BRT Primer

Sam Zimmerman

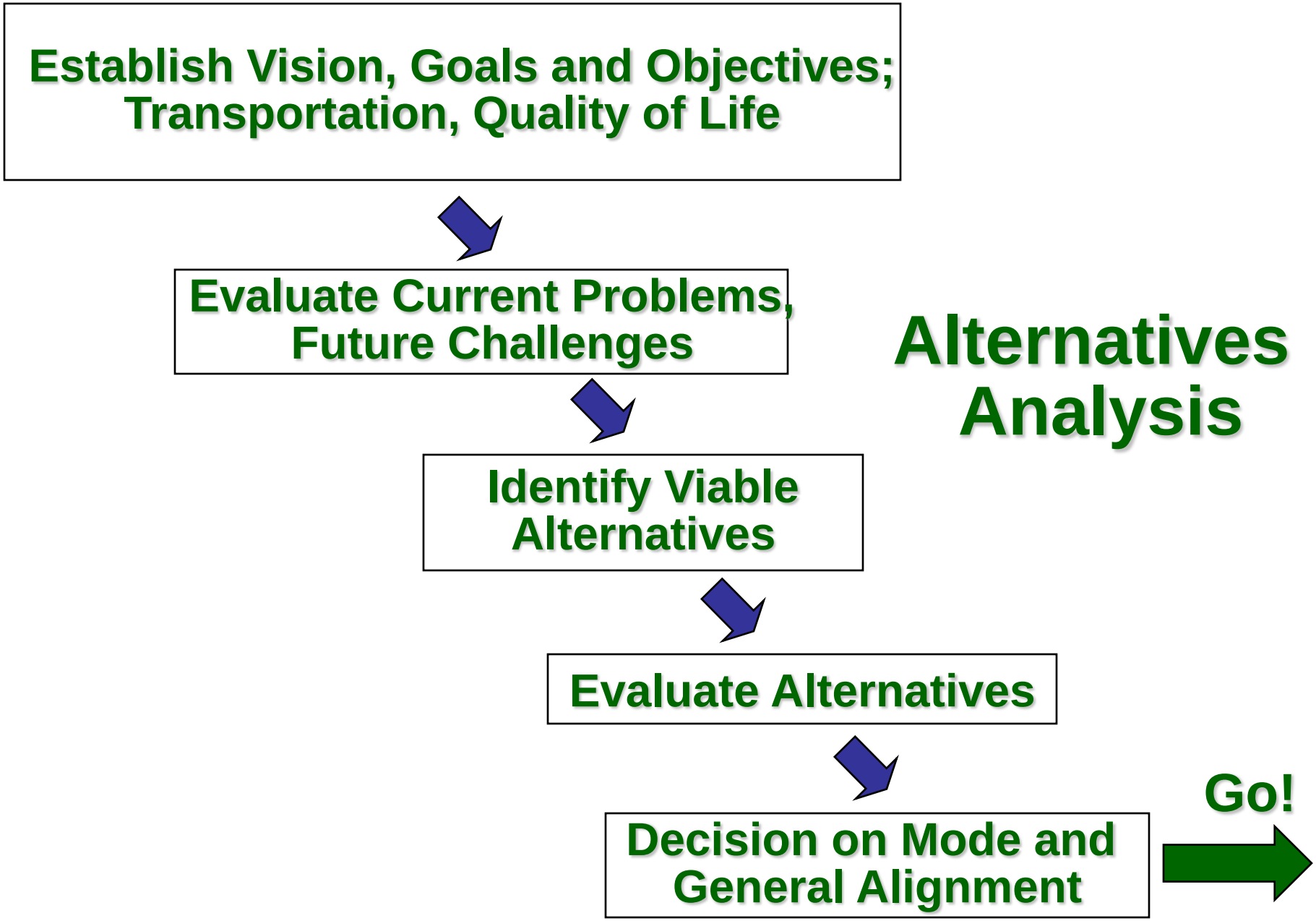
- **Choosing a rapid transit mode**
- **Countering the myths: BRT as a high performance, high capacity, high quality rapid transit alternative**
- **Lessons learned after 30+ years**

Buying A New Personal Vehicle

1. Where are our transportation needs?
2. How much money do we have to spend?
3. What are our options?
4. How do the options compare?
    - Do they meet our needs?
        - Size
        - Features
        - Comfort
    - Cost to buy and operate
    - Repair record
5. Opinion of spouse, spouse's brother?
6. Decision

???

Why should buying a >>$500M public transport line or highway be different?



Alternatives Analysis

BRT: An Alternative to Consider

- Imagine a rapid transit mode with the appeal of LRT but:
  - Doesn't require tracks or power systems;
  - Can effortlessly support a variety of services *on one running way;*
  - Can provide high-speed connections between a variety of origins and destinations without forcing transfers;
  - Can be built and operated for modest cost, using local materials and expertise

BRT: Bus Rapid Transit

- ***Flexible*****,** permanently integrated, high performance system with a quality image and a strong ID
- Package of components appropriate to current and future:
  - ***Markets served***
  - ***Physical, operating environment***

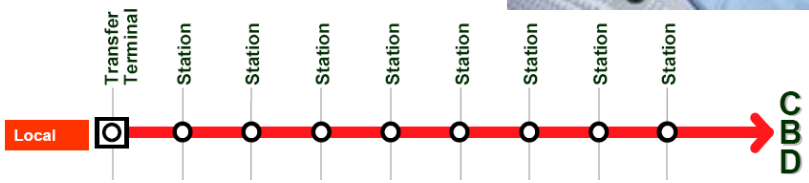
BRT System Elements

Vehicles

Running Ways

Stations & Terminals

Systems



Service Plan

Flexibility of BRT

Simplest	Stations	Running Ways	Service Plan	Vehicles	Systems
	“Super” Stops, Shelter	Mixed Traffic, Queue Jumpers	Single All-Stops Line	Buses with Unique Rte. ID’s, Head Signs	Digital Radios, Electronic Fare Boxes
Most Complex	High Platforms, P/R, Amenities, Services	Fully Grade-Separated Transitway	All-Stops; On-Line Expresses; Feeder/Line - Haul	Hybrid, Guided Specialized Vehicles	Central Control Room, TSP, CAD, Smart Cards Proof of Payment

BRT
Infinite Possibilities, But …

Must have essential attributes

- **High speed, reliability**
- **Easy to use:**
  - **High service levels at all times**
  - **System Integration**
  - **Simple network structure**
  - **Identity, image "branding"**
- **Attractive: High over-all system quality**

Without these attributes, "BRT is only old wine in a new bottle"

Running Ways

- BRT can operate in broad variety of physical and operating environments, but key planning criterion is as much segregated, dedicated running way as feasible and cost-effective
- Critical planning and design criteria:
  - ***Safe, rapid, reliable service***
  - ***Safe BRT vehicle access***
  - ***Efficient traffic operations***
  - ***Good community integration***
  - ***Easy enforcement of dedication***

Arterial Curb Bus Lanes

London
"BRT Lite"

Hangzhou, China

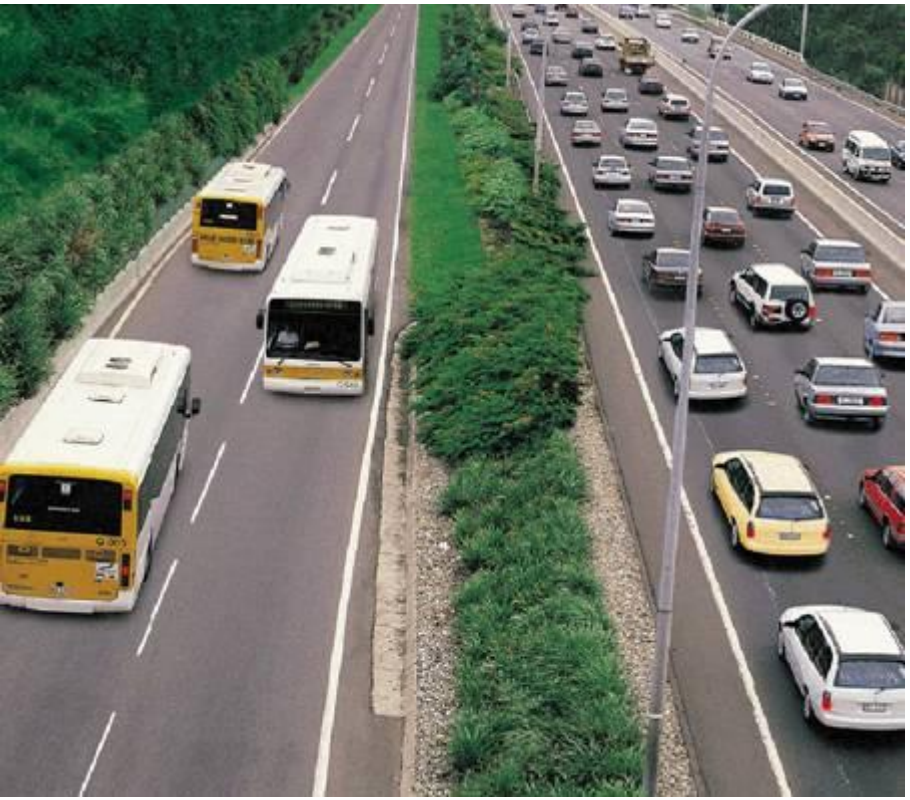
Arterial Median Transitways

One-Way Streets

Guayaquil

Pereira

Bus/Transitway on Expressway/Freeway ROW's



Shoulder
Brisbane: SE Busway

Median
Istanbul

Dario Hidalgo
EMBARQ

Busway on Railroad ROW

Amsterdam: Zuidtangent

Pittsburgh: East (MLK) Busway

Elevated

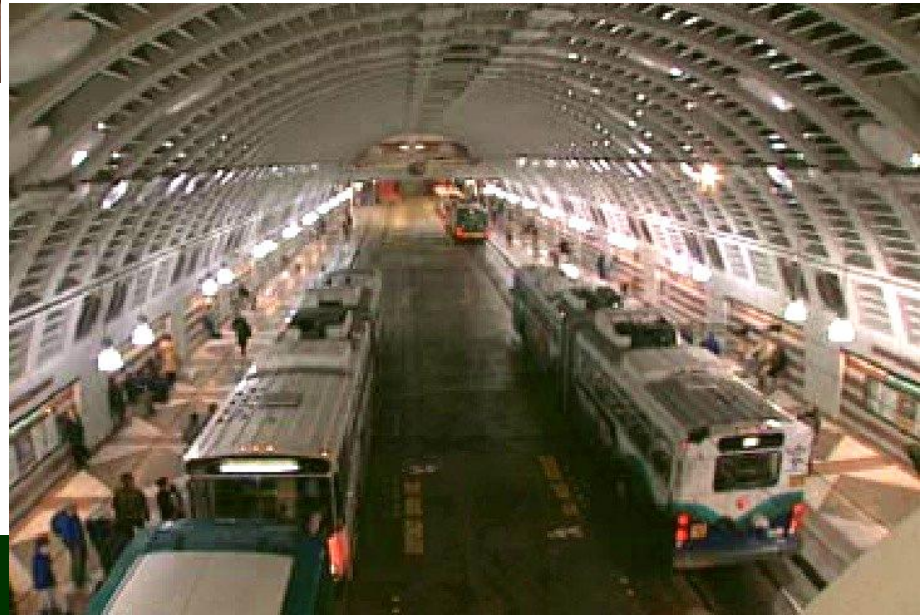
Adelaide, Australia

Runkorn, UK

Tunnels

Boston:
Silver Line

Seattle:
Bus/LRT Tunnel



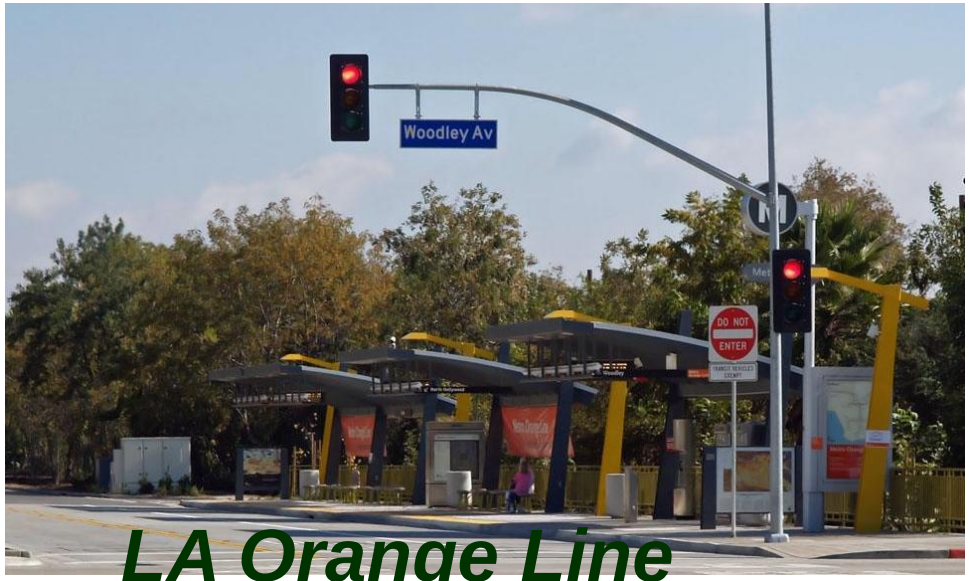
Stops, Stations and Terminals

- .5 – 2 Km. station spacing
- Permanent, substantial, weather protected
- Amenities, passenger information
- Safe pedestrian, bike access
- Seamless local bus, auto access
- Safe, secure
- Convey identity and image
- Design integrated with surroundings

Stations

Eugene EMX

Amsterdam



LA Orange Line

Brisbane

High Volume, Capaity Stations

Brisbane

Bogota Transmilenio

Mexico City

Intermodal/Interchange Terminals

VIVA

Vehicles

- Rubber-tired, steered and/or guided
- Variety of sizes through 27 Mtrs.
- Conventional buses or specialized BRT vehicles
- Environmentally friendly
  - *Low air pollution emissions*
  - *Quiet*

Conventional Buses

Jinhua-Neoplan Centerliner 18 Mtrs, Low Floor Hangzhou

Marco Polo/ Volvo High Floor 18 Mtrs Mexico City

Specialized BRT Vehicles

Evo/Mercedes
"Capacity"
19.5 Mtrs
Istanbul

27 Mtrs
High Floor
Bogota

Buscar/Volvo

BRT Vehicle Interiors
Open, Well- Lit, Attractive

Vehicle/Station Interface: Level, No Gap Boarding, Alighting

Vehicle Guidance

Magnetic
Eindhoven,Ndls.

Optical
Rouen, France

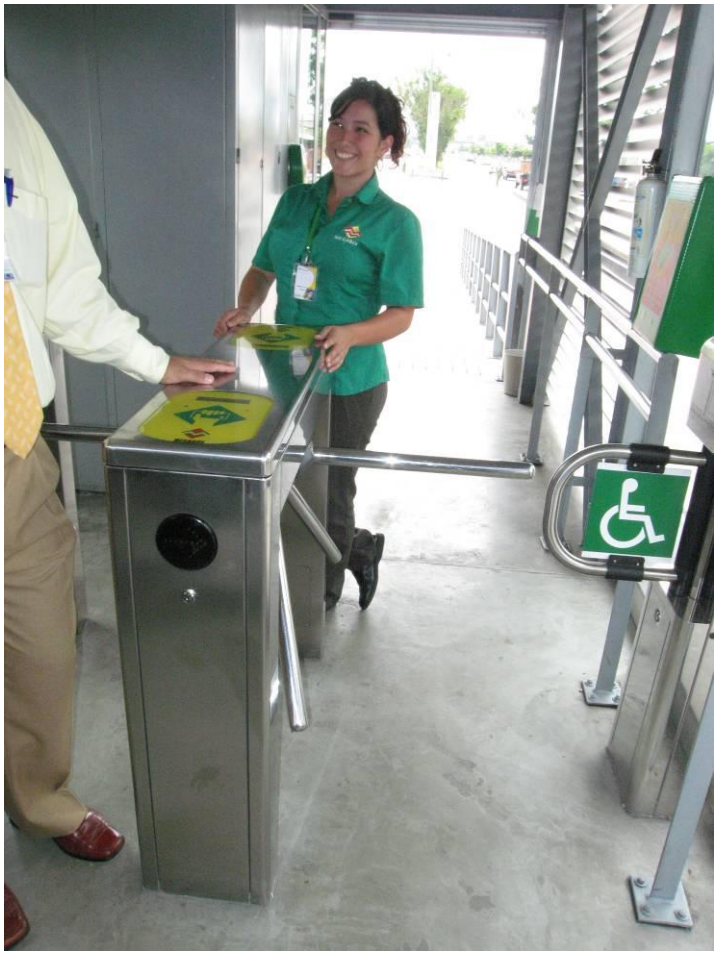
Mechanical
- **Adelaide**
- **Cleveland**
- **Leeds**
- **Cambridge**

Kassell Kerb
Zuidtangent
Amsterdam

Fare Collection

- Needs to facilitate fast, efficient multiple stream boarding
  - Off-board (preferred)
  - On-board multi-point payment
  - Significant pass utilization
- Integrated with but may not be the same as for local bus system
- “Smart (IC) Cards” rapidly finding favor as fare medium of choice
  - Fare gates
  - Barrier-free

Off–Board Fare Collection Options



Smart Card Fare Gates
Megabus, Pereira

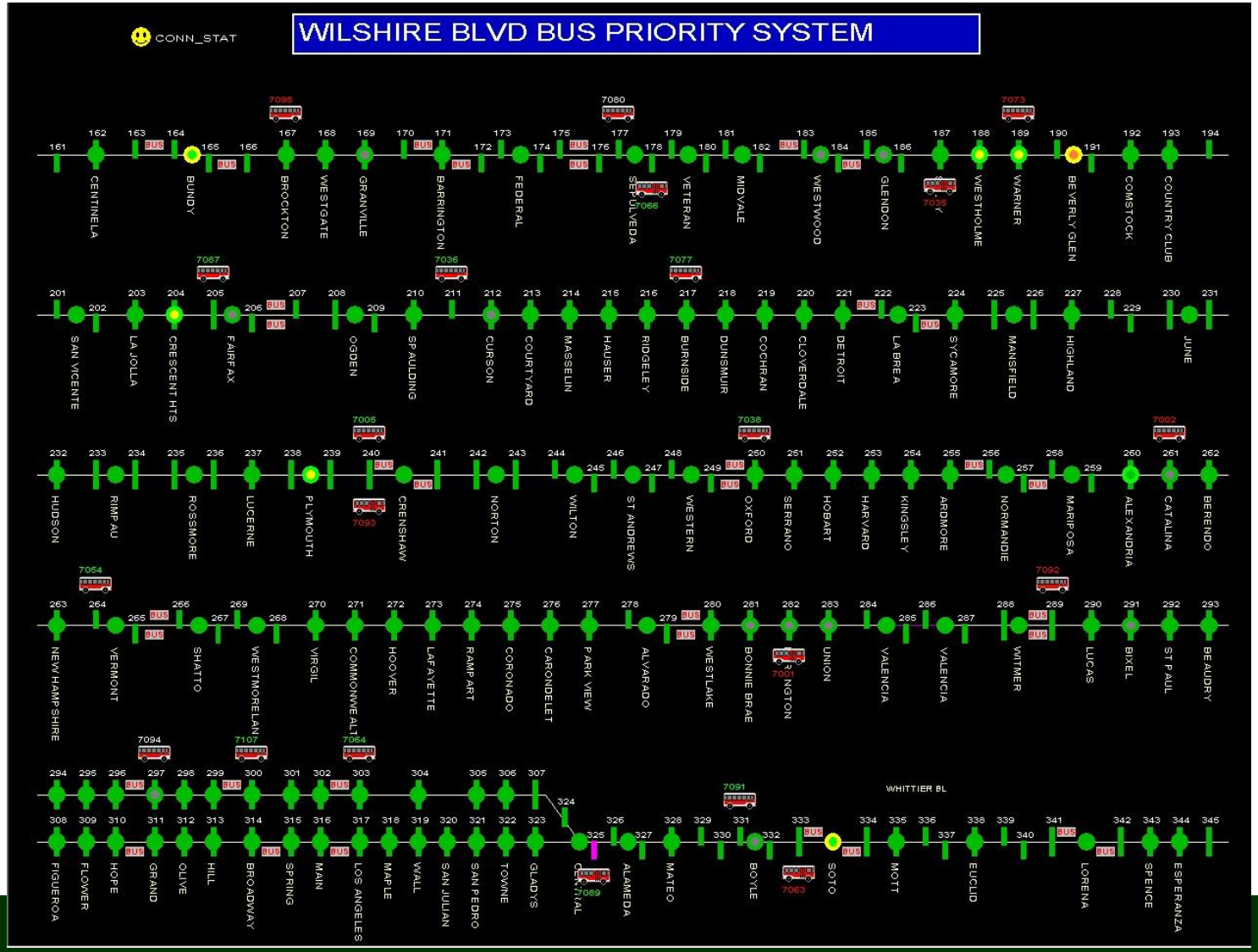
Smart Card Fare Gates
TransMillenio, Bogota

BRT ITS Applications

- Automatic vehicle location
- Service dispatching, monitoring, supervision
- Passenger information
- Safety, security
- Signal priority
- Communications
- Fare collection
- Vehicle guidance and control

Central Control Room
Service Monitoring, Supervision

Service Supervision Screen



Station Security: CCTV

Passenger Information

San Francisco

At Stations

Paris

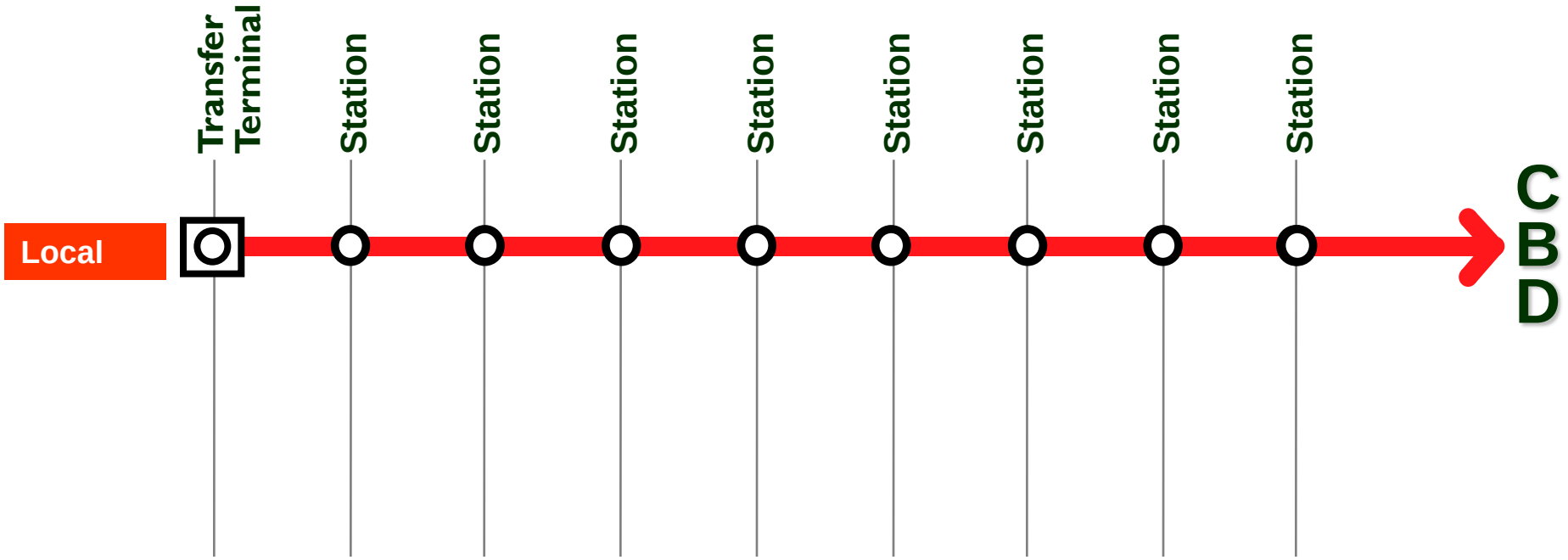
On Board

Service Plan

- All-day, week frequent service
  - Max. headway 5-10 minutes in peaks
  - Max. headway 10 minutes in off-peak
- Integrated with rest of transit system
- Simple network structure
  - Minimum variations (less than 4 distinct BRT routes preferred), easy to understand
- Use BRT flexibility
  - Maximize directness, O/D speed
  - Minimize transfers

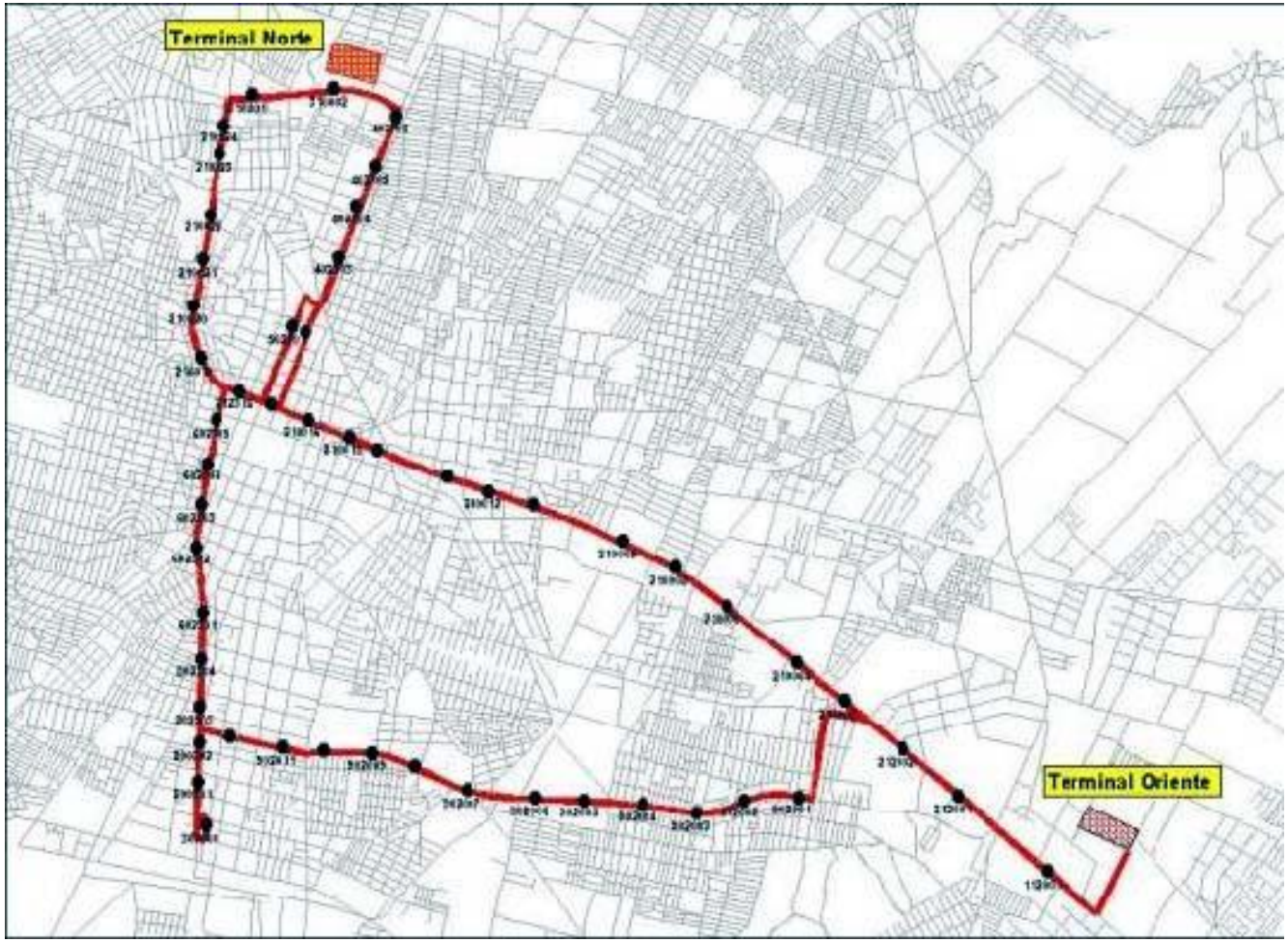
BRT Service Plan Options: Single All-stops Route/Corridor

All-day, all-(limited) stops trunk line



(e.g., Mexico City, Leon, Beijing, Quito, Jakarta)

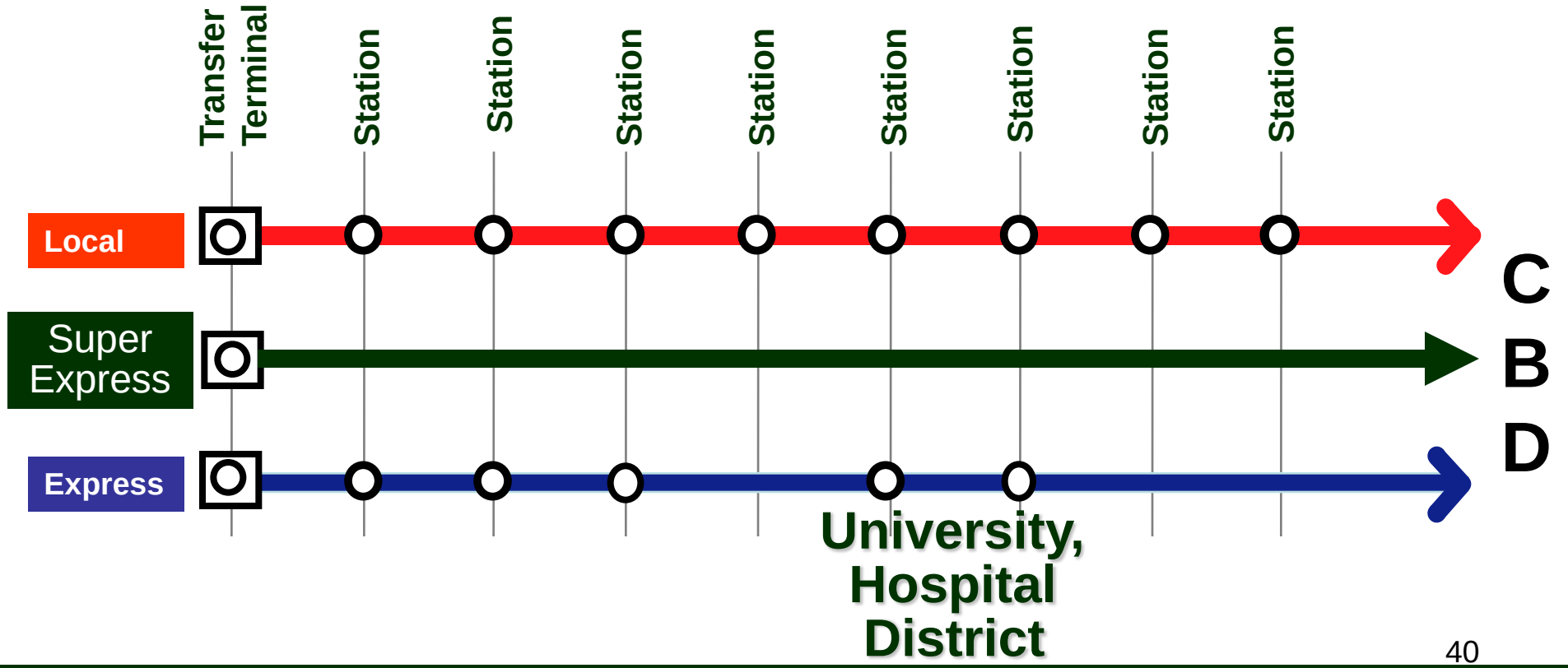
BRT Service Plan Options: Single All-stops Route/Corridor



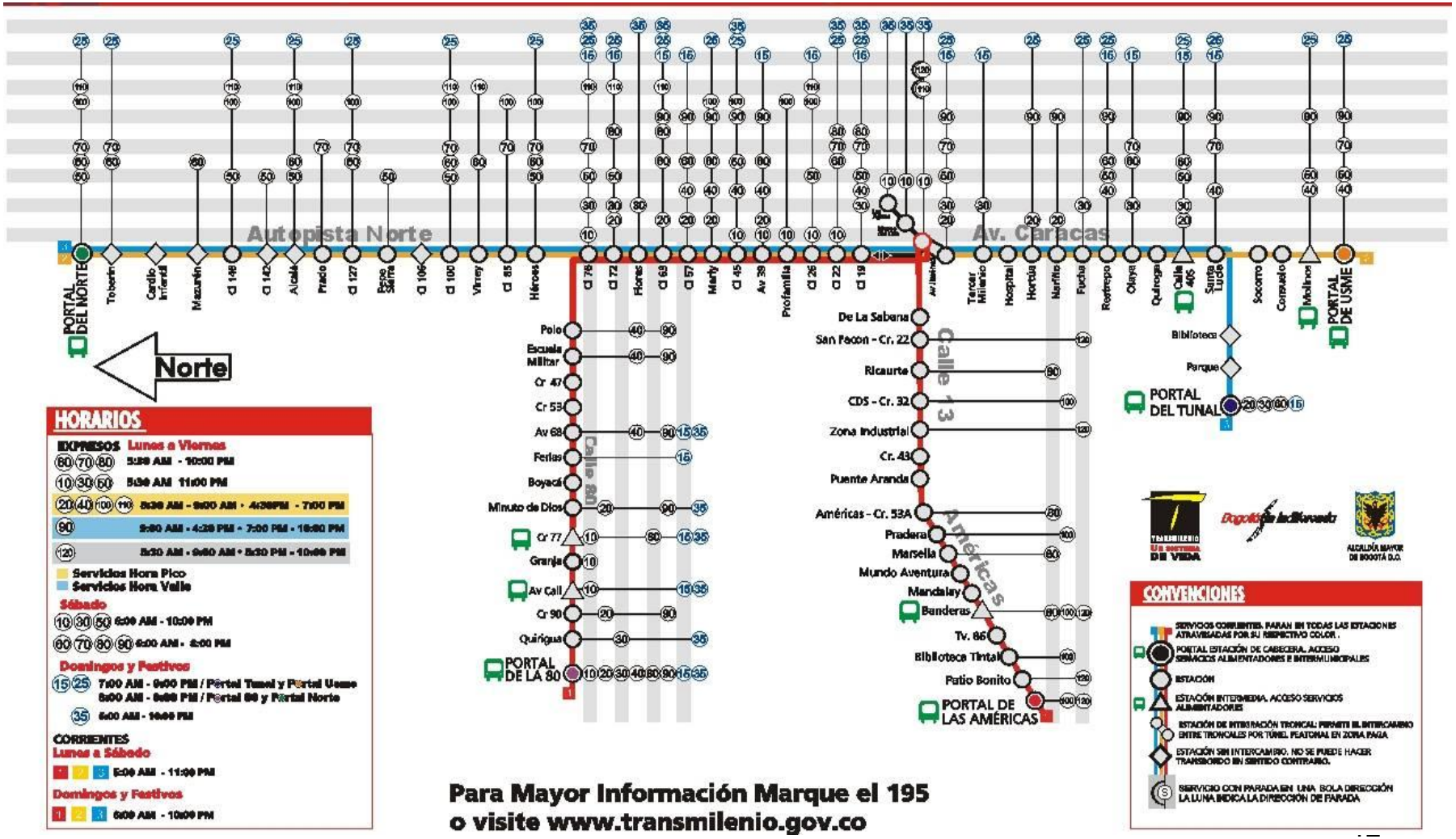
Leon, Mexico "Oruga"

All Stops Local + Multiple Expresses

- *Base: All-day, all-stops trunk line*
- *Overlay: Peak-only or all-day express services*

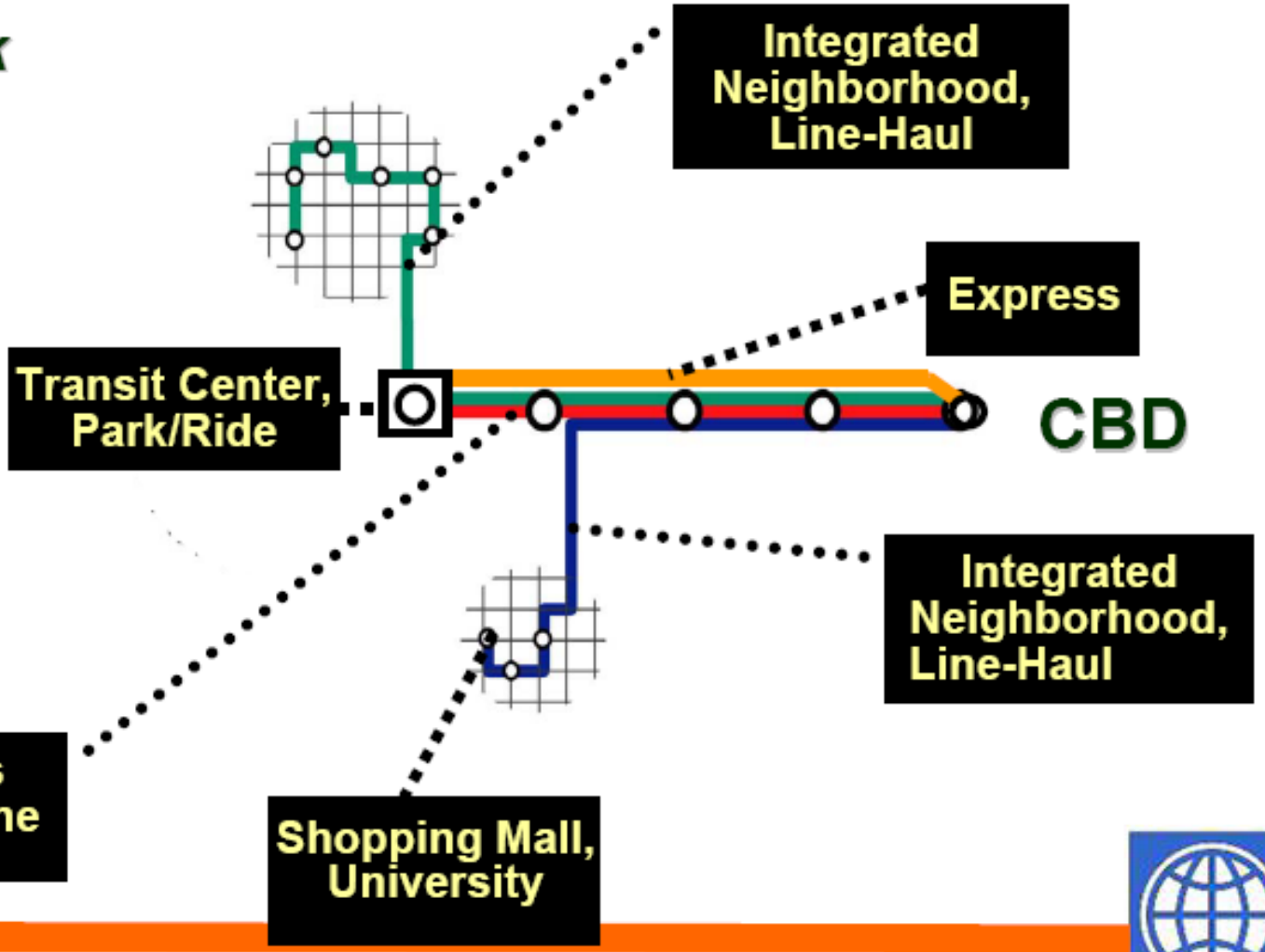


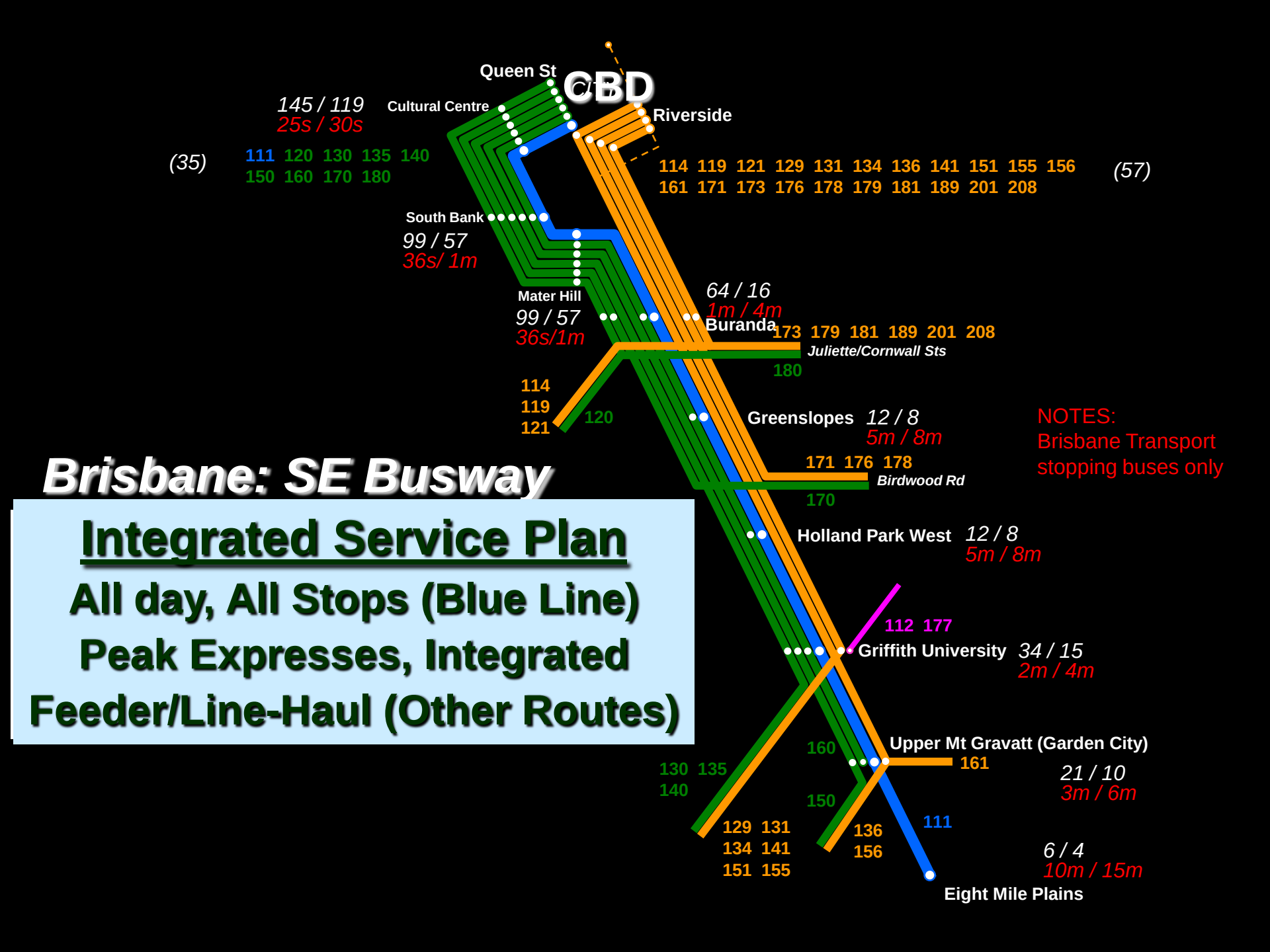
Local, Multiple Expresses Transmilenio



BRT Service Plan Options: Integrated (e.g. Ottawa, Brisbane)

- *Base: all-day, all-stops trunk line*
- *Peak-only or all-day integrated services*
- *Peak-only or all-day expresses*

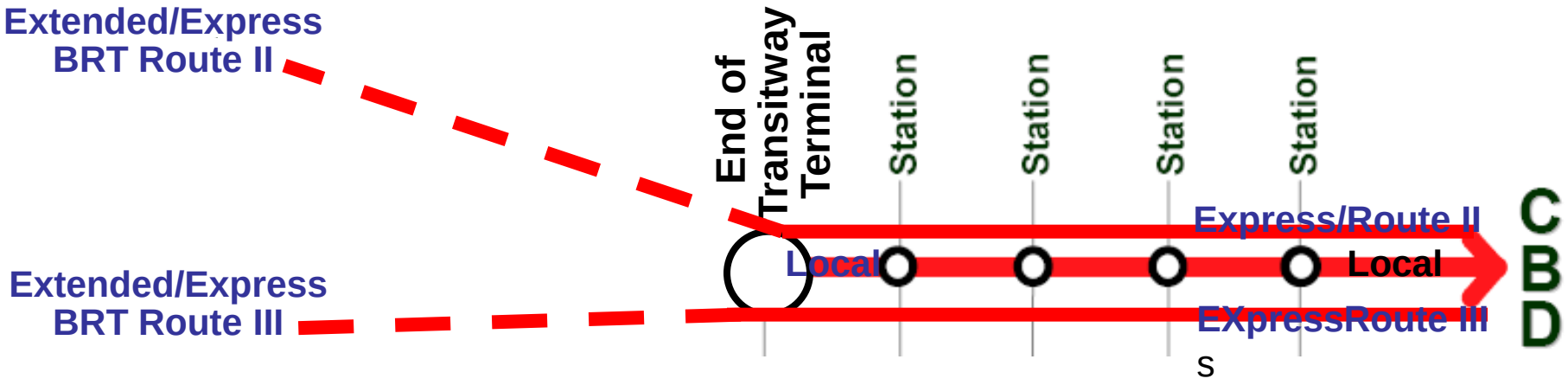



Queen St
CBD
145 / 119
25s / 30s
Cultural Centre
Riverside
(35)
111 120 130 135 140
150 160 170 180
114 119 121 129 131 134 136 141 151 155 156
161 171 173 176 178 179 181 189 201 208
(57)
South Bank
99 / 57
36s/ 1m
Mater Hill
99 / 57
36s/1m
64 / 16
1m / 4m
Buranda
173 179 181 189 201 208
Juliette/Cornwall Sts
180
114
119
121
120
Greenslopes 12 / 8
5m / 8m
171 176 178
Birdwood Rd
170
Holland Park West 12 / 8
5m / 8m
112 177
Griffith University 34 / 15
2m / 4m
Upper Mt Gravatt (Garden City)
160
161
21 / 10
3m / 6m
130 135
140
150
129 131
134 141
151 155
136
156
111
6 / 4
10m / 15m
Eight Mile Plains
Brisbane: SE Busway
Integrated Service Plan
All day, All Stops (Blue Line)
Peak Expresses, Integrated
Feeder/Line-Haul (Other Routes)
NOTES:
Brisbane Transport
stopping buses only

“Open” Service Plan

Transitway Portion of Route

Off-Transitway, Mixed Traffic Portion of Route



Conveying Brand Identity, Image: Pervasive and Consistent

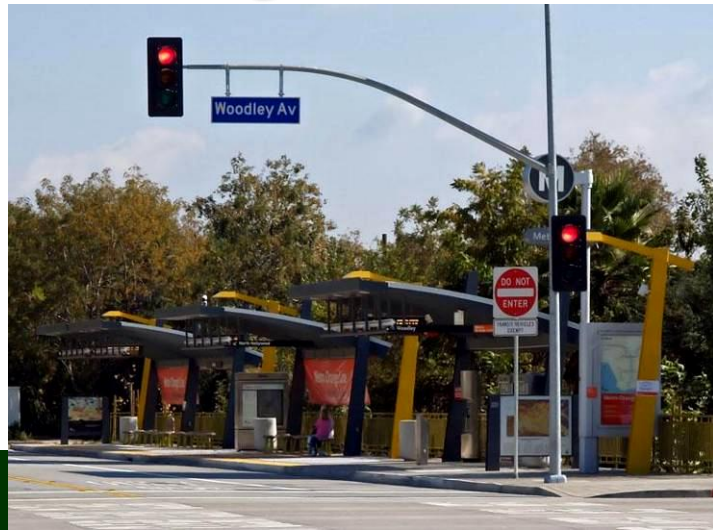
- Vehicles:
  - Design, colors, graphics, signage
- Stops, Stations, Terminals:
  - Design, colors, graphics, signage, materials
- Running Ways:
  - Barriers, pavement markings/materials/ colors, graphics, signage, landscaping

Consistent, Unique Station Design LACMTA

Local Bus: Not

MetroRapidBus BRT "Lite"

Orange Line BRT



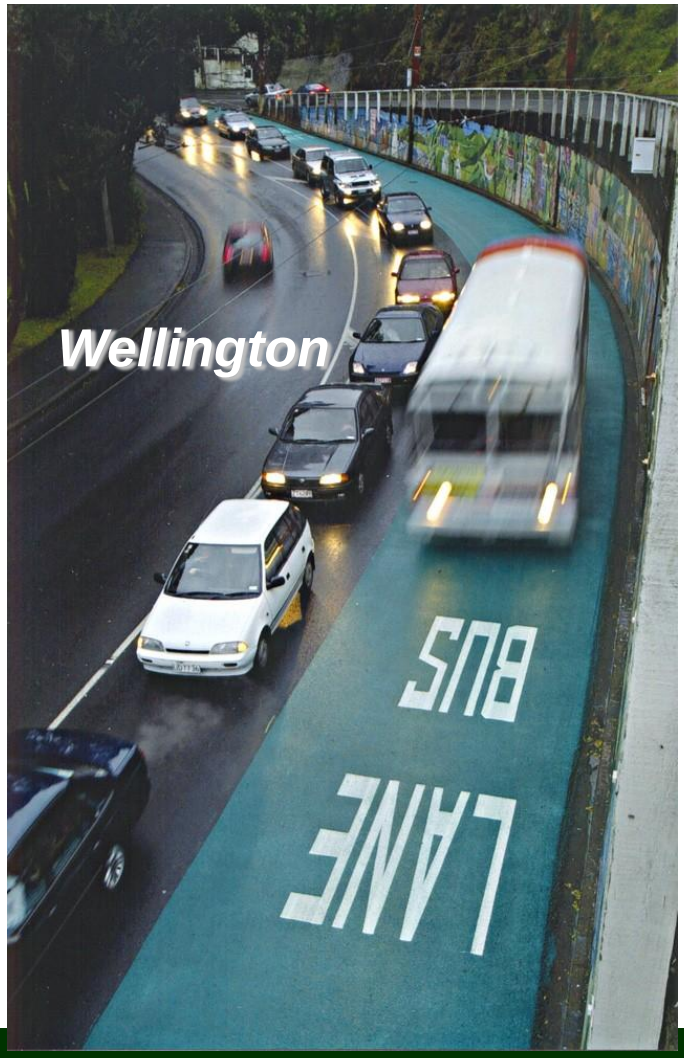
Functional Hierarchy
LA Vehicles

Local Bus

Metro Rapid
BRT "Lite"

BRT

Running Way Color, Markings



Consistent, Unique Graphics, Icons

Brisbane: S.E. Busway

busway South Bank

busway Woolloongabba


VIVA


V
Leslie Street


V
VIVA

VIVA


5203
VIVA
VIVA


V
York University


5102
VIVA
V
Leslie Street

BRT Experience To Date

Focus on BRT Mythology

- Not attractive for travelers with a choice
- Low Performance
- Insufficient capacity
- Expensive to Operate and Maintain
- Not Attractive to Developers and Unable to induce Sustainable Development Patterns

Total Daily BRT Ridership

System	Trips/Day
Beijing South Line	>120,000
Mexico City MetroBus	>250,000
Leon, Mex. “Oruga”	225,000
Transmilenio System	~ I.4 million
Brisbane SE Busway	>75,000
Ottawa Transitway System	>200,000

Attractive to New Customers

	% Ridership Gain in Corridor(s)	% of Ridership ***New*** Transit Trips
Los Angeles (MRB)	+40% (3 Years)	>30%
Miami	+85% (5 Years)	>50%
Brisbane	+70% (3 years)	>45%
Boston	+100% (18 months)	>30%
VIVA	NA	>30%
Kansas City	>40%	30%

Boston MBTA Silver Line:* Prior Means of Transportation

Prior	Percent
Bus	67%
Subway	32%
Auto	4%
Did Not Make Trip	25%
Other	20%

***Adds up to more than 100% because of multiple answers**

AC Transit San Pablo Rapid Bus Prior Means of Transportation

Prior	Percent
Bus	55.2%
BART	12.9%
Auto	18.9%
Did Not Make Trip	8.7%
Other (e.g., taxi)	4.2%

Attractive to Choice Customers: Houston*

Houston Metro Services, Customers	% Riders with Household Incomes > $50,000/Yr	% Riders with Household Incomes > $75,000/Yr	%Riders from Households with > 2 Vehicles
Park/Ride Services (Rubber-tired Commuter Rail)	70%	50%	61%
Local Bus Services	11%	-	16%

**** 2002 On Board Survey***

Resulted in Significant Increases in Revenue Speeds over Local Bus

BRT Line/System	% Speed Increase
Mexico City	100%
Bogota	35%+ (est.)
Los Angles Metro Rapid "BRT Lite"	33% (compared to former limited route)
Boston Silver Line	25%

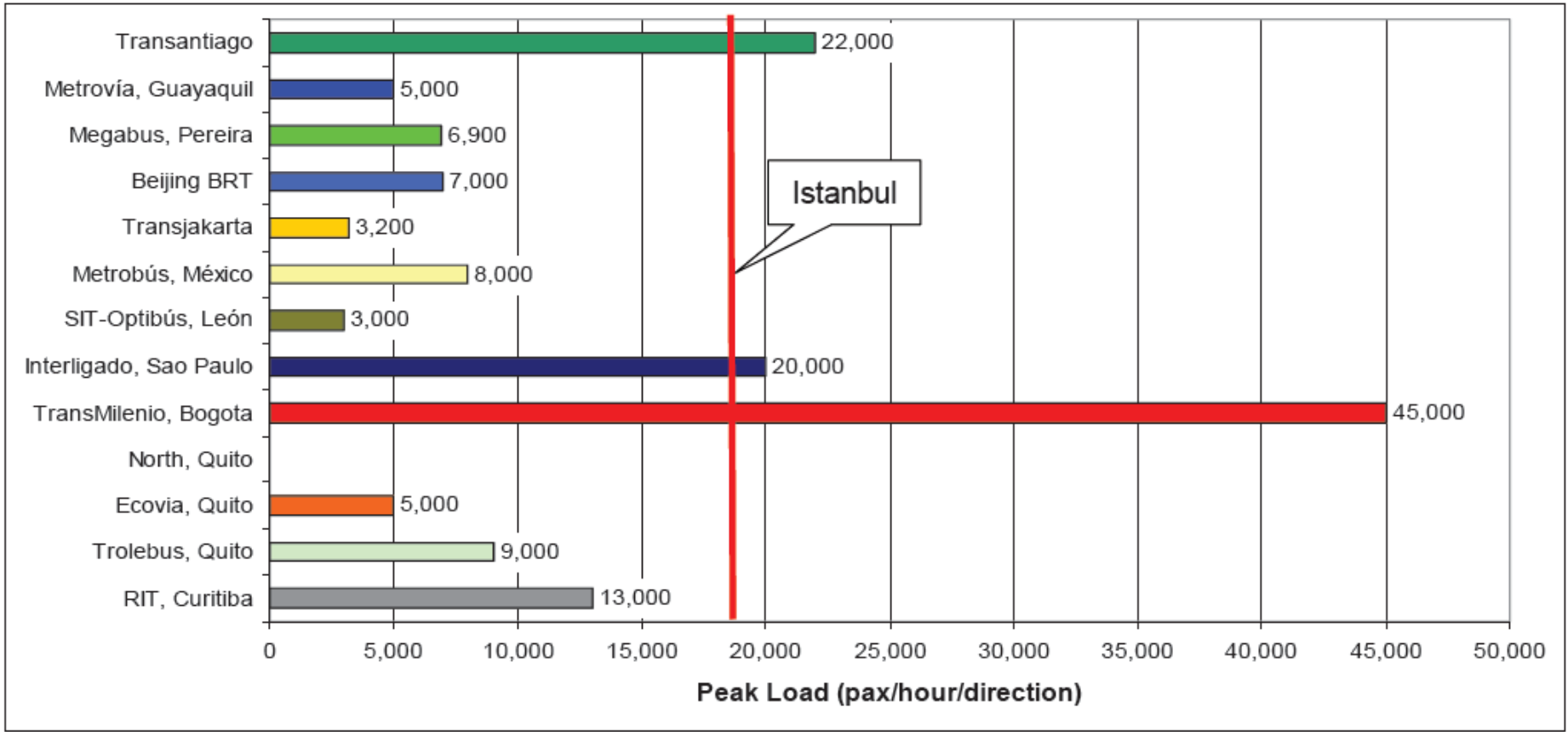
Capacity: Rarely an Issue

- High volumes (e.g., Transmilenio, >35,000/Hr, with passing lanes) can be carried at reasonable levels of service and comfort
- Capacity covers range of LRT and much of Metro experience
  - Metro: 4,000 - 75,000/Hr.
  - LRT: 1,500 – 15,000/Hr.

Actual Maximum Load Point Peak Hour, Pk Direction Volumes

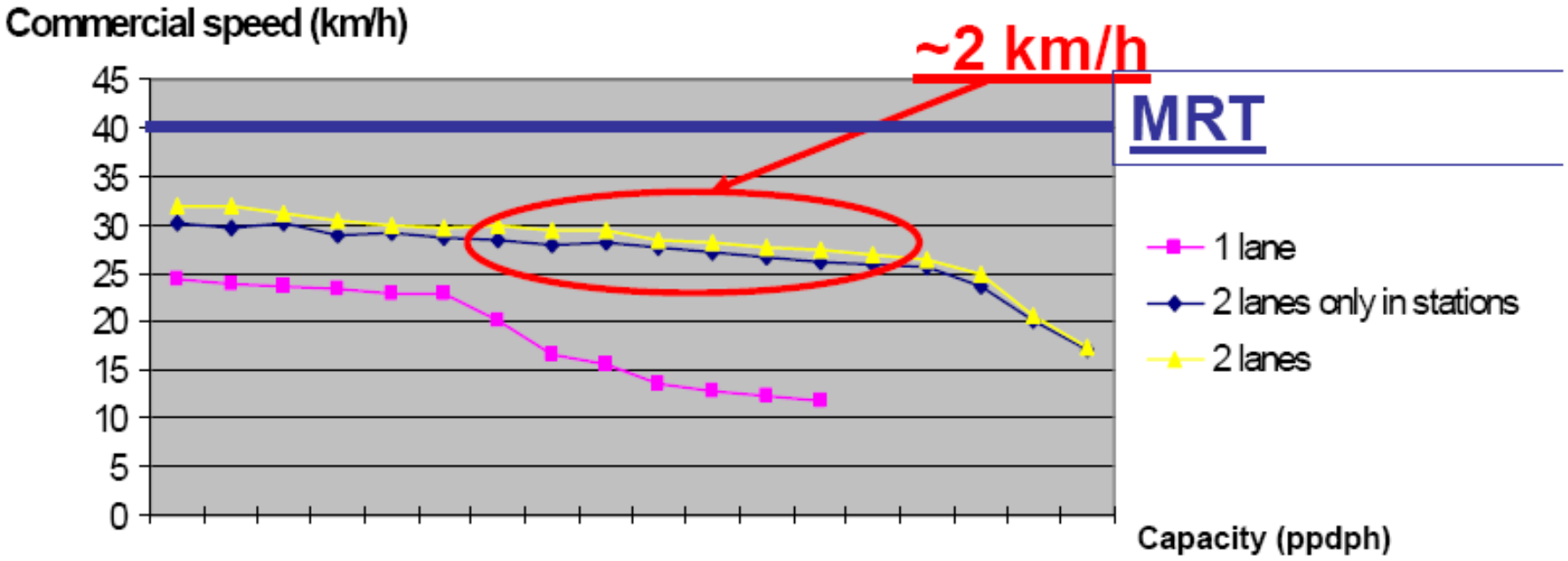
Bogotá Transmilenio, (passing lanes all stations)	>35,000 /Hr.
Porto Alegre, Sao Paulo, Istanbul, Brisbane	15 – 25,000 /Hr.
Curitiba, Ottawa, Quito	10 – 15,000 /Hr.
Mexico City, Leon, Mex. Quito, Beijing (Single Lane/Direction)	3 - 10,000/Hr.

BRT Maximum Load Point, Peak Hour, Peak Direction Volumes*



***From presentation by Daio Hidalgo, WRI/EMBARQ**

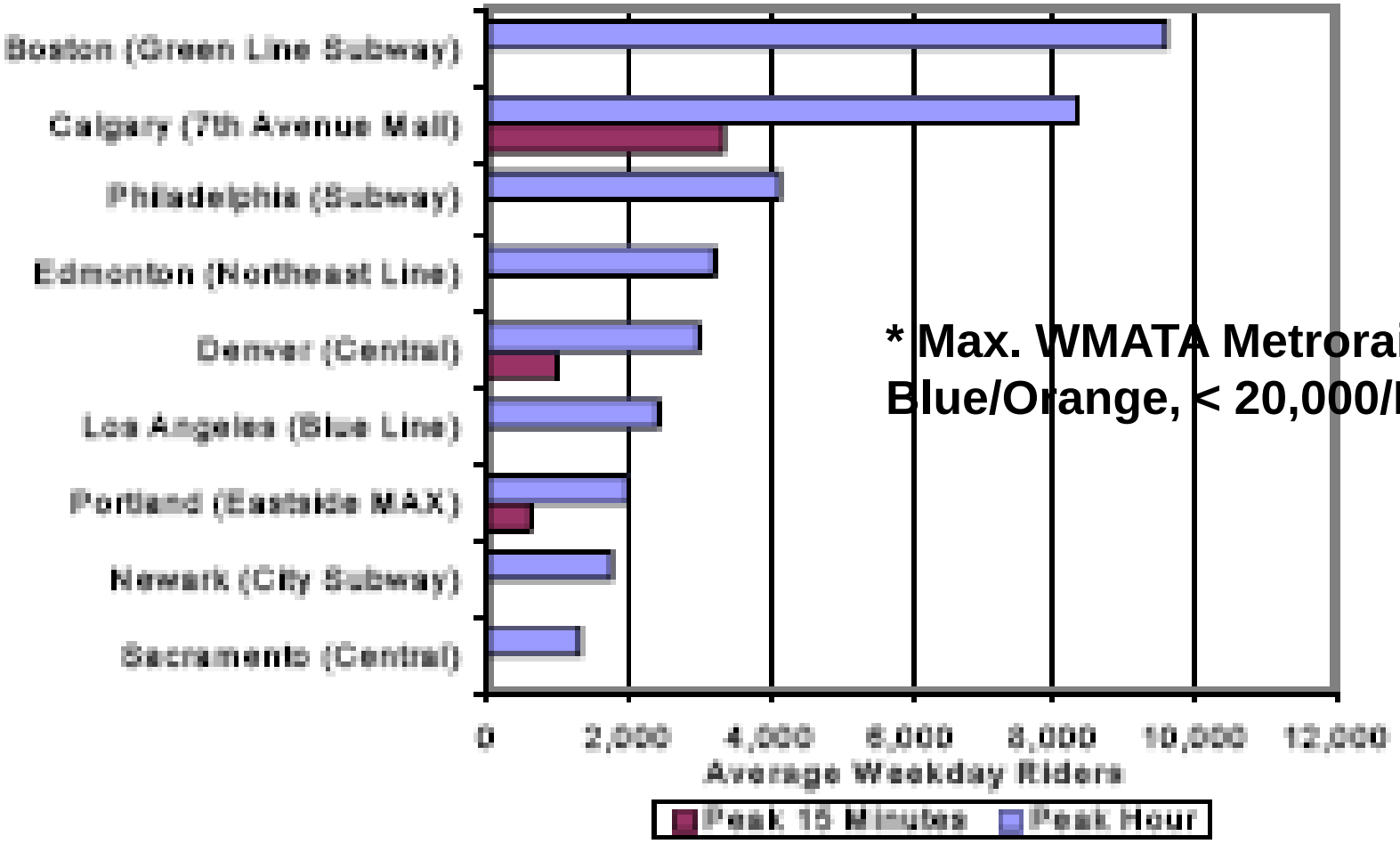
BRT - Limits of capacity *



		100 p/bus	160 p/bus
1 lane everywhere :	150 buspdph	15000 ppdph	24000 ppdph
2 lanes in station :	300 buspdph	30000 ppdph	48000 ppdph
2 lanes everywhere :	300 buspdph	30000 ppdph	48000 ppdph

*Source: Montassar DRAIEF - SYSTRA

North American LRT Demand
Peak Hr, Pk. Direction, Max. Load Point



*** Max. WMATA Metrorail, Blue/Orange, < 20,000/Hr.**

***Transportation Research Board**
"Transit Capacity and Quality of Service Manual"

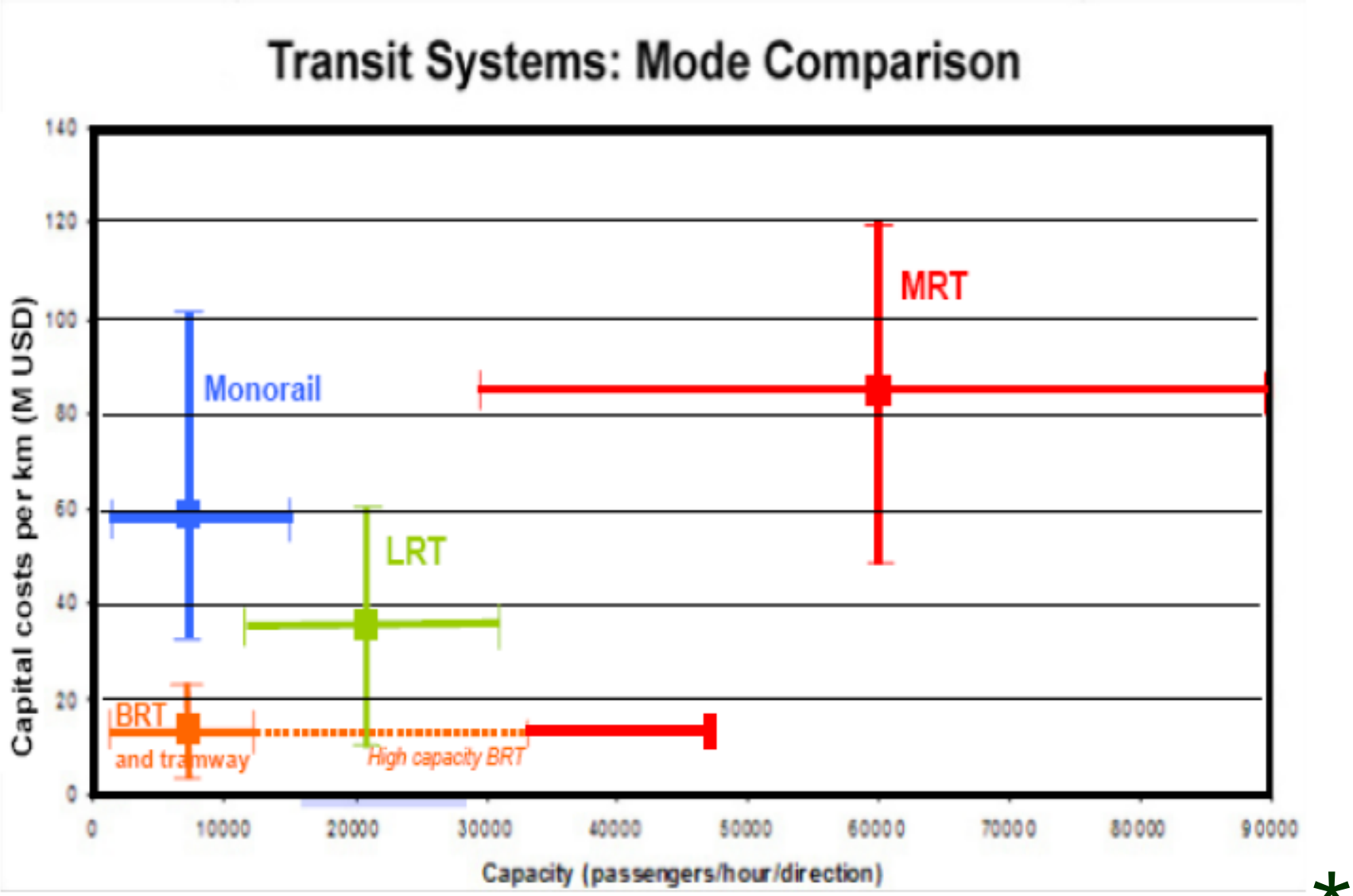
Implementation Costs: Generally Modest

- A function of:
  - Implementation environment
    - Physical, operations conditions
      - Available ROW
    - Market
  - Nature of system
    - Vertical, horizontal alignment
    - Design details
    - Required capacity

Implementation Costs

City - Line	Total Costs $/Km.
Amsterdam Zuidtangent	~$15M
LA Orange Line BRT	~$15M
Miami So. Dade BRT Extension	<$10M
Lane County EMX	<$4M
Toronto (York) VIVA Rapid Bus	<$2M Cdn
LA Gold Line LRT	~$40M
Salt Lake City So. Line LRT Extension	~$33M

Source: Montassar DRAIEF - SYSTRA



*

Operating and Maintenance Costs

- BRT O/M Unit Costs a function of:
  - Required Capacity
  - Level of sophistication and system content
  - Operating speeds
  - Service/demand patterns, peaking characteristics
  - Unit driver, mechanic, labor and other costs

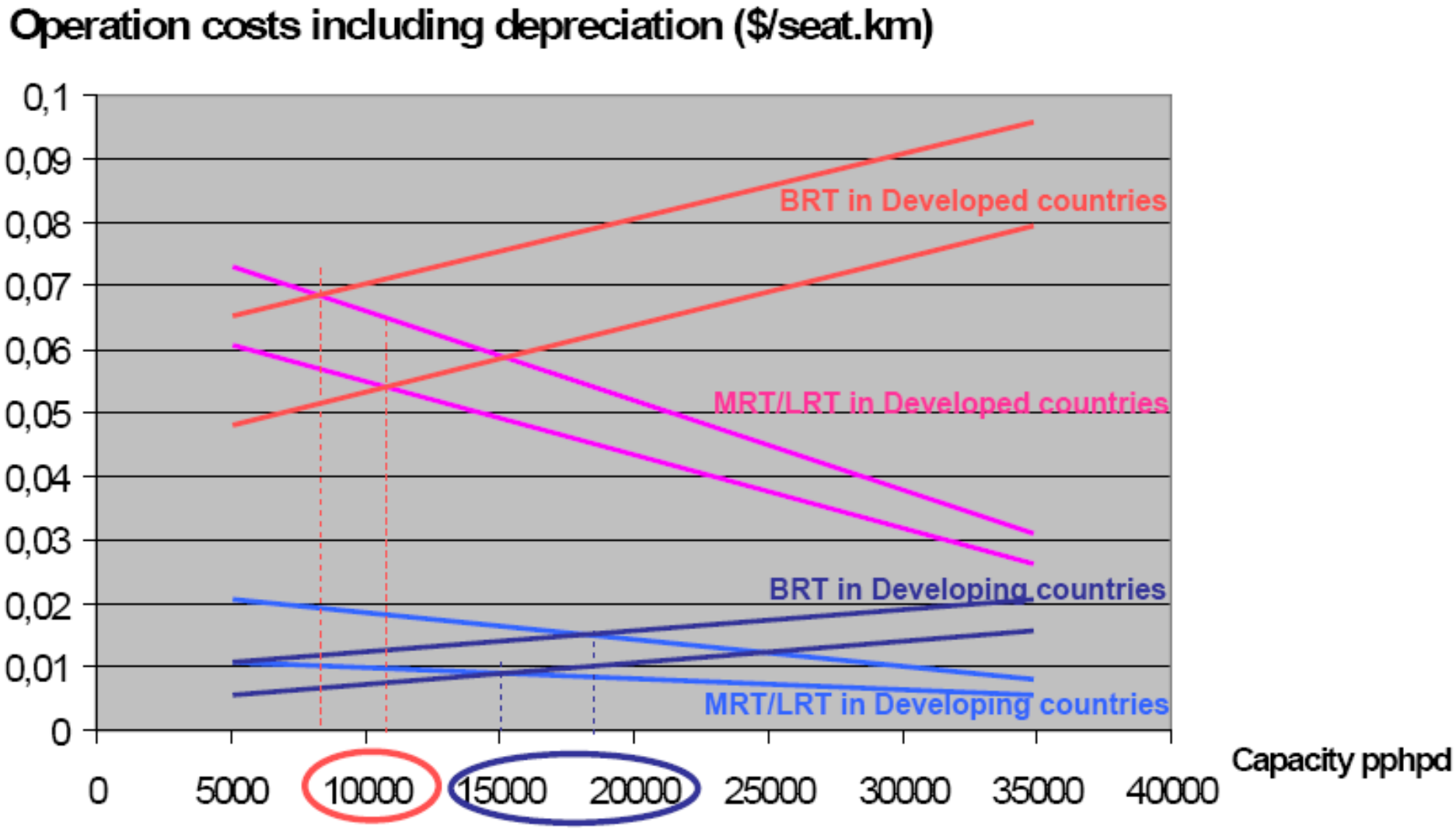
Operating and Maintenance Costs

- BRT O/M $/passenger trip and /Km. will be different than average for local bus system
  - Significantly higher revenue speeds
  - Higher passenger productivity/Hr., /Km.
  - Significantly different service peaking, span
  - Larger vehicles
  - More support “systems”
  - More infrastructure

BRT O/M $ Comparisons to LRT

- depend on trade-offs among:
  - direct operating costs (i.e., drivers)
    - related to maximum load point peak hour peak direction volume, peaking characteristics
    - Related to work rules and labor rates
  - additional mechanics, technicians required for rail rapid systems compared to BRT

Source: Montassar DRAIEF - SYSTRA



O/M Cost Comparison*

	LRT $/Veh.Hr.	Bus $/Veh.Hr.	Ratio
Baltimore	324.67	12l.31	2.68
Cleveland	213.83	99.59	2.15
Pittsburgh	281.77	125.43	2.25
St. Louis	240.98	93.25	2.58
San Fran.	191.17	135.22	1.41
Boston	198.18	117.18	1.69
Dallas	337.78	104.22	3.24
San Diego	117.34	87.20	1.35
Denver	139.11	92.67	1.50
Los Angeles	383.41	110.26	3.48

*USDOT FY 2006 National Transit Database

Toronto Transit Commission FY 2006

	Ridership Trips/Day	Daily OM $ (Cdn) per Veh. Hr.
Queen St. (SC)	41,200	$153.20
King Street (SC)	47,900	$168.04
Carlton Street (SC)	41,200	$163.72
Spadina (LRT)	43,400	$144.74
Eglington	62,000	$101.90
Steeles	47,100	$104.38
Lawrence	52,700	$103.53
Dufferin	43,600	$97.73

Attractive to Developers, Owners

- Significant Urban Development Effects
  - Curitiba
  - Bogotá
  - Quito
  - Brisbane SE Busway
  - Ottawa Transitway System
  - Boston

Transit-Oriented Land Use, Curitiba

Shopping

High Density Mixed

Amarillo Developers
Bogota

Bogotá Transmilenio

Malls

Mixed-Use Development

Silver Line Phase II

Convention Center Station

Boston MBTA Silver Line Phase II South Piers

New Mixed Use Development Adjacent to Stations

Brisbane SE Busway

"Brisbane Courier Mail," 1/26/02

Busway boosts house values

Joel Gulfroy

PROPERTY values along Brisbane's South-East Busway have jumped as much as 20 per cent as buyers take advantage of traffic-free travel to the city.

Prices in the southern suburbs of Holland Park West, Upper Mount Gravatt and Eight Mile Plains have increased since the $250 million busway opened in March 2001, providing an escape from South East Freeway traffic snarls.

Real Estate Institute of Queensland research shows suburbs with direct access to the busway's stations had solid growth over the recent quarter.

"Most other suburbs next door to these busway suburbs also performed well, however they did record percentage changes slightly below those near the busway," REIQ president Mark Brimble said.

The most outstanding jump was in Holland Park West, where values rose 20.86 per cent.

The neighbouring suburb of Holland Park, which does not have direct busway access, rose 6.23 per cent.

The comparisons showed busway suburbs were performing above city-wide increases which have seen nearly all areas within 10km of the CBD improve in value.

Other neighbouring suburbs that did not perform as well include Mount Gravatt East, which recorded 4.78 per cent compared with 0.23 per cent in the busway suburb of Mount Gravatt, and Kuraman, which increased by 1.56 per cent compared with a jump of 1.93 per cent in busway suburb Eight Mile Plains.

"This research supports the trend that more people are moving to areas within five to 10km of the CBD which are close to convenient public transport such as the busway," Mr Brimble said.

Queensland Transport recorded a "patronage boom" on the busway, with a 40 per cent growth in passenger figures in its first six months, or about 18,000 passenger trips a day.

The figures also showed approximately 375,000 private vehicle trips were converted to public transport along the busway, which straddles the South East Freeway.

Property values also would increase if proposed extensions of the busway along northern and eastern routes went ahead, analysts said.

National Property Research analyst Matthew Gross said areas near public transport nodes would nearly always rise in value.

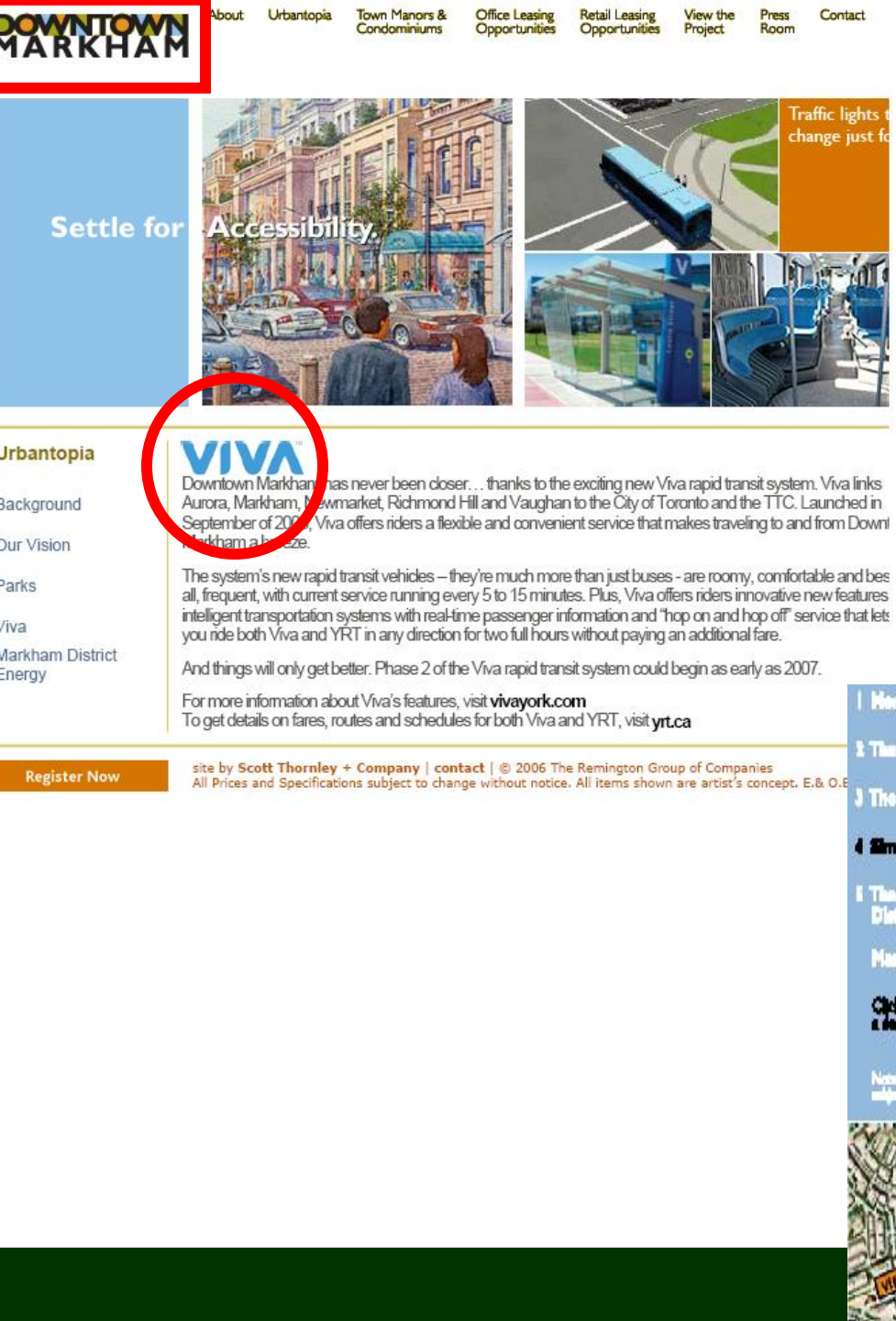
"Historically, housing h... always followed public tran... port nodes. Those closer ... transport generally have high... values," Mr Gross said.

"A lot of investor stock ar... rental properties are considere... worth more if they are close ... public transport because th... are easier to rent."

The $135 million Inner North... ern Busway is nearing com... pletion, and the planne... dedicated bus lanes will gi... passengers uninterrupte... travel as far as Kedron.

York VIVA: Opened 9/2005

Downtown Markham Remington Group Toronto



Wright Group UK
"Streetcar"

Lessons Learned

- BRT is an attractive, potentially cost-effective rapid transit option
  - High speed, reliable service relative to local bus,
  - Attractive to passengers of all incomes
  - Attractive to developers
  - Relatively modest costs, easy to build and operate
- BRT can be a valuable addition to the public transport network of almost any city, currently with or planning Metros and/or LRT

There Is No Single BRT System Prescription

- **Use transportation planning analysis to develop BRT system package**
  - ***Begin with market analysis***
  - ***Match markets with service plans, plan for running ways, vehicles, stations, etc.***

Focus on System Integration

- **Make running ways, service plan, stations, vehicles, ITS, fare collection one system**
- **A unique, *pervasive* brand identity and quality image are important as passenger information and marketing devices**
- **Maintain system integrity and quality**
  - **Resist "de-construction," the removal of key components because its "just a bus**

Lessons Learned

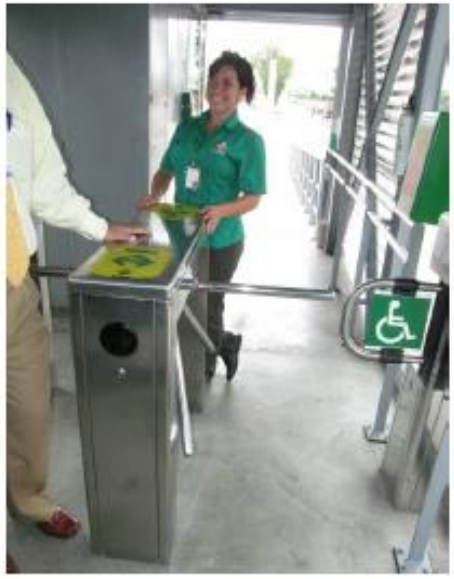
- **Work hard to overcome the negative image of most bus "systems"**
- **Ensure that decision-makers and the general public know what BRT is and what its potential benefits might be for their city**

What BRT is Not!

- Scatteredimprovements in local bus systems
  - Nice stations or terminals
  - New, “hi-tech.” buses
- “Special” bus routes (e.g., limited stop or express) on freeways or arterial streets
- Special routes with conventional buses painted a special Color
- Bus lanes, busways with few or no other BRT elements

Lessons Learned

- ***Be willing to spend money on BRT; in most situations, it will still have life cycle costs orders of magnitude less than any alternative***



BRT Primer

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