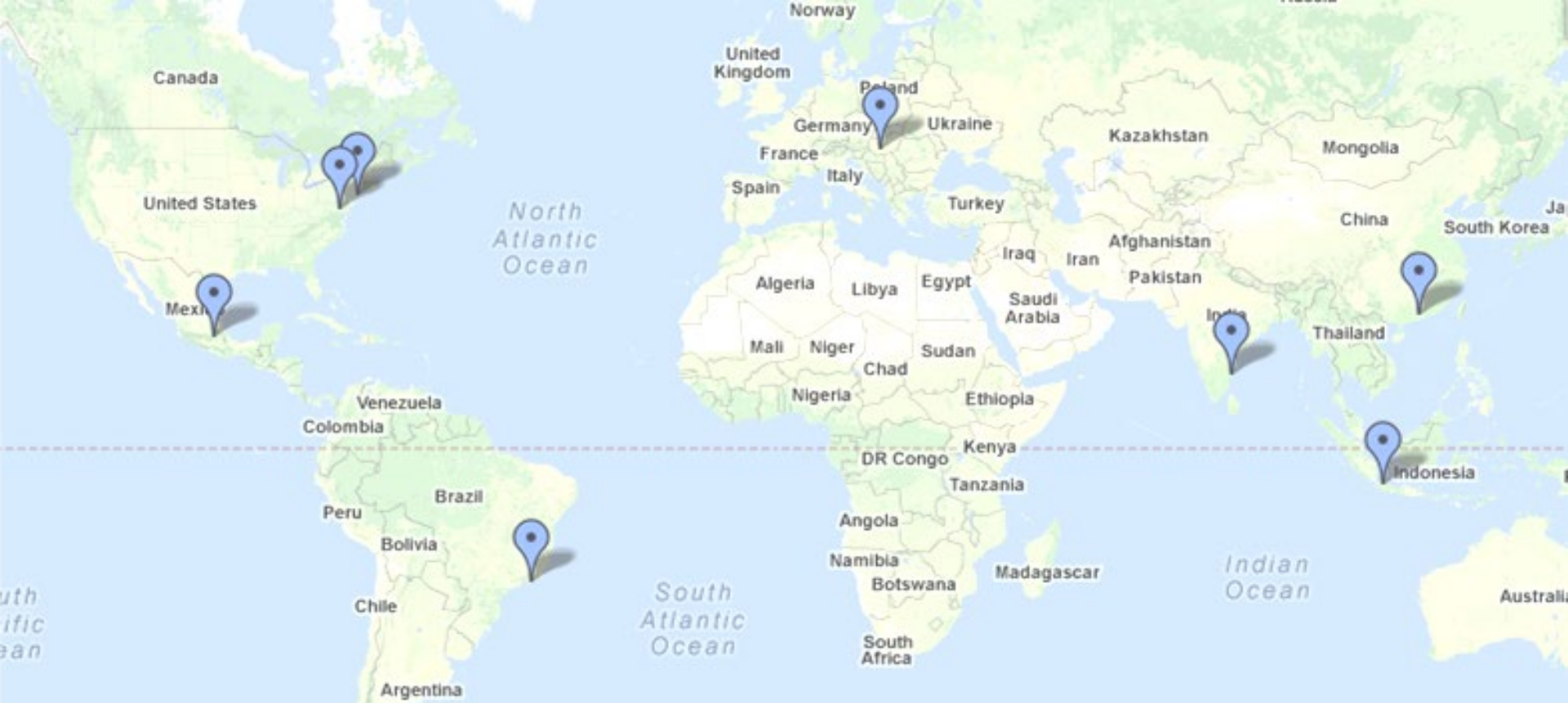
Bus Rapid Transit Development around the World as Transit Option

Faela Sufa | @itdpindonesia

Institut Teknologi Sepuluh Nopember , Surabaya, 25.04.2019



Institute for Transportation and Development Policy (ITDP)

Promotingenvironmentallysustainableandequitable 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.

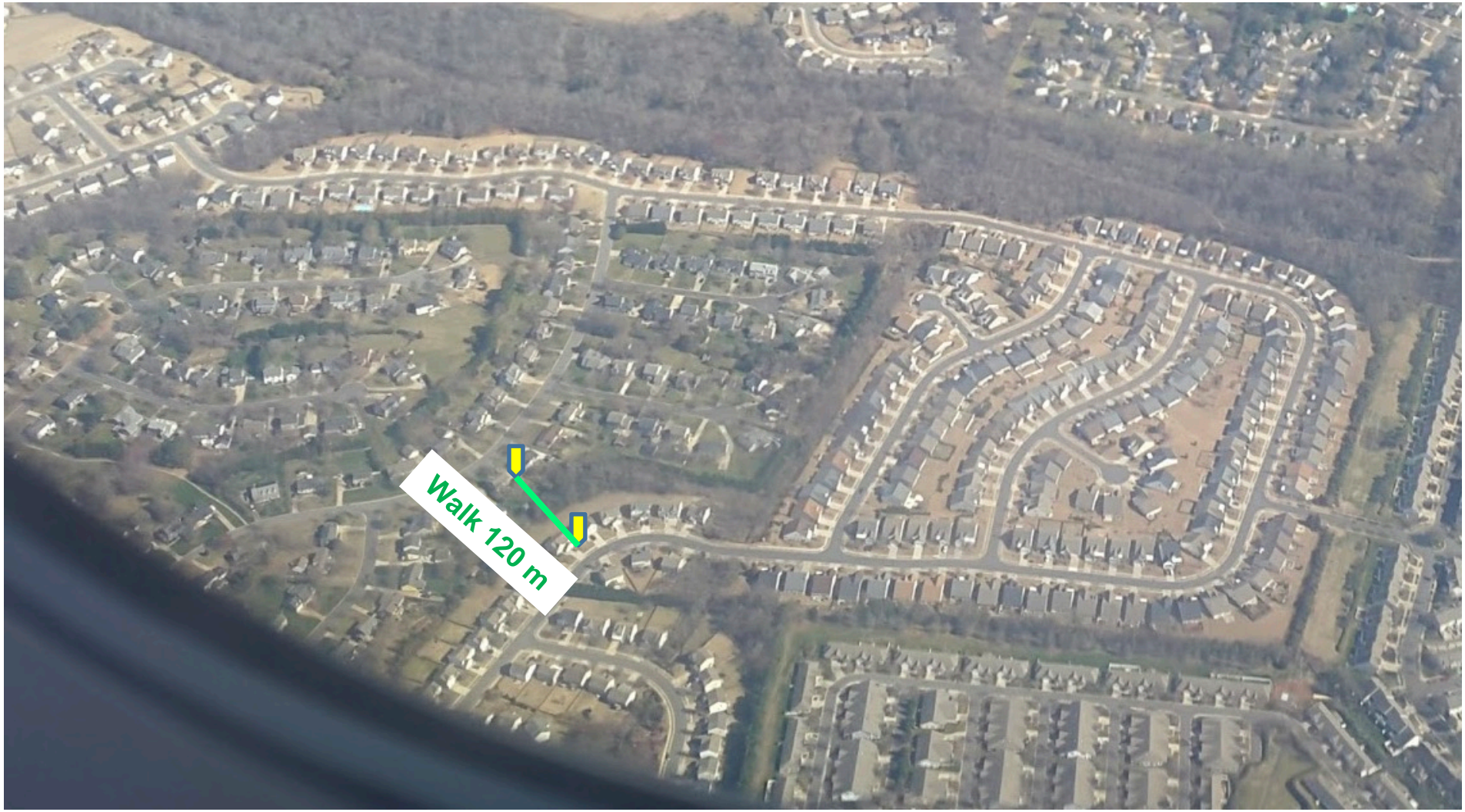
ITDP started to work in Indonesia since 1999 for Non-Motorized Transport development. Since then, we have been working in establishing Transjakarta, the first BRT system in SE Asia.

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…

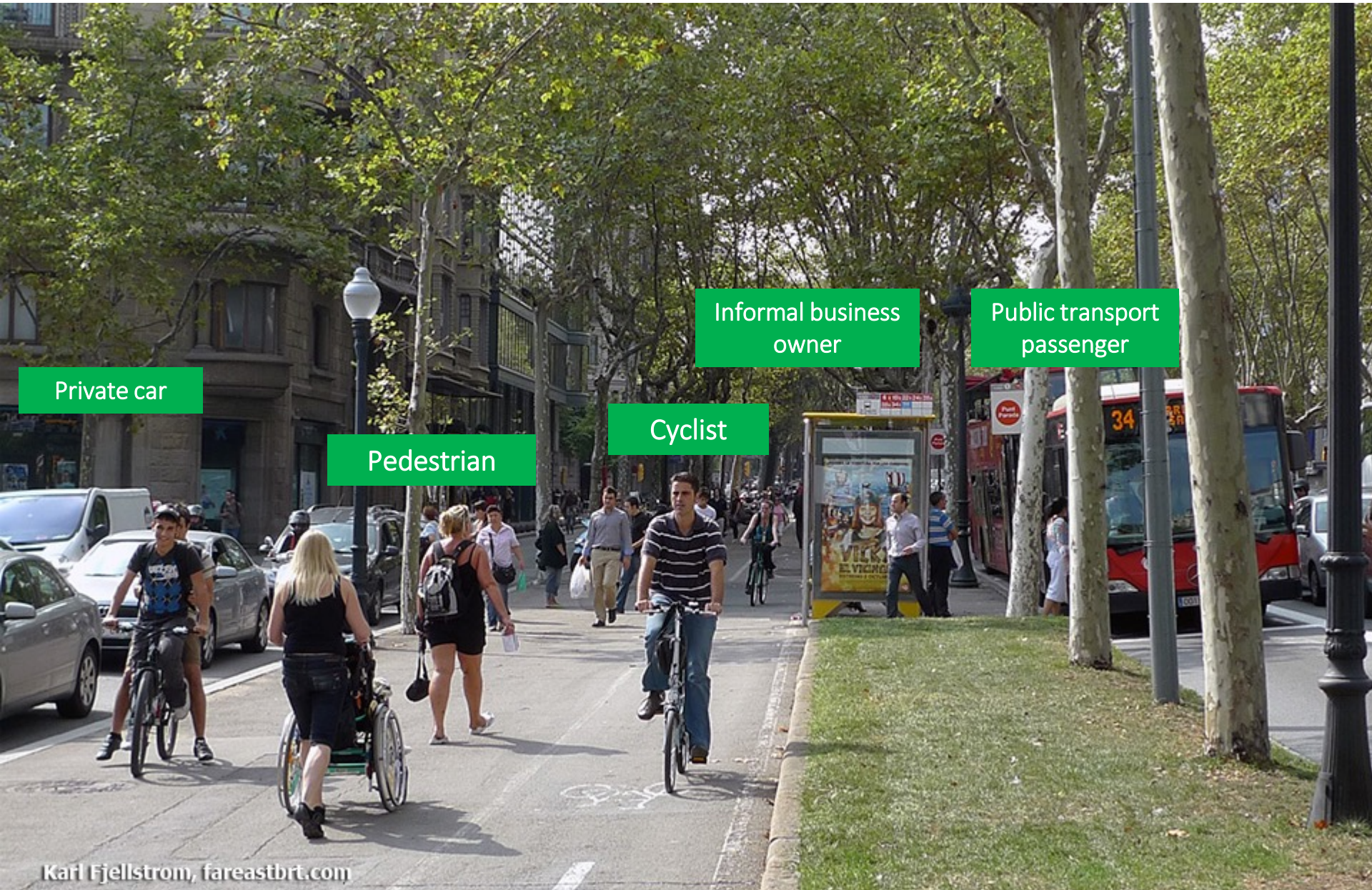


Short trip 120 meters to 2.5 km by car

Vehicle Oriented Development

Pedestrian do not have rights in the road space

Road Users


Private car
Pedestrian
Cyclist
Informal business owner
Public transport passenger
34
Karl Fjellstrom, fareastbrt.com

TOD Standard Principles

Walk
Develop neighborhoods that promote walking

Mix
Plan for mixed use/mixed income

Cycle
Develop neighborhoods that promote cycling

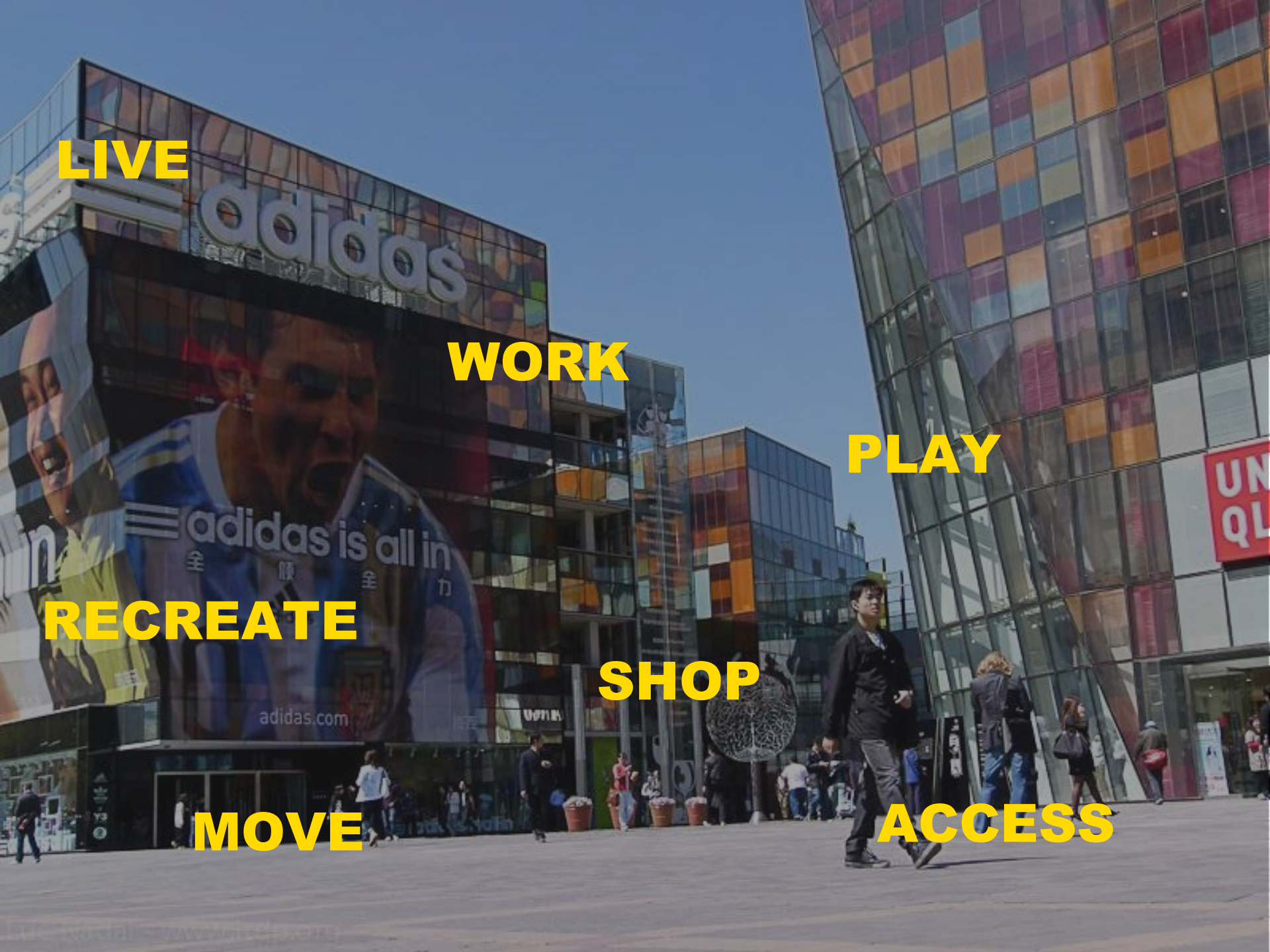
Densify
Optimize density and transit capacity

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
adidas
adidas is all in
adidas.com

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 | TOD REQUIREMENT

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 points

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 kendaran 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

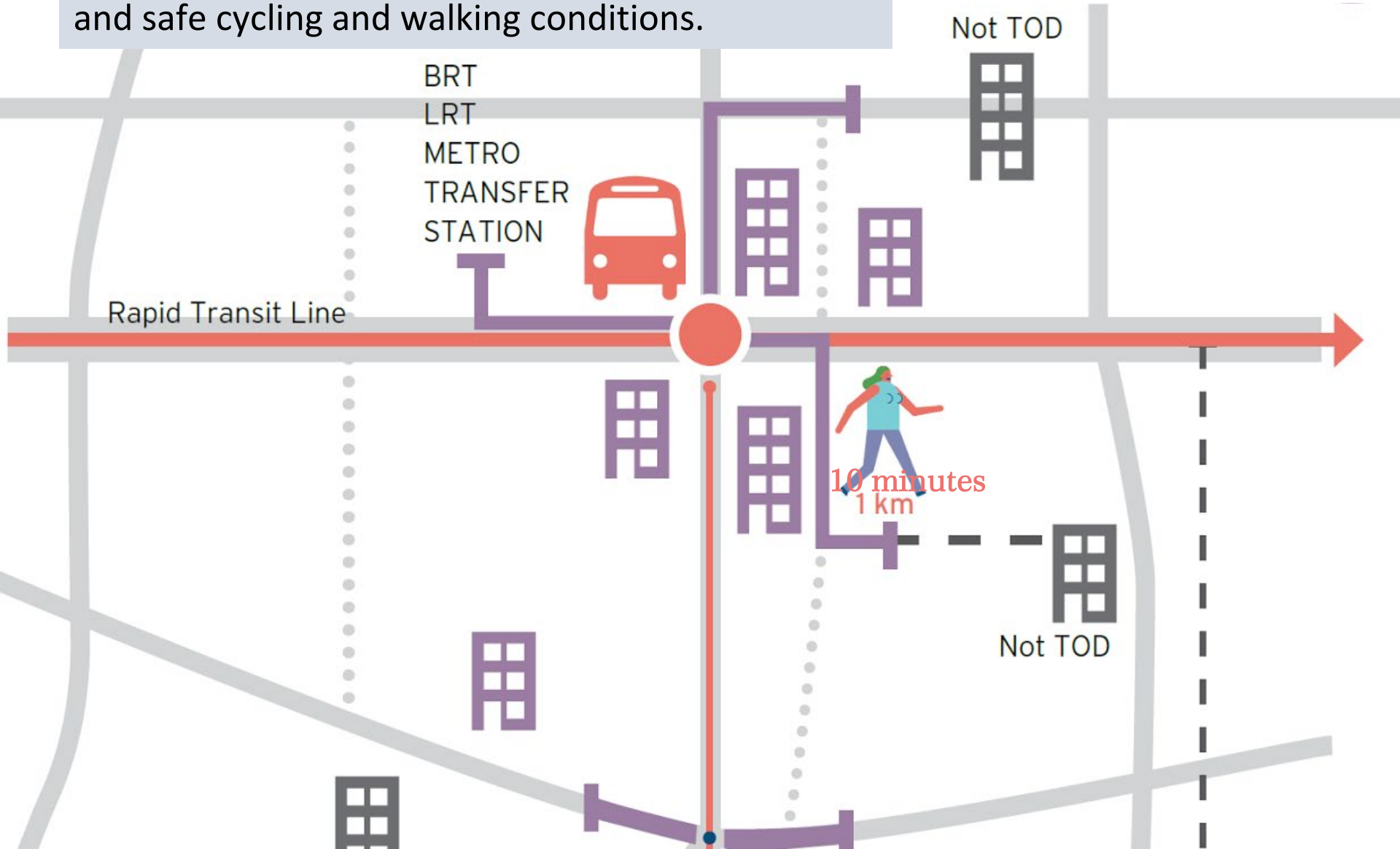
- Stasiun angkutan umum massal dalam jangkauan berjalan kaki

Kyoto Metro Station

Principle 4: TRANSIT

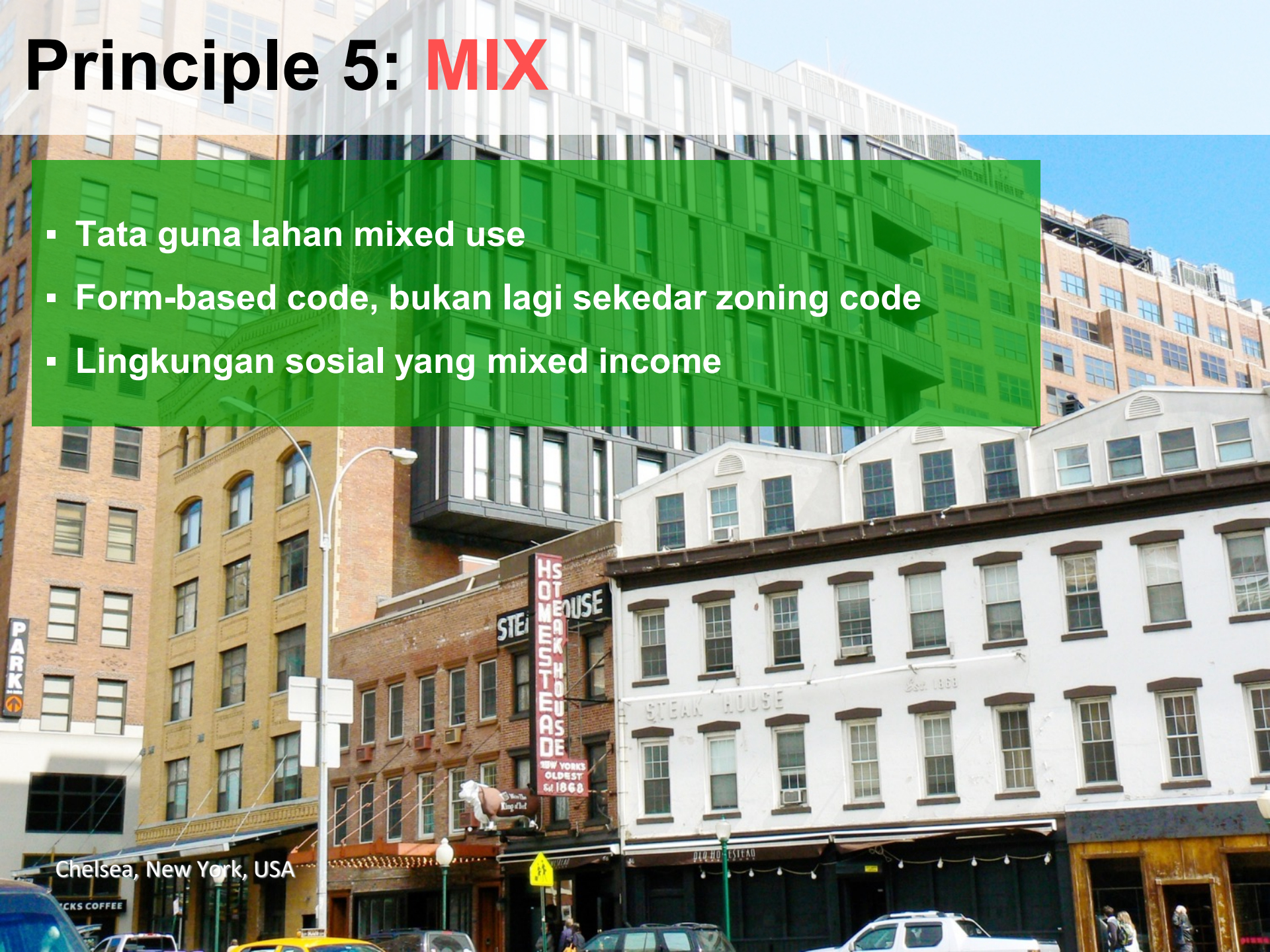
Transit-Oriented Development

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

- 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

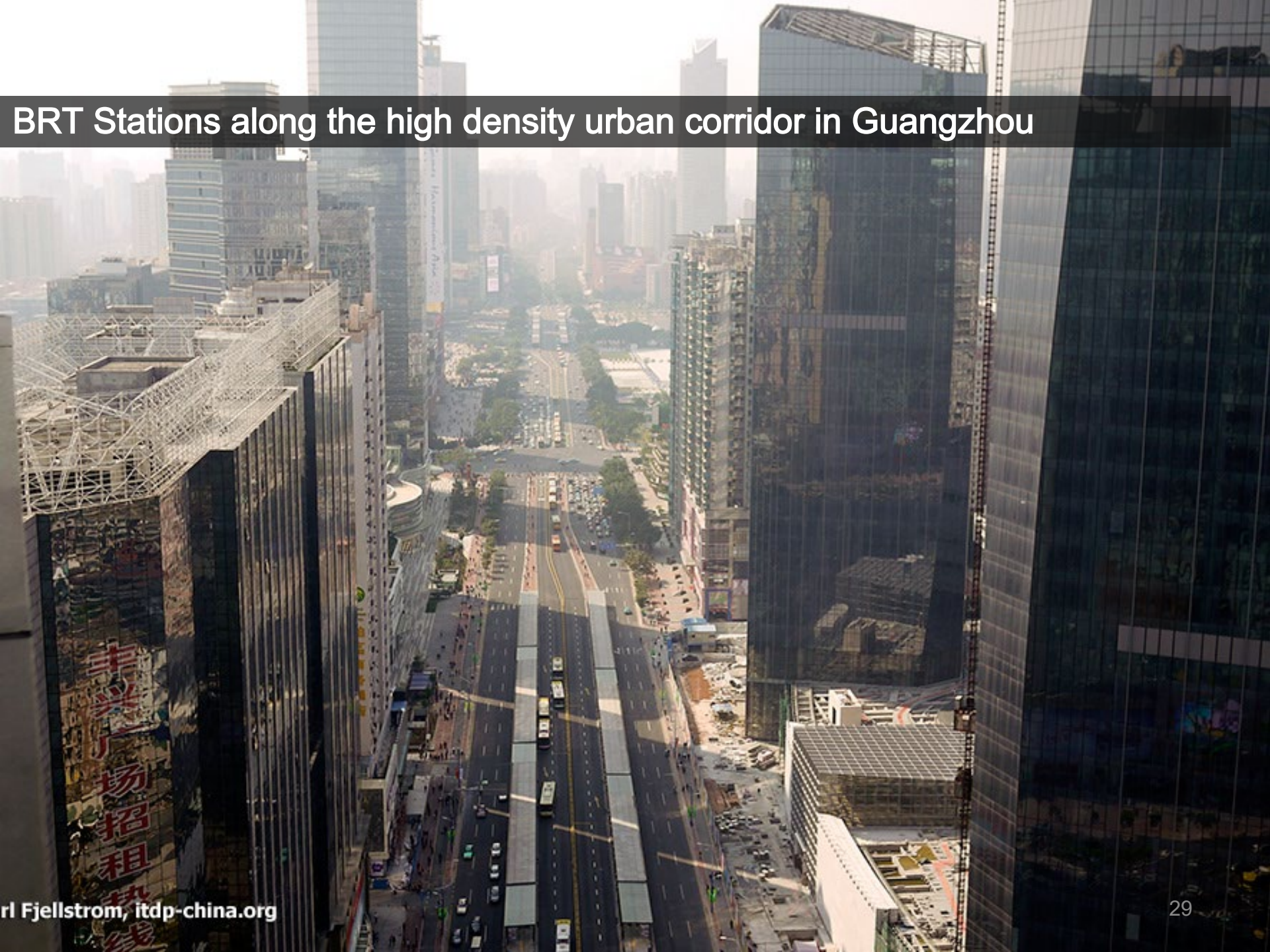
Curitiba, Brazil

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

Bogota, Colombia – the next big revolution in BRT design. This is the system in the downtown – a 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

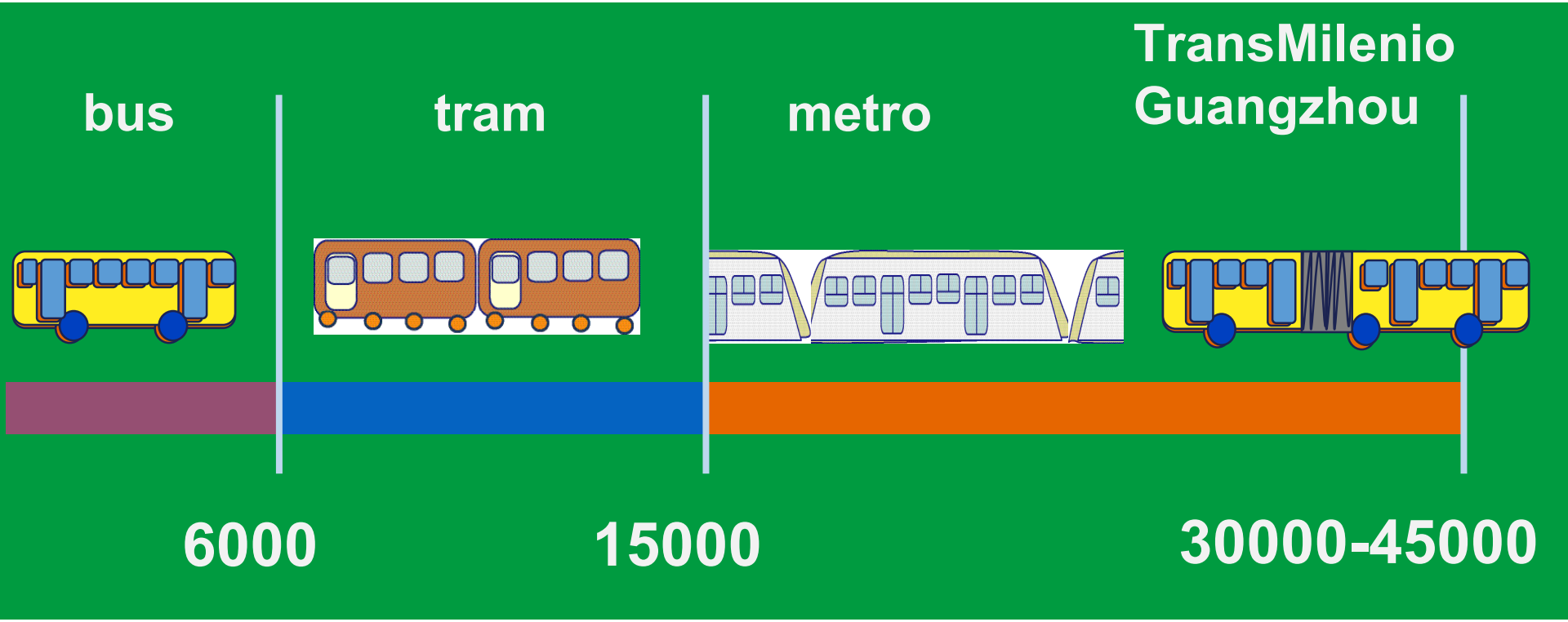
Planning and construction time

BRT : 18 - 24 months

Metro: 3 – 30 years

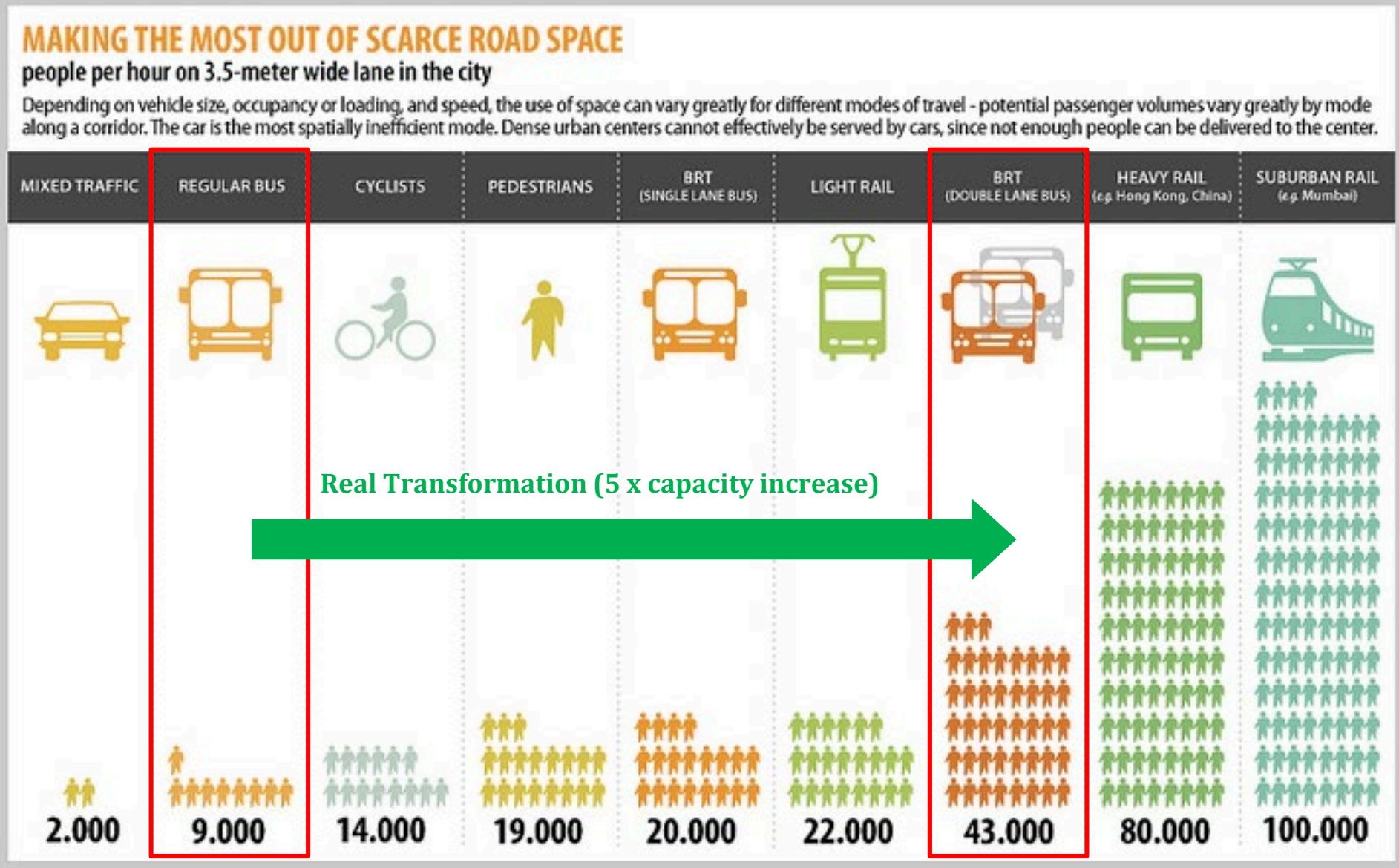
Passenger travel time savings are the main benefit of BRT Project

High capacity BRT systems in Bogota and Guangzhou n carry more than most metro systems worldwide



Passengers per hour per direction

Different Mass Transit corridor Capacity



Source: Changing Course in Urban Transport – an illustrated guide (ADB – GIZ)

Changes before-after BRT

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


IT快修中心

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


Tianhe Gongyuan before the BRT
ellstrom, ITDP


Tianhe Gongyuan before the BRT


Tianhe Gongyuan after the BRT implementation

Bogota, Colombia: Public transit beforeTransMilenio

BRT in Bogota


HPS PORTAL TUNAL
Av Calle 100
Av NQS
50

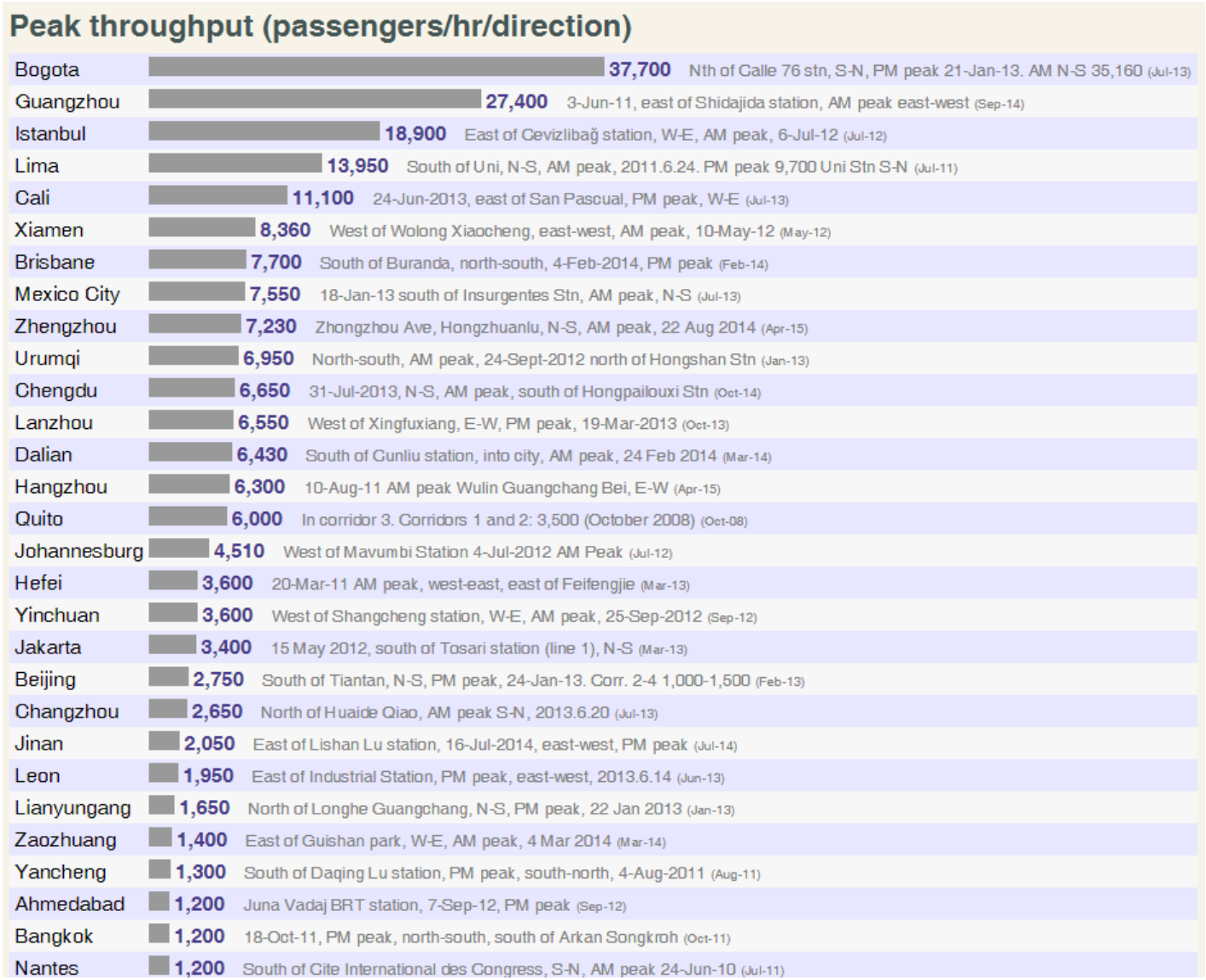

BRT in Bogota – highest throughput point in the system: only 36m wall-to-wall
TransMilenio
H20
S110

Why should we keep building BRT?

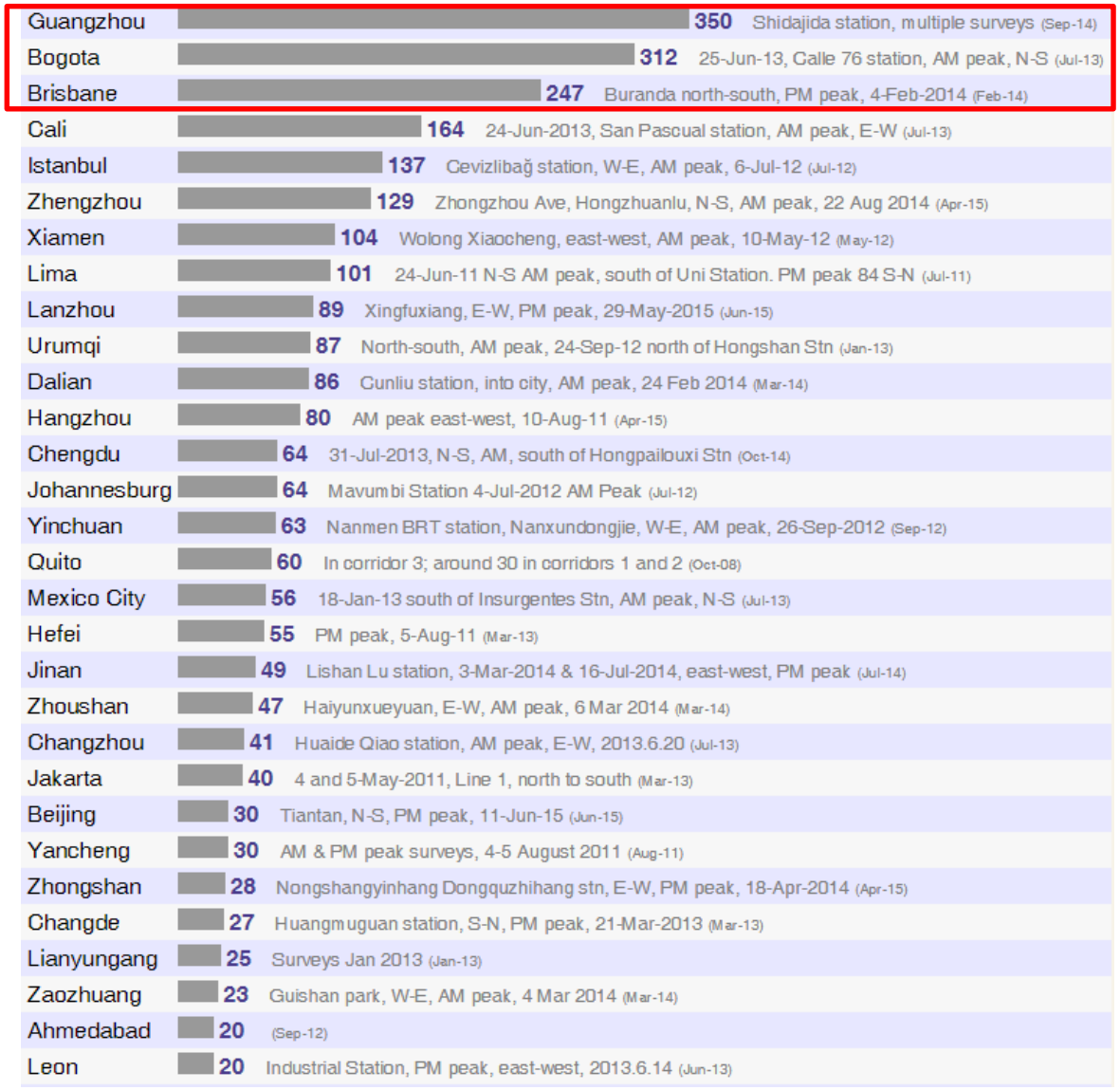
- Quick decision making process (finance less complicated, technology available)
- Faster time of construction
- Road infrastructure supports the system
- Flexibility in determining the bus route
- Suitable infrastructure for transition before the implementation of bigger system such as Subway
- Efficient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

BRT Concepts & Principles

BRT Passenger Throughput



City Centre bus frequency (bus/hour/direction



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
TransMilenio
TransMilenio
TransMilenio

Principle of BRT Design

BRT Key Design Components

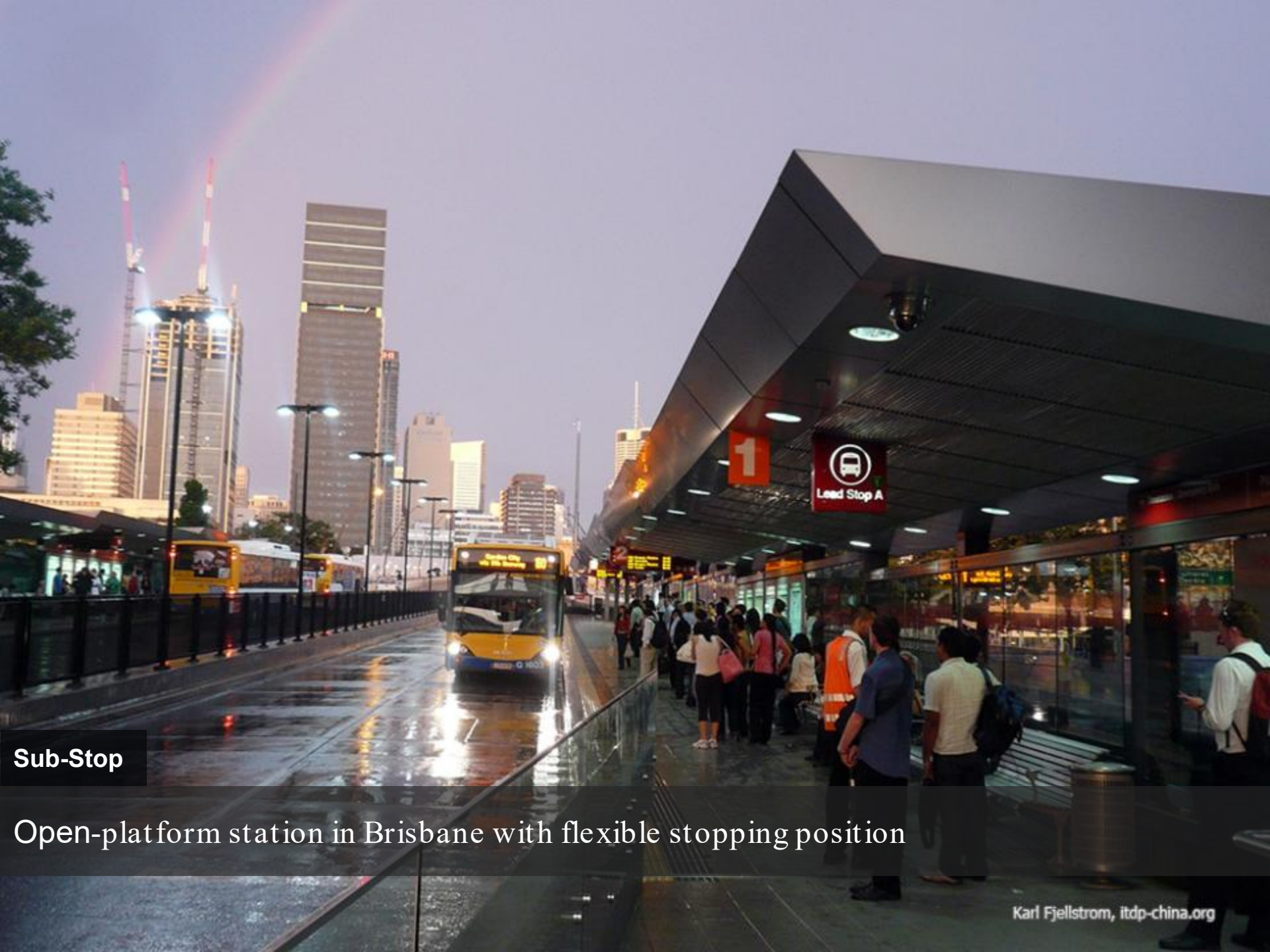
Sub-Stop

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

rt Fjellstrom, itdp-china.org

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

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

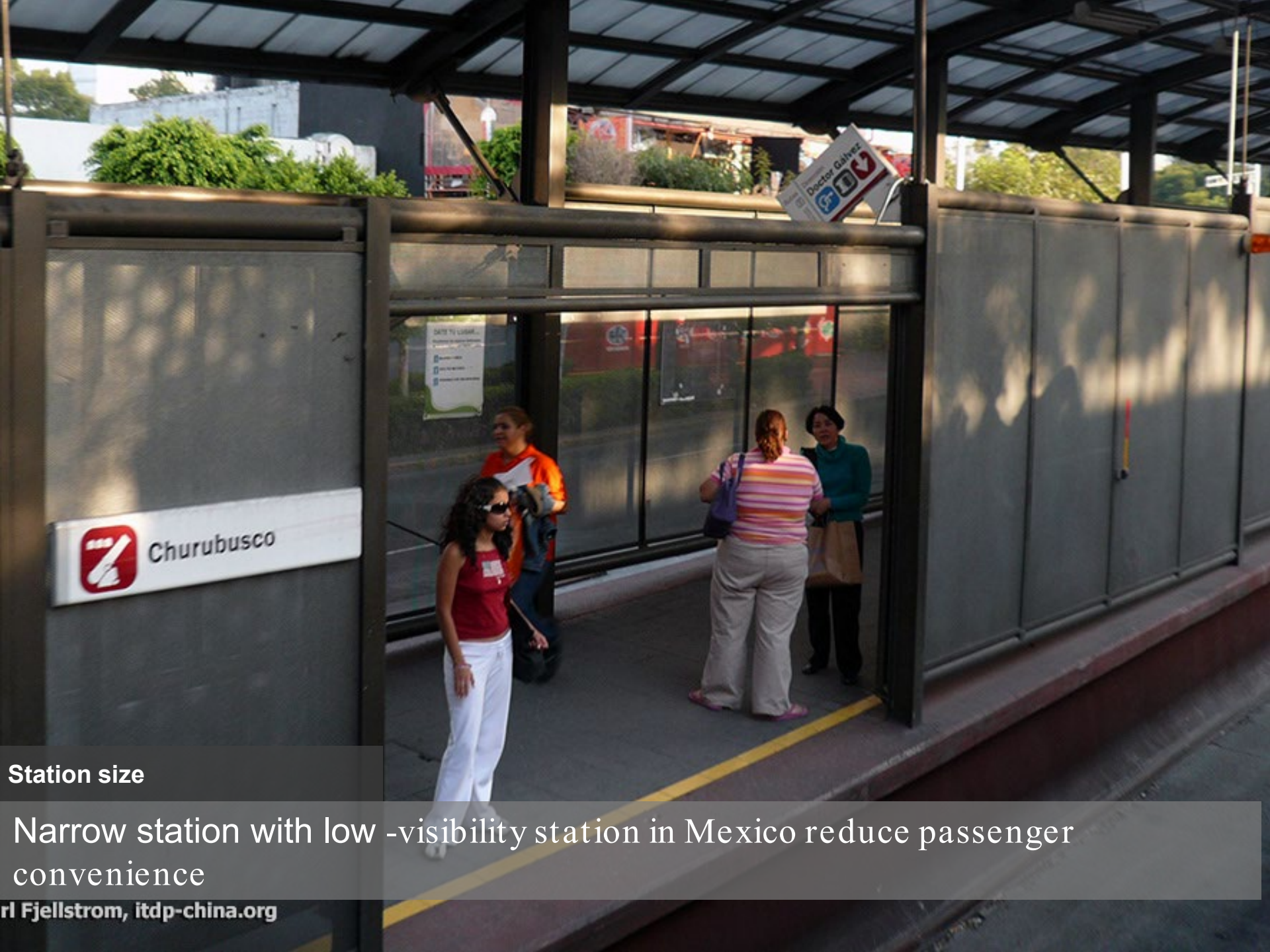
BRTBasics: Off board fare collection – Mexico City, Mexico

Off-board Fare Collection

Automatic barrier installed in Bangkok BRT


Off-board Fare Collection
Off board fare collection in urumqi
rl Fjellstrom, itdp-china.org


Station size
Long and wide BRT station in Johannesburg to anticipate future growth
Yoga Adiwinarto, ITDP-Indonesia.org



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
nyuan Zhu, itdp-china.org

Station location

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

Station design

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

rl Fjellstrom, itdp-china.org

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

ga Adiwinarto, ITDP-Indonesia.org

Station design

Outstanding BRT station design in Capetown promotes the BRT brand

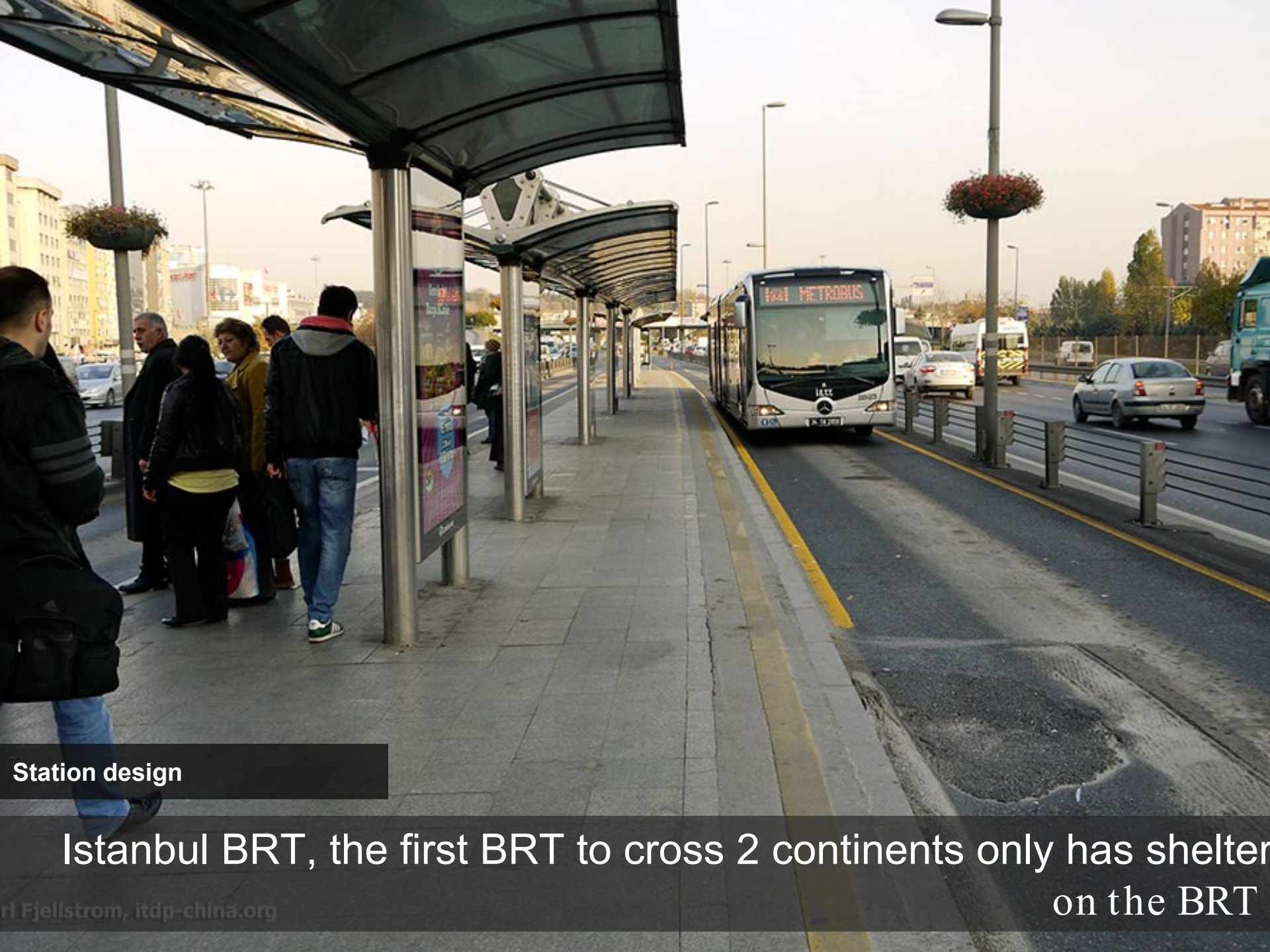
Station design

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 ci



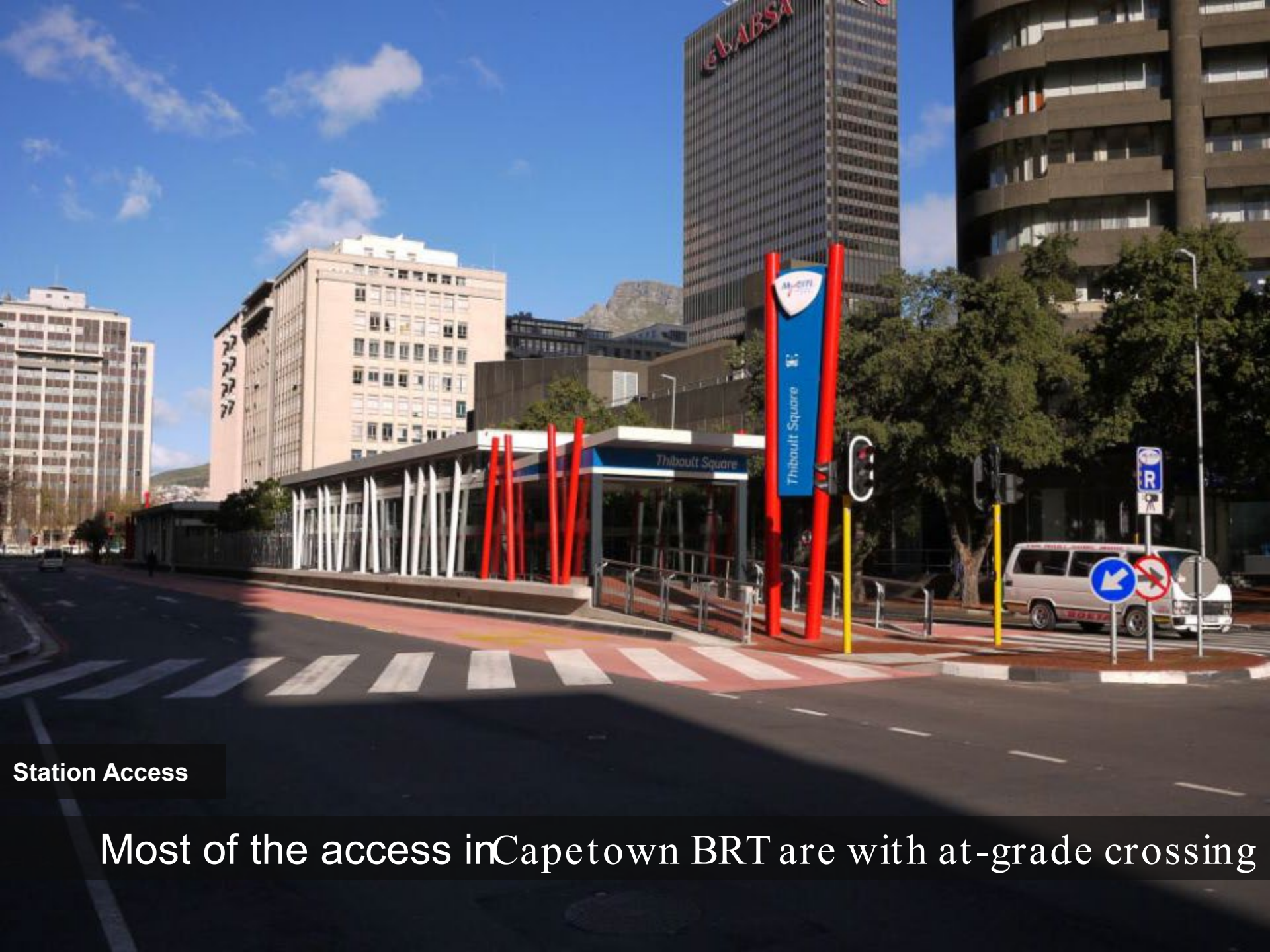
Station design

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 Capetown BRT are with at-grade crossing

Station Access

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

Station access

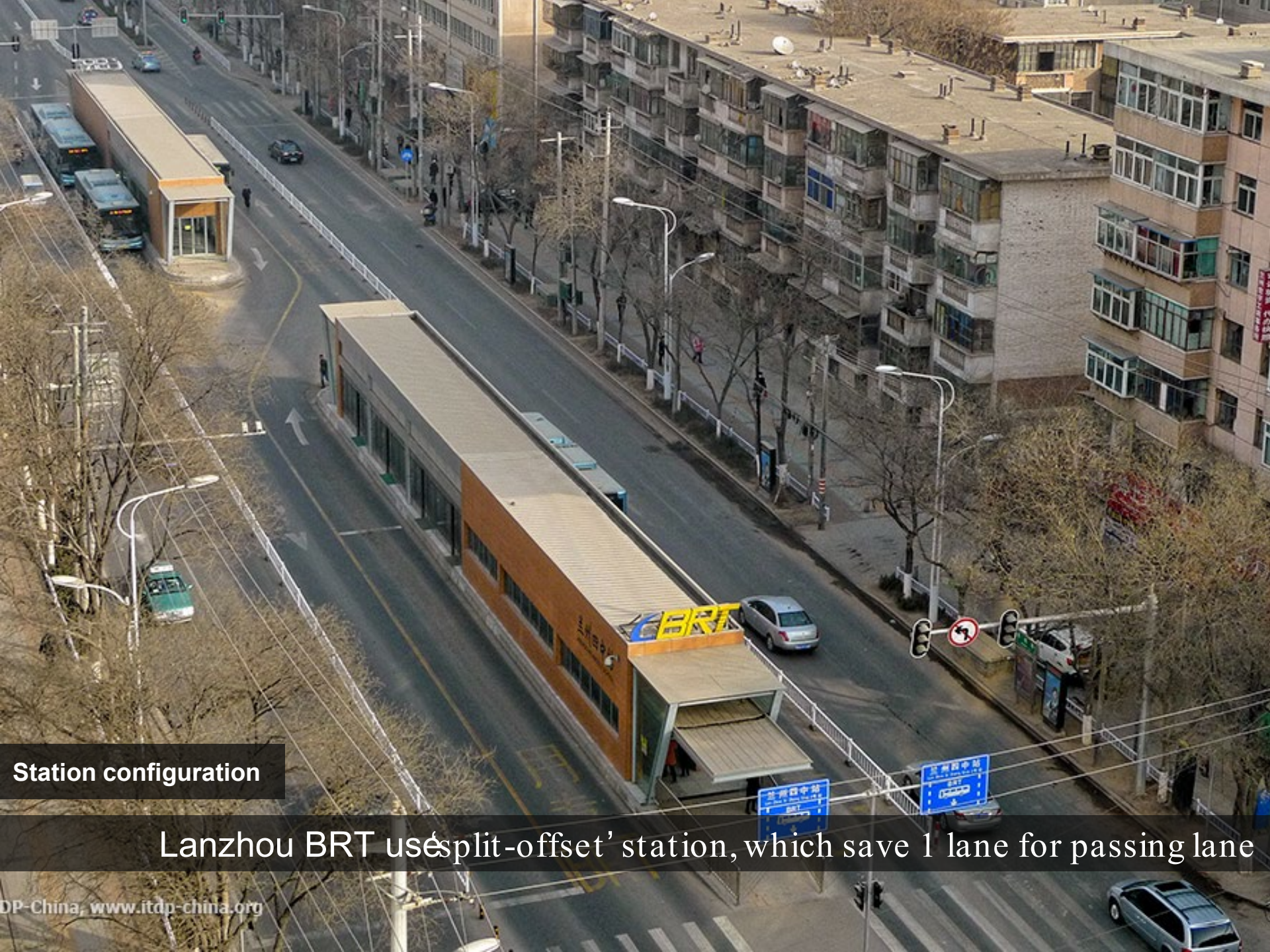
Long pedestrian bridge in Bogota BRT is overcrowded during peak hour

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


TransMilenio
TransMilenio
TransMilenio
TransMilenio
TransMilenio
TransMilenio

Depot Facility

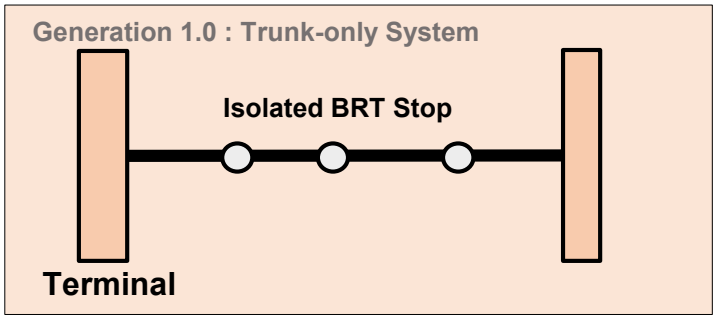
Modern bus Depot and workshop will support the bus lifetime, like in Bogota, where after 10 years contract, the contract was extended due to still perfectly good fleet

Fleet

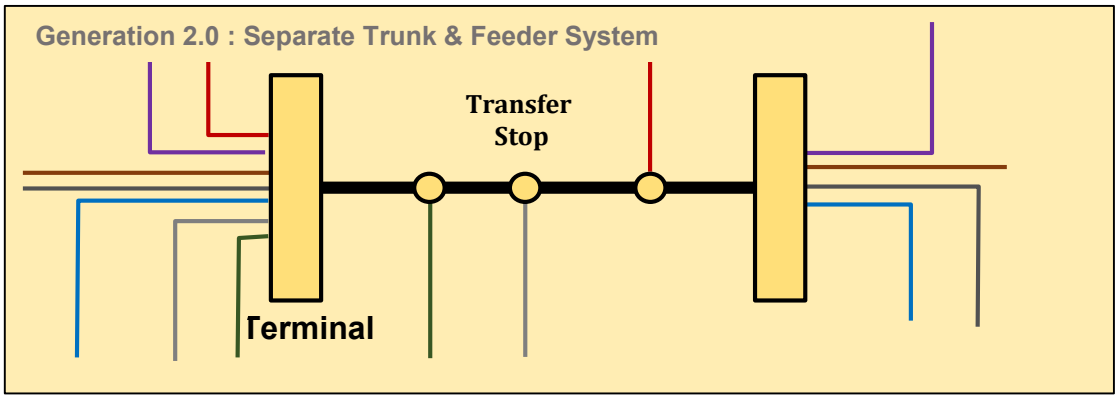
BRT fleet is design with high capacity, from 12 meter, 18 meter and 24 meter. The latter has capacity of 24 passengers.

BRT Operation

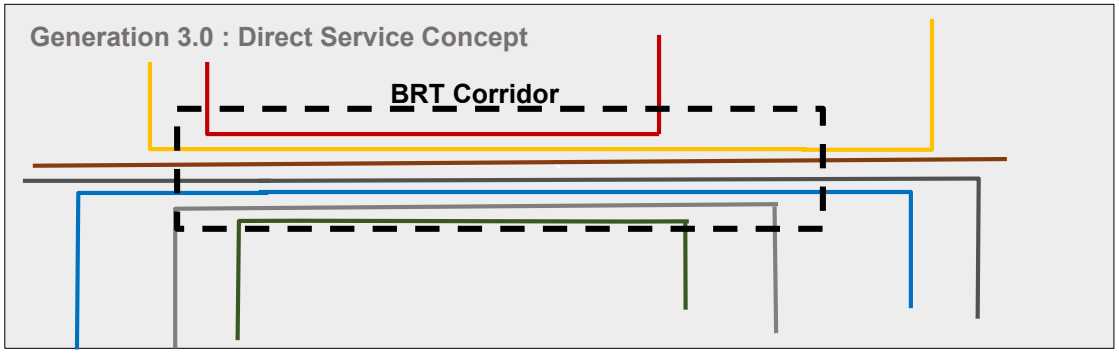
Different types of BRT Operation



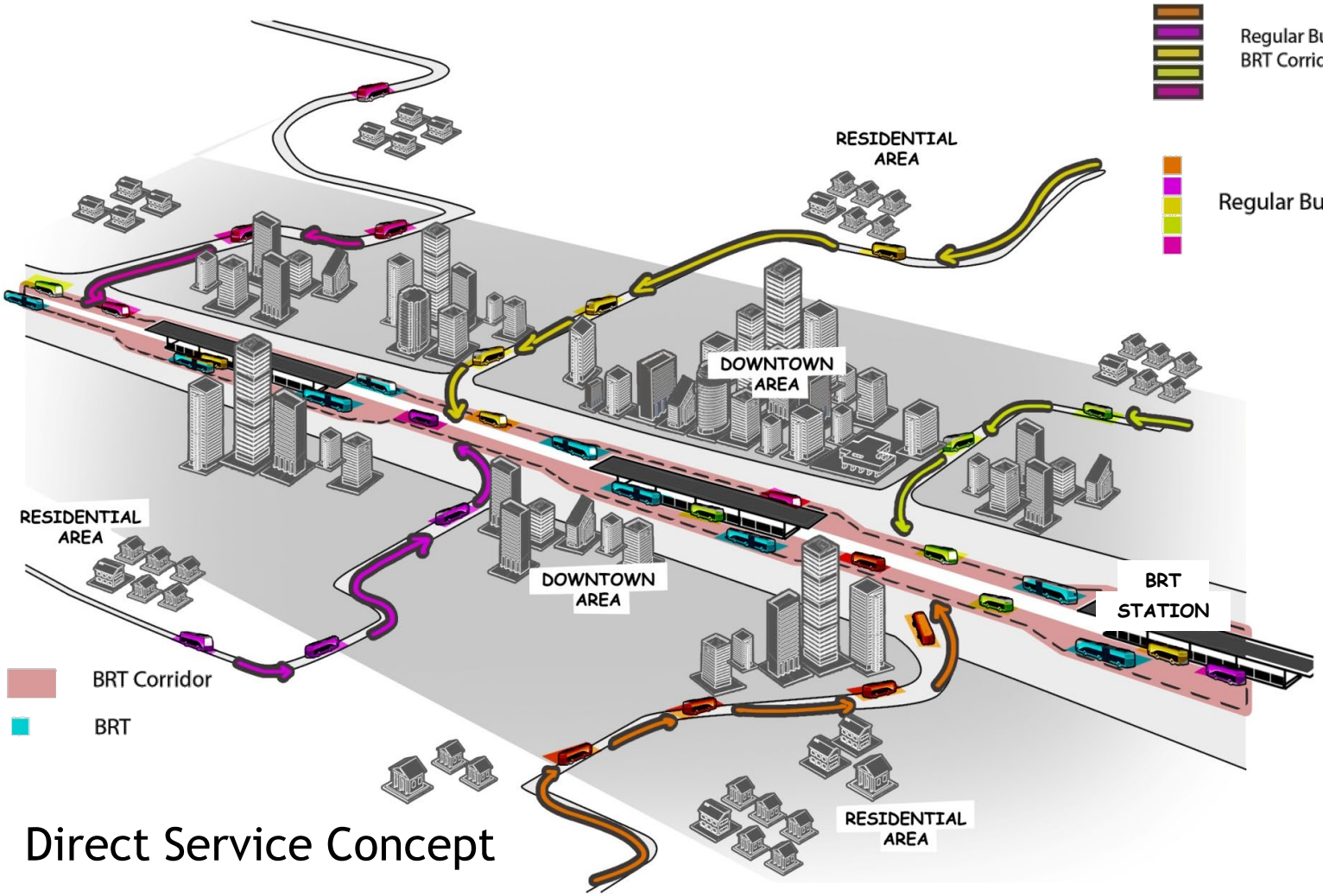
- **Trunk-only system** is the first generation of BRT
- Many have failed due to highly inflexible system, unable to grow and expand
- Should be avoided for future BRT system introduced



- **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



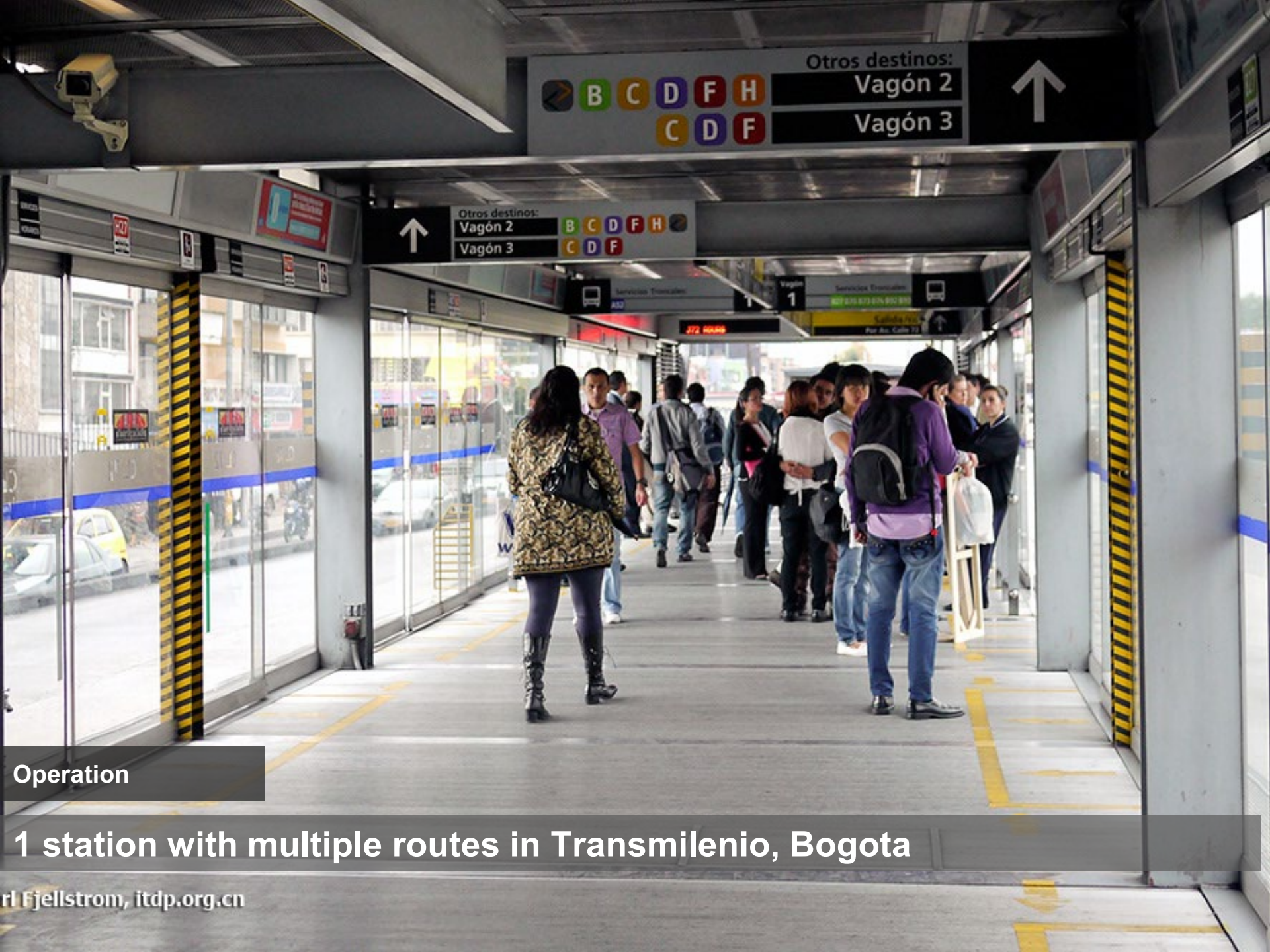
- **Direct service system** minimizes passenger transfers
- Frequency on the BRT lane increases, as many more routes are included in the BRT
- Route service for the BRT service will also be greatly expanded throughout the city



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

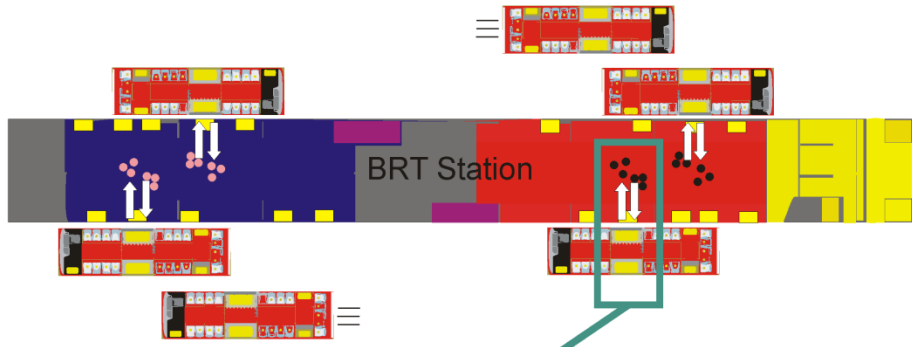
1 station with multiple routes in Transmilenio, Bogota

rl Fjellstrom, itdp.org.cn

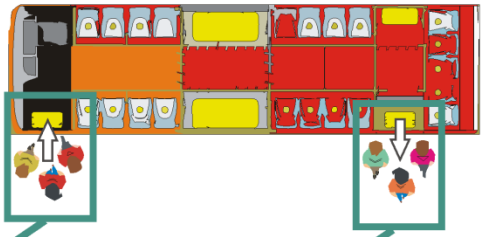
Direct Service Operational Model

-

BRT Segment



Off BRT Segment



Access for BRT Station

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

ENTRANCE

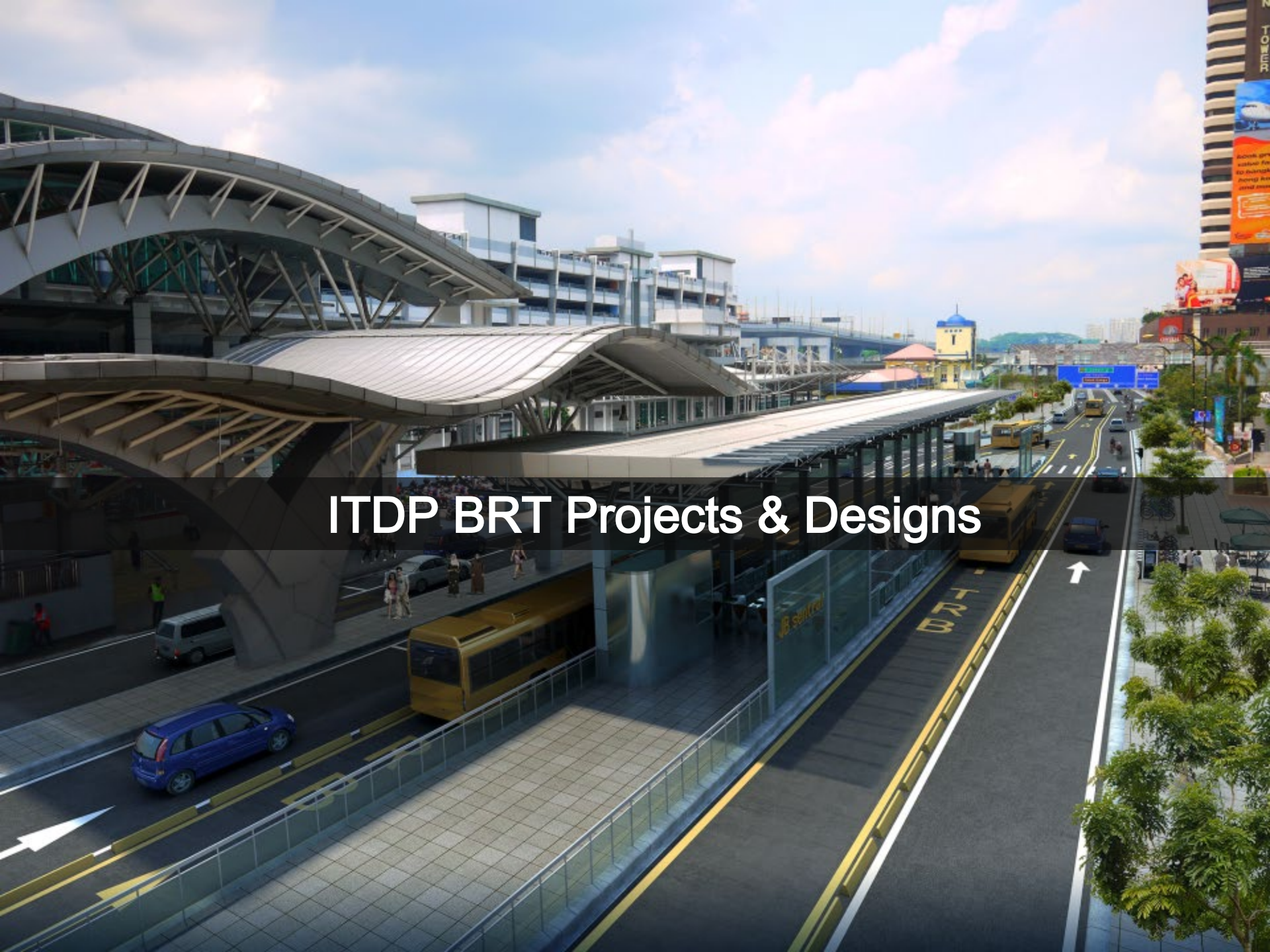
EXIT

- 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)
Karl Fjellstrom, itdp-china.org

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



ITDP BRT Projects & Designs

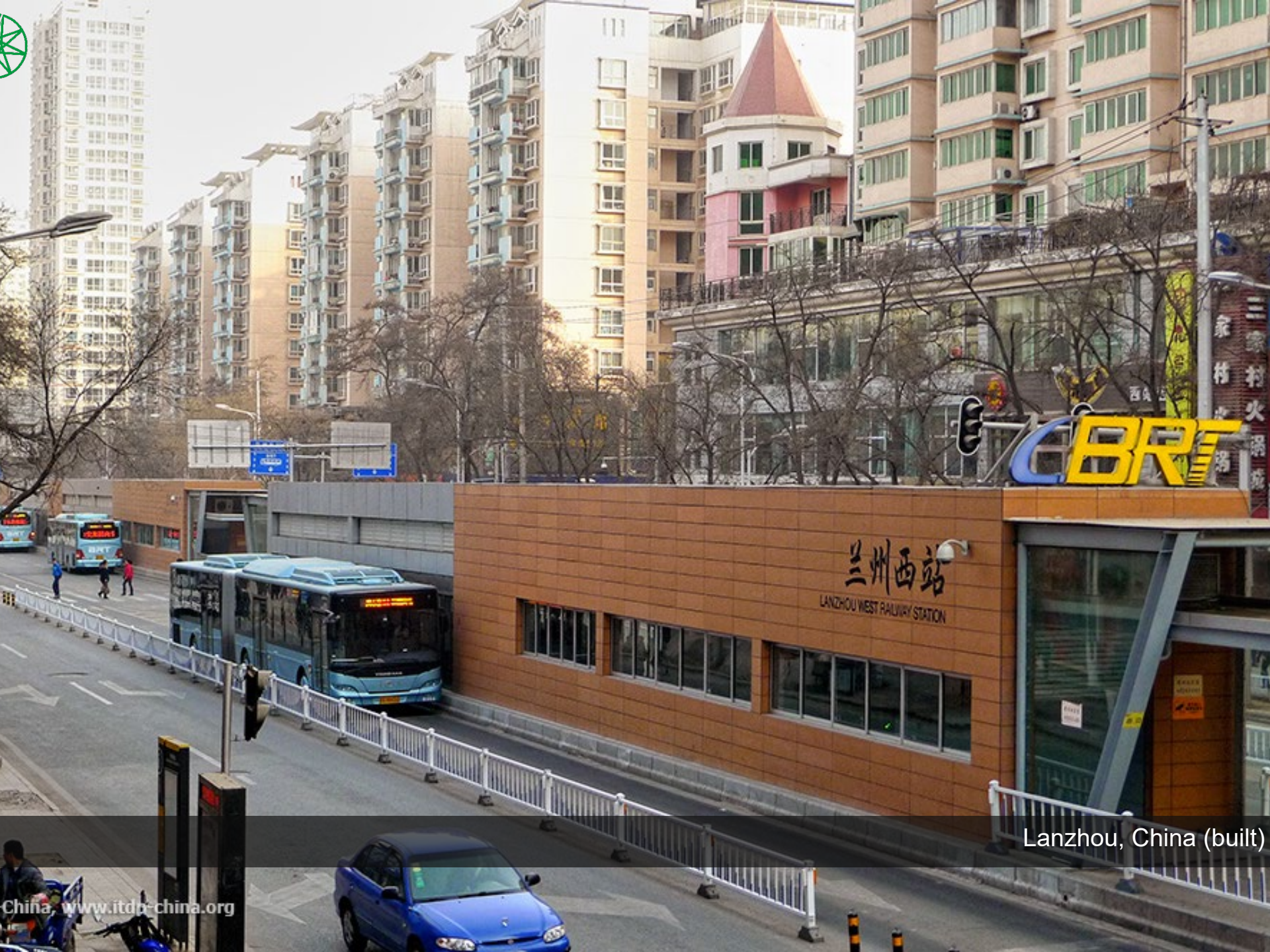
Johor Baru, Malaysia

Kuala Lumpur, Malaysia

Vientiane, Lao PDR

Vientiane, Lao PDR

Jakarta, Indonesia



Lanzhou, China (built)

Guangzhou,China(built)

Yichang, China (during construction)

Yichang, China (recently opened)

faela.sufa@itdp.org