PUBLIC TRANSPORTATION OPTIMIZATION

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PT issues in many developing cities

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- Dirty, overcrowded buses- "poor man's mode"
- Mix of modes
- >50% trips; <5% vehicle share
- Ad hoc planning
- No priority on roads

- Often high tax burden (much more than cars)
- No quality monitoring

Redefining Public Transport, Why?

CO_2 emissions from passenger transport vs. modal split: mode share can be influenced by policies and infrastructure

	% of public transport, walking and cycling	CO2 emissions (kg per capita per year)
Houston	5%	5690 kg
Montreal	26%	1930 kg
Madrid	49%	1050 kg
London	50%	1050 kg
Paris	54%	950 kg
Berlin	61%	774 kg
Tokyo	68%	818 kg
Hongkong	89%	378 kg

Source: UITP

Redefining Public Transport, Why? (cont'd)

Energy consumption and transport

	Modal share of walking, cycling and public transport		Average energy consumption per person (MJ)	
	1995	2001	1995	2001
Athens	34.1	40.9	12.900	12.600
Geneva	44.8	48.8	23.600	19.200
Rome	43.2	43.8	18.200	17.100
Vienna	62	64	10.700	9.050

Cities which increased the modal share of walking, cycling and PT saw a decrease in the consumption of energy for passenger transport per capita.

Source: UITP

Redefining Public Transport, Why?

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How far can I travel on 1 ton of CO_2?

(values given in passenger-kilometers)

All values reflect a **100% occupation rate.**

All values in passenger-kilometers (Pkm), **reflecting a 100% occupation rate**.

All data given in this diagram should be considered as guideline values, as real values may differ considerably, depending on e.g. actual load factors, smoothness of traffic flow and technical standards of vehicles and infrastructure.

Redefining Public Transport, Why?

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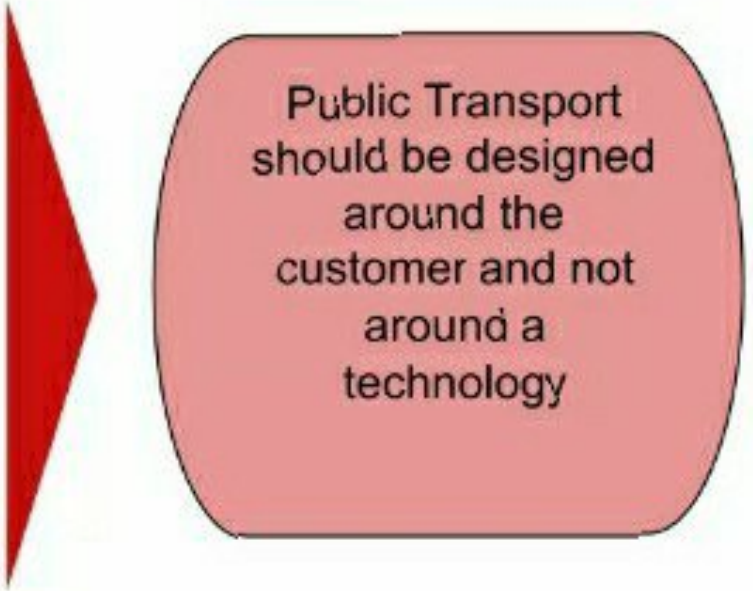
What do citizens want?

- ✓ Easy access
- ✓ Rapid journey
- ✓ Convenience
- ✓ Comfort
- ✓ Frequent Service
- ✓ Safety
- ✓ Security
- ✓ Customer Service
- ✓ Low cost
- ✓ Have a network



Conventional Public Transport Planning Approach

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Step 1. Choose technology

Technology chosen due to manufacturer lobbying efforts

Design chosen to please existing operators

Technology chosen to help property developer

Step 2. Fit city to the technology

Reduce size of network due to financing limitations

Charge higher fares in attempt to pay for expensive system

Operate infrequent services to reduce operating losses

Require large subsidies for lifetime of system's operation

Step 3. Force customer to adapt to technology

Extensive marketing campaign to convince customers that system is in their interest

The innovative and successful approach

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Step 1. Design a system from customer's perspective

Rapid travel time

Few transfers

Frequent service

Short walk to station from home / office

Full network of destinations

Low fare cost

Safe vehicle operation

Secure environment

Comfortable and clean system

Friendly and helpful staff

Step 2. Evaluate customer-driven options from municipality perspective

Low infrastructure costs

Traffic reduction benefits

Environmental benefits

Economic / employment benefits

Social equity benefits

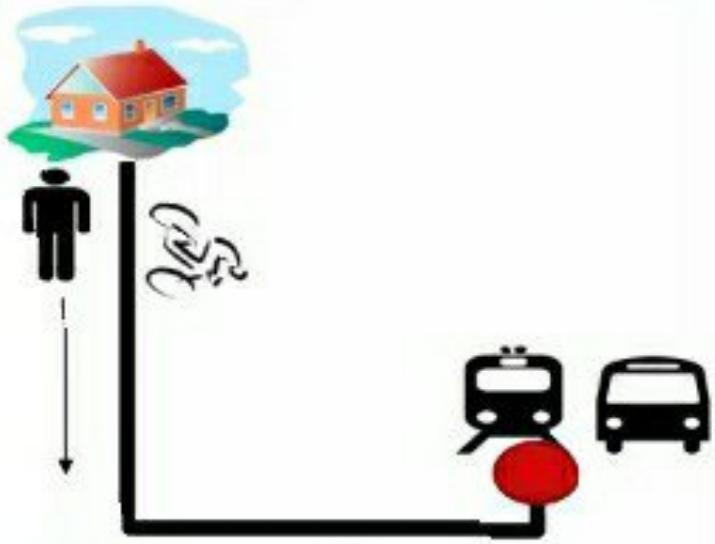
City image

Step 3. Decision

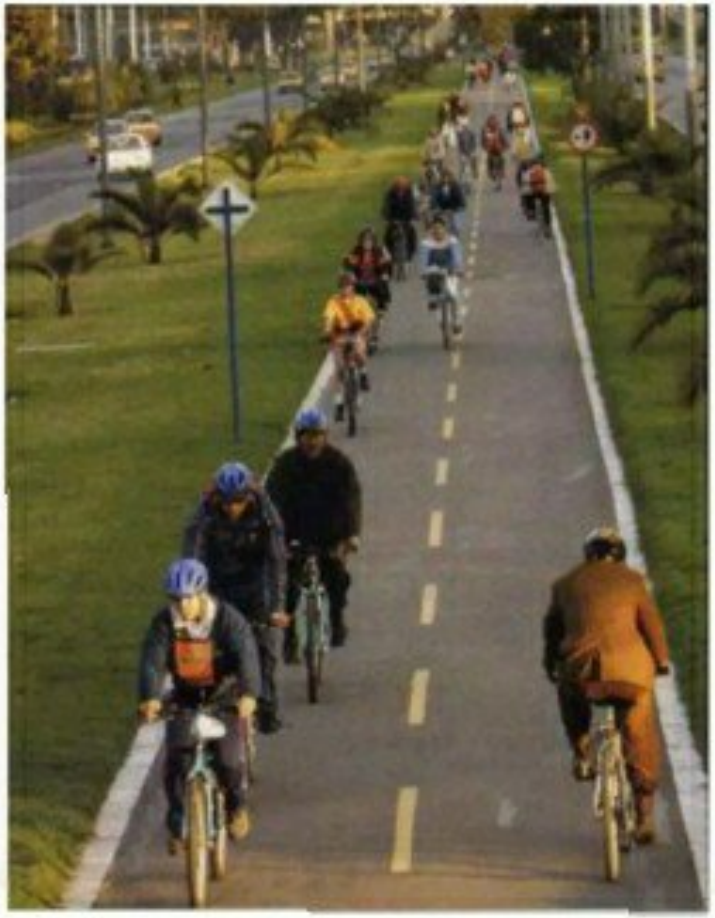
Technology decision based on customer needs and municipality requirements

Checklist for efficient public transport planning

Accessibility- Options



- How to reach the PT station?
  - Walk, bike or drive
  - How good is the path?



Station Design

- Passenger friendly designs?
  - Clear signage, disabled friendly
  - Better interchanges
  - Public amenities

Vehicle and infrastructure design

- Comfortable
- Capacity
- Attractive

Source: Carlos F. Pardo

Which one to select?


Source: Carlos F. Pardo

Public Transport priority

- Is PT prioritized over other modes?

Modal Integration

- Can an individual take his/her bicycle? Is it easy to walk? Should he/she can drive to the station?

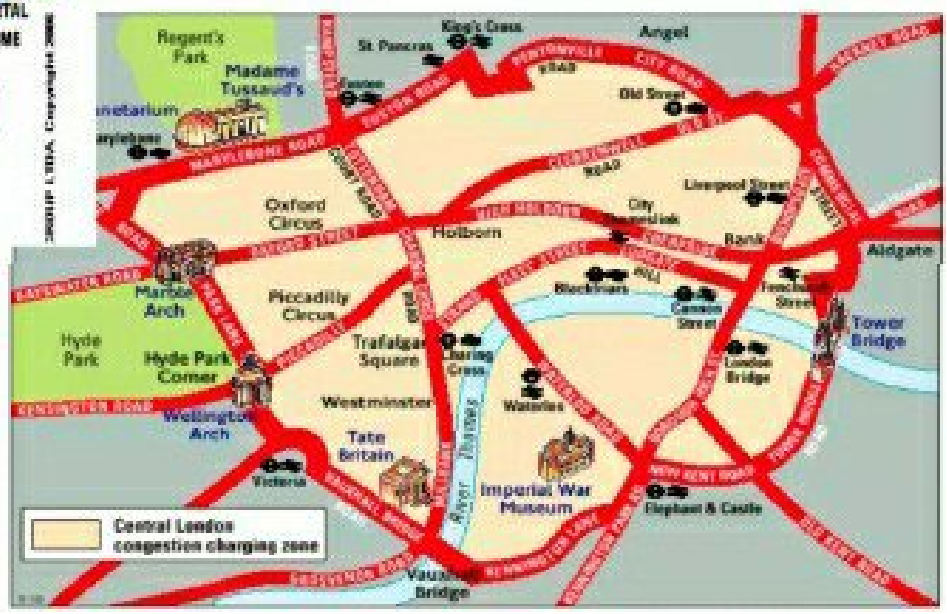
Professionalism

- Are the stations and the fleet clean?
- Do the drivers have good road etiquettes?

Slides developed originally by Lloyd Wright

Network coverage

- Can I reach the CBD, shopping district, *my home*?



Frequency, Reliability

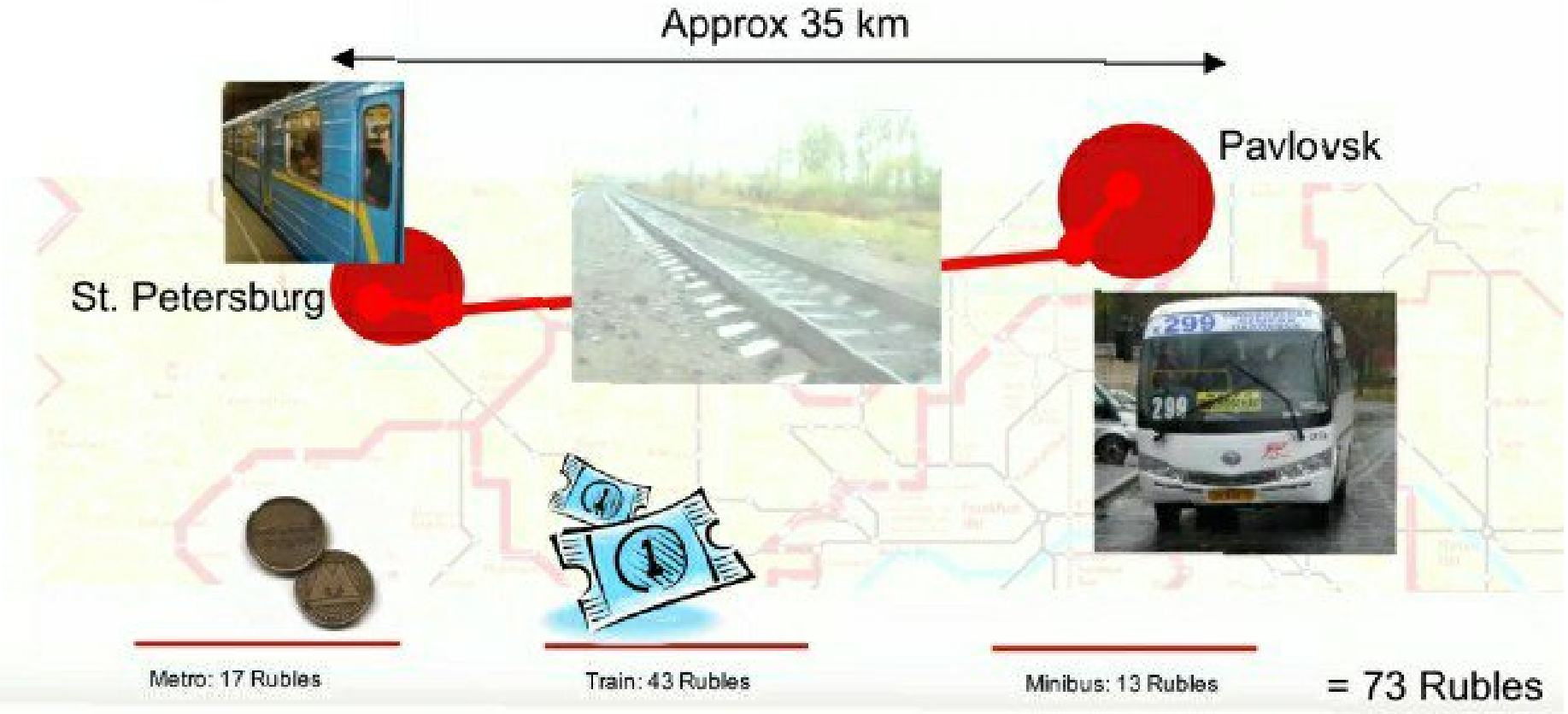
- How soon can I get a the next train, bus, tram?

Fare Integration

How not to do...

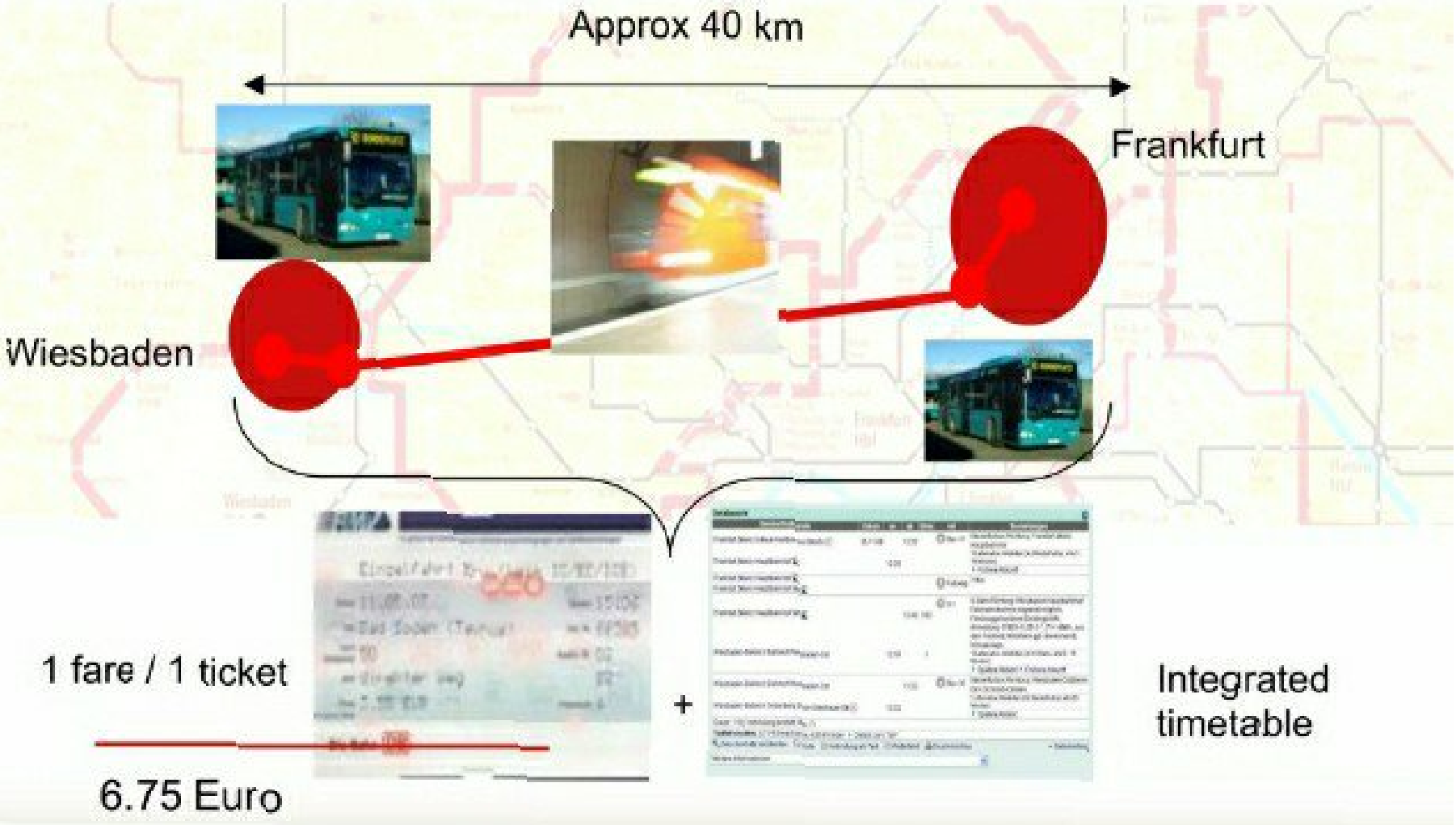
- How many times one should buy a ticket?
- Where one should buy the ticket?
- Who are the operators?

an example



Fare Integration...(contd)

How to do...an example



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Now let's look at
available options in Mass Transit

Different Mass Rapid Transit Modes available

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Heavy urban rail

Monorail

Underground metro

Light rail

BRT

Personal rapid transit

Selection of MRTS

- Selection of a particular mass transit system for a city will always remain a challenging task
- Affected by passengers, transit operators and the city or community
- Largely depends on the desired form and character of the city and its metropolitan area, and on its financial capability.
- Planning of transit systems is based on the projection of future demand for transit travel
- Depends mostly on the availability of right-of-way (ROW) for the transit systems.

Selection Criteria for MRTs

- Availability of the mode to meet demand
- Cost
- Right-of-way availability
- Environmental impact
- Journey time
- Safety
- Comfort
- Flexibility
- Reliability
- Fare
- Technical sophistication
- Implementation complexities
- Image

When comparing alternatives, there is no technological option that will outperform the others in every aspect...it will be a trade off

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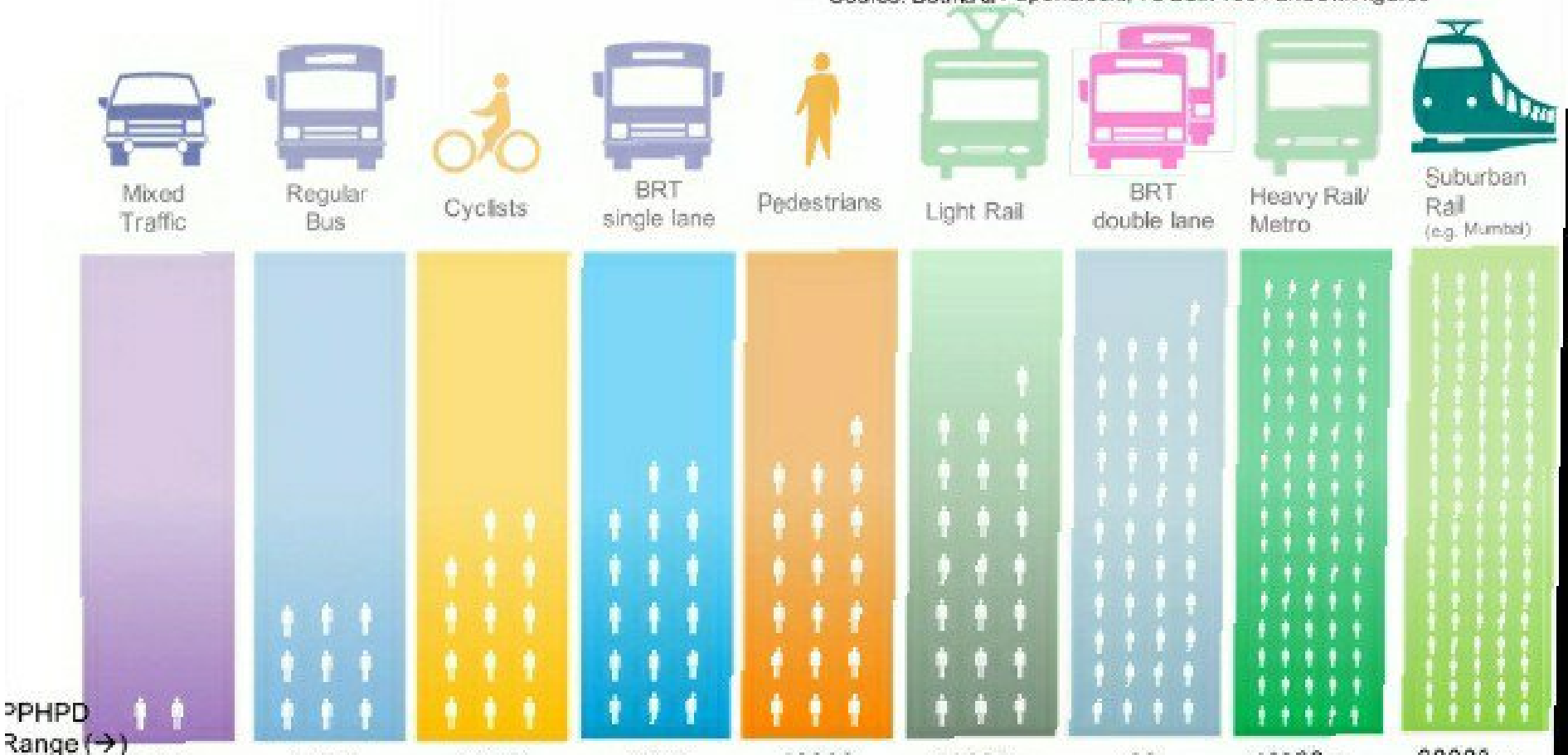
Characteristic	Priority lanes / only bus	Light rail/ street car	Heavy rail/ Metro	Bus Rapid Transit BRT
Required space	2-4 lanes existing roads	2-3 lanes existing roads	New road underground or elevated	2-4 lanes existing roads
Flexibility	High	Limited	Low	High
Impacts on traffic	Variable	Variable	Congestion reduction (?)	Variable
Integration with feeders	Easy	Difficult	Difficult	Easy
Level of service (frequency and occupancy)	Regular	Good	Very Good (dense corridor)	Good
Safety	Regular	Good	Very Good	Good
Emissions	High	Low	Low	High Medium
Reliability	Low	Low (bunching)	Good	Media
walk/transfers	Low	Medium	High	Medium

Sources: Adapted from el D. Hidalgo de Halcrow Fox, 2000, L. Wright and K. Fjellstrom, 2003, y V. Vuchic, 1992

Choosing modes – Carrying Capacity

(people per hour on 3.5 m wide lane in the city – PPHPD [PAX/hour/direction])

Source: Botma & Papendrecht, TU Delft 1991 and own figures



	Mixed Traffic	Regular Bus	Cyclists	BRT single lane	Pedestrians	Light Rail	BRT double lane	Heavy Rail/ Metro	Suburban Rail (e.g. Mumbai)
PPHPD Range (→)	1500-2000	5000	14000	9000	19000	18000–20000	??	40000–60000	60000–90000
Maximum PPHPD achieved & where (→)	2000	8000	14000	17000, Curitiba	19000	20000	43000, Bogotá	80000, HKK	>100000, Mumbai

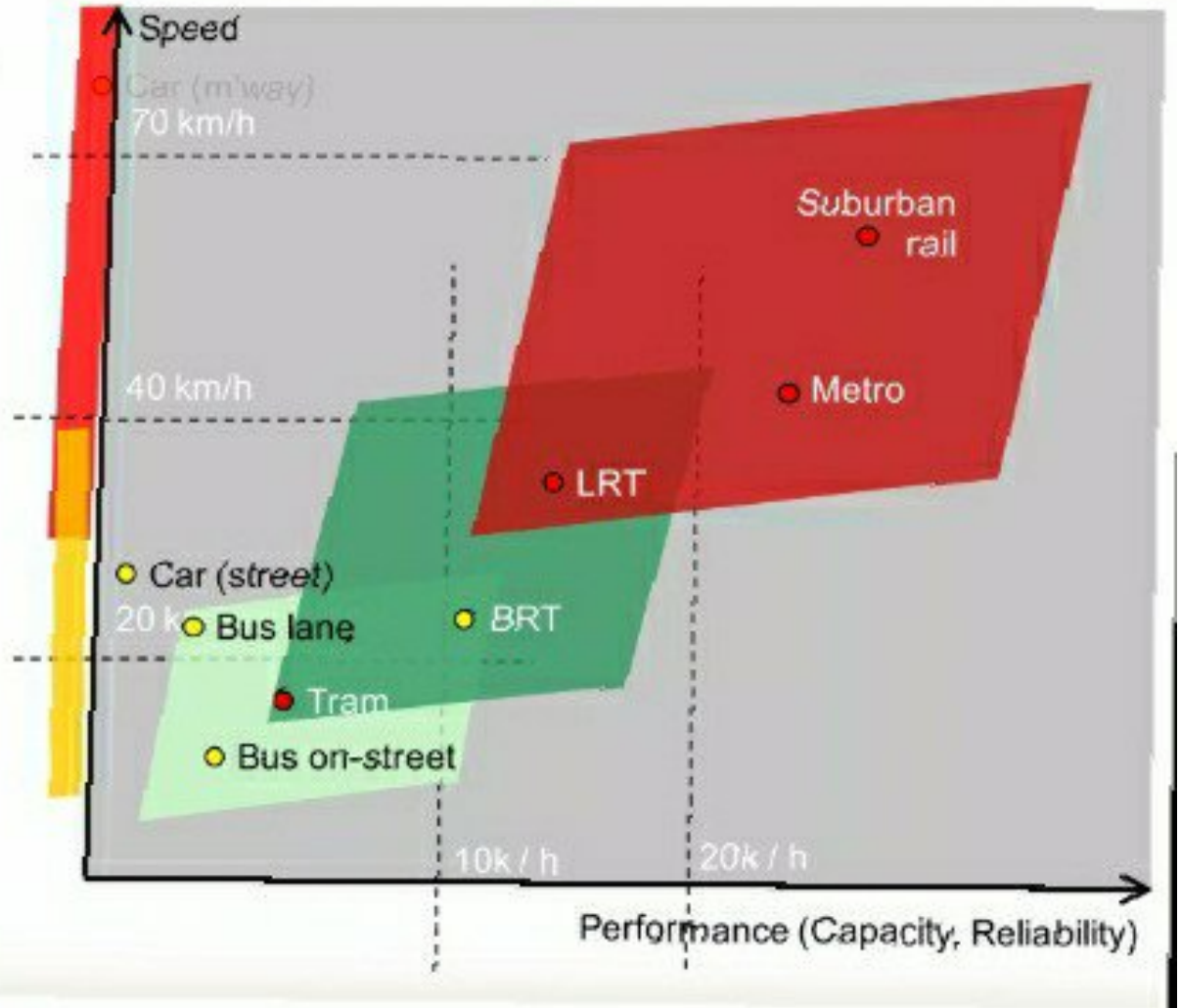
Equivalency road width: In order to carry 20,000 automobile commuters PHPD, a highway must be at least 18 lanes wide.
(assumption 1.2 passengers per automobile)

Comparison of modes - Capacity and operating speed

- Bus and BRT
  - Low inter-station spacing, small vehicles, poor acceleration, Bus priority
- LRT vs BRT
  - Dynamic performance, vehicle capacity,
- Tram vs LRT
  - Signalling, own ROW, vehicle capacity
- LRT vs Metro
  - Acceleration, signalling, longer vehicles, max speed

Suburban rail vs Metro

- Inter-station spacing, longer vehicles, max speed



Time for construction

Bus Rapid Transit
< 18 months
i.e. within the term of a Mayor

Metros
> 5 years

Comparing the costs

Tram
US$ 10 – 25 millon / km

Light Rail Transit (LRT)
US$ 15 – 40 millon / km

Urban commuter rail
US$ 25 – 60 millon / km

Elevated rail
US$ 50 - 125 millon / km

Metro
US$ 50 millon – 320 millon / km

BRT
US$ 0.5 – 15 millon / km

Image source: Manfred Breithaupt

Lloyd Wright

Characteristics of a "full" BRT

- ✓ Segregated, median bus ways + stations
- ✓ Pre-board fare collection and verification
- ✓ Restricted operator access
- ✓ Free transfers between corridors
- ✓ Modal and fare integration, user oriented
- ✓ Competitively bid concessions
- ✓ High frequency service and low station dwell times
- ✓ Level boarding and alighting
- ✓ Emissions reductions through newer fuel technologies

BRT and busway systems in the world

source: EMBARQ, 2011

BRT and busway systems in the world

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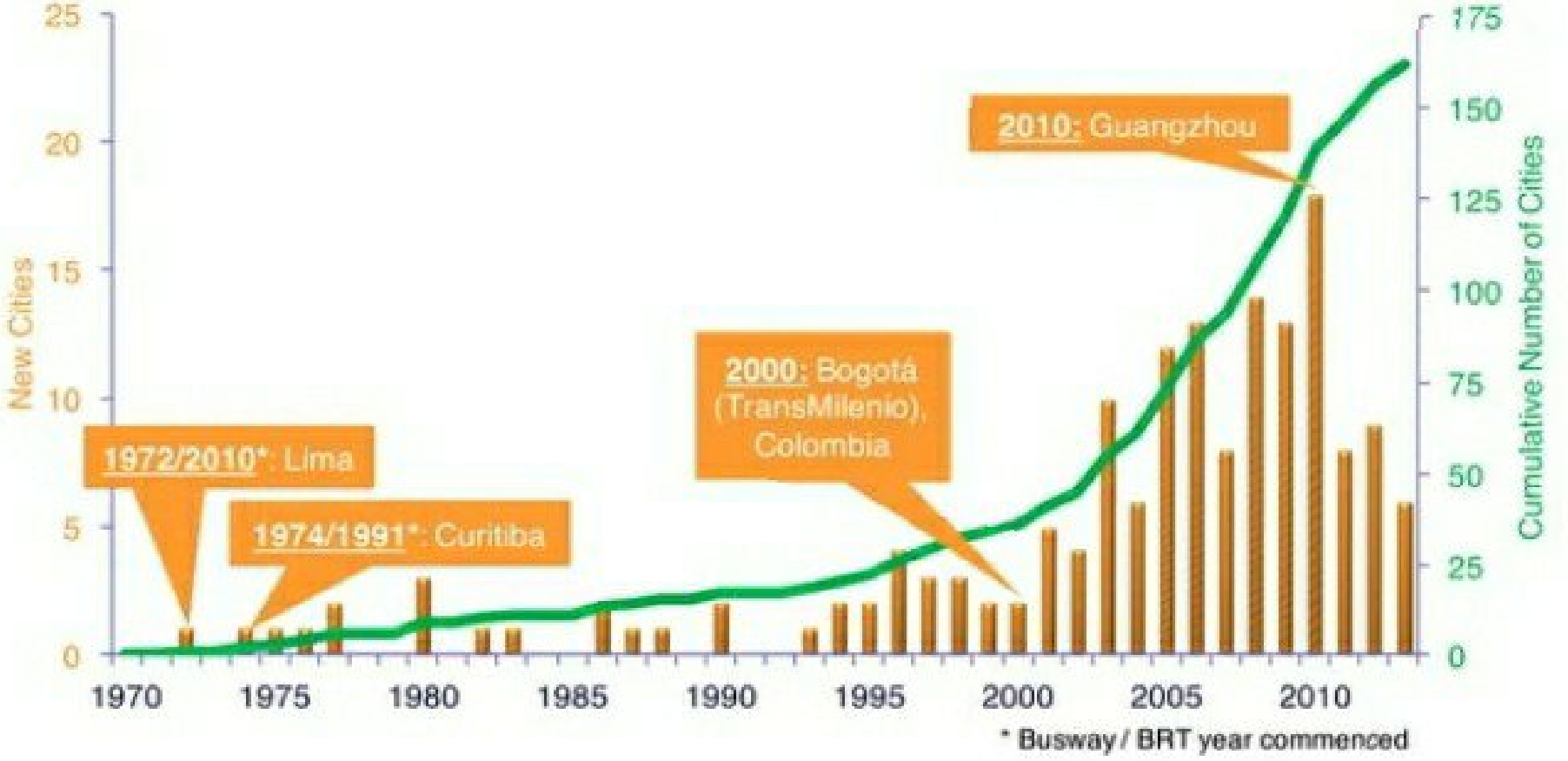
Evolution of the number of cities per year



BUS RAPID TRANSIT ACROSS LATITUDES AND CULTURES · EMBARQ · EMBARQ Brasil · iea · SIBRT

source: BRTdata.org, September 2013

BRT Guangzhou (Winner of 2011 STA Award)

- 22.5 km of dedicated busway
- Over 800,000 passengers per day on a single corridor
- 27,400 passengers per peak hour per direction


THANK
YOU