Traffic Management to Achieve Priority for Streetcars and LRT

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TRB

APTA

Key Messages

- Streetcar priority best for ridership and safety
- Streetcar priority does *not* increases congestion
- Banning opposed turns key for Streetcar safety
- Traffic in grid soon adjusts to lane reductions
- Focus on design for property access and service
- Permit service access (only) to obtain ROW B
- Limit ROW C to local traffic with turn bans

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Scope: Streetcar and street running LRT

- *Street level* Streetcars and LRT
- Focus on traffic and transport performance
- Right of Way (ROW) definitions as per Vuchic:
- A – fully *controlled* ROW (grade separated)
- B – *separate* ROW with intersections = LRT
- C – ROW *shared* with traffic = Streetcar

Right of Way (ROW) A

- Right of Way fully controlled, with no crossings

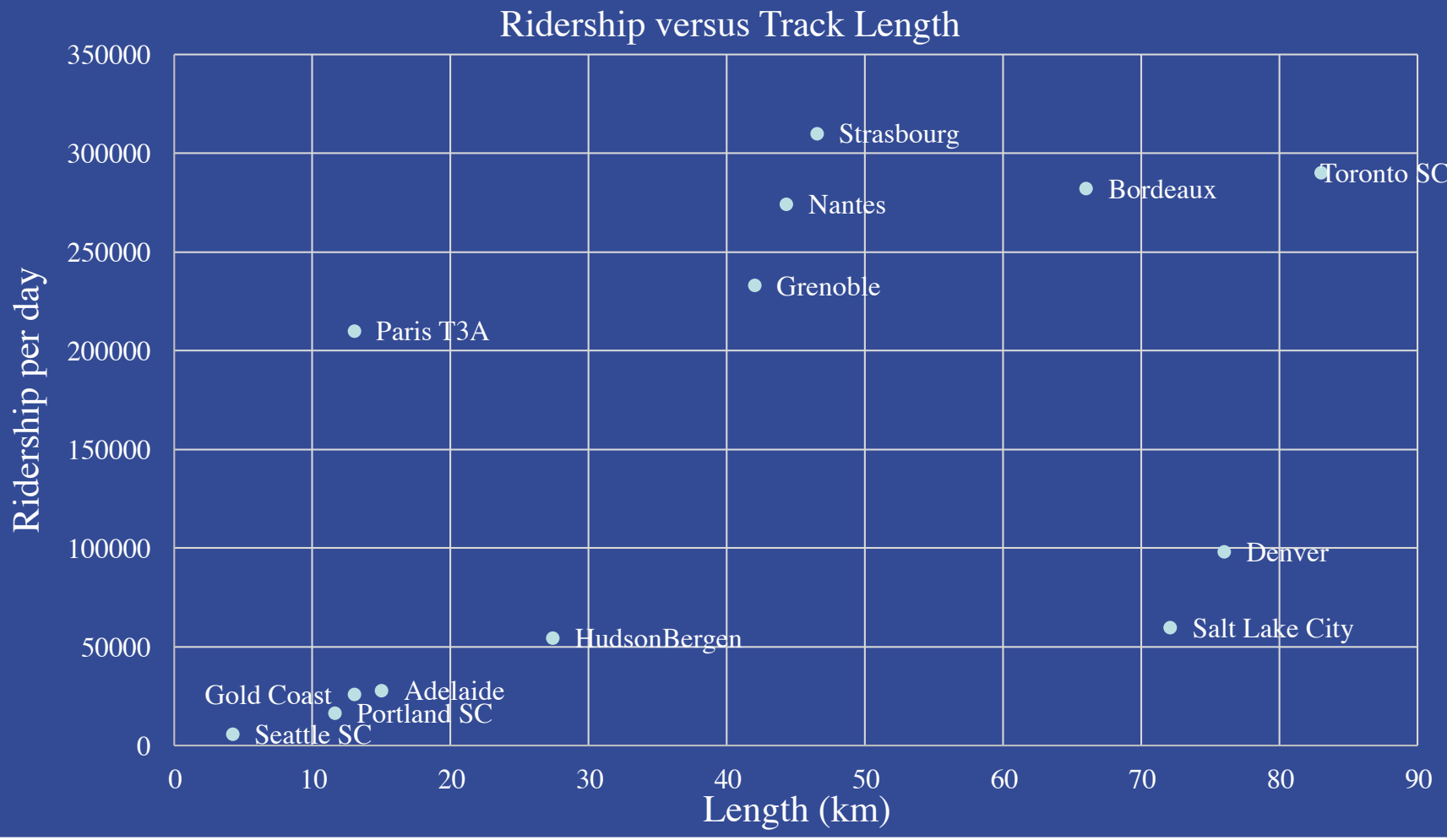
Right of Way (ROW) B

- Right of way on surface, separate from traffic

Right of Way (ROW) C

- Right of way on surface, shared with traffic

We know ROW B is more efficient than C



We know ROW B is more efficient than C

- Higher speed (+30%)
- Travel time reliability
- Higher capacity (+50%)
- Higher ridership (+20%)
- Better safety (Cost)

- ***So how do we get from ROW C to ROW B?***
- ***Propose traffic management rules for ROW B***

Case Studies: Inserting streetcars & LRT

- Adelaide Tram
- Gold Coast LRT
- Melbourne Trams
- King Street, Toronto
- Denver Light Rail
- Portland Streetcar
- Salt Lake City LRT
- Seattle Streetcar
- Nantes Tramway
- Grenoble Tramway
- Bordeaux Tramway
- Paris T3A Tramway

Case Studies: Glenelg tram, Adelaide CBD

- Streetcar extended 5km
- Separate track, turn bans
- No signal priority 12 km/hr
- Opposed turns banned
- Patronage +12,000/day
- Traffic 25000 → 21000 vpd
- Traffic congestion *less*

Case Studies: Gold Coast G Link

- New 13km street running LRT
- ROW B, lanes removed; local access only
- Turns signal controlled
- Signal priority 22 km/hr
- Ridership 21,000 ppd
- Traffic volume -15%
- Congestion less *in area*

Case Studies: Melbourne Trams

- 250km Streetcar network
- Mostly ROW C some ROW B
- Low speed 15 km/hr
- Patronage 560,000 ppd

- Busiest priority B = 2600 cars/hr; 9800 pphr (FS)
- Busiest priority C = 2400 cars/hr; 2500 pphr (Kew)
- Net congestion = -3.4% (Nguyen Phuoc, Currie)

Case Studies: King Street, Toronto

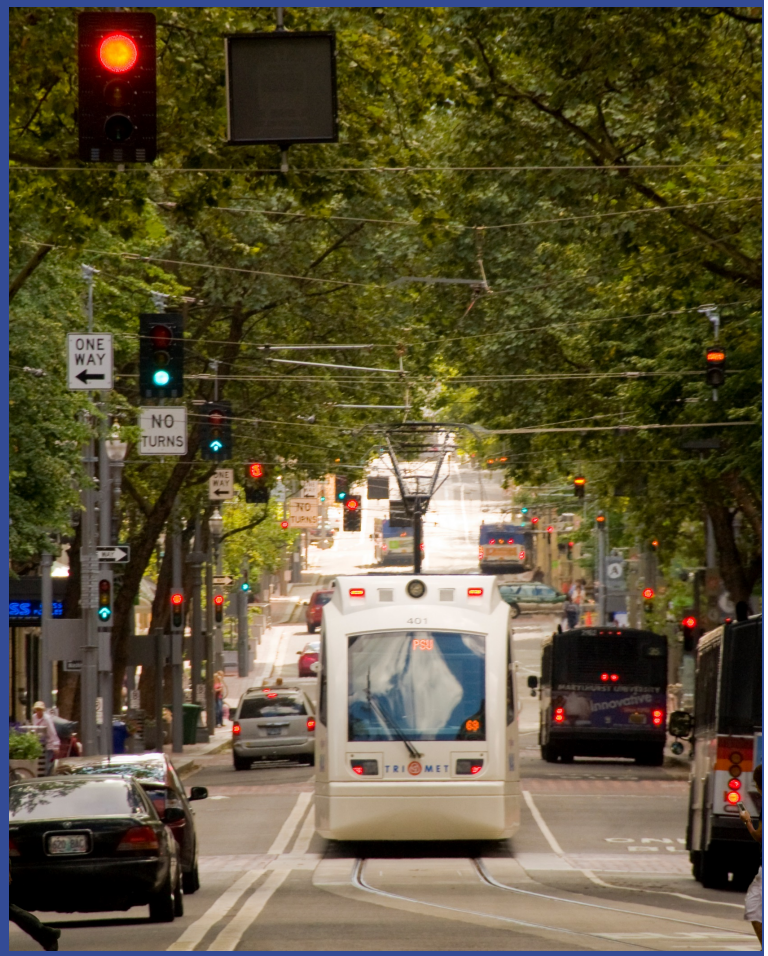
- Local traffic only, 1 block
- Traffic 20,000 vpd
- Ridership 65000 +17%
- TT Reliability +84%
- Car travel time +/-1min
- Transit travel time -5min
- Retail trade +5.8% (base +3.7%)

Case Studies: Denver Light Rail

- Bhattacharjee & Goetz 2012:
- Denver LRT 76km; 86000 ppd
- Short term traffic drop
- Traffic growth reduced in zone of influence of LRT
- Disputed due to low volume (Ransom & Kelemen 2016)

Case Studies: Portland Streetcar

- Loop service streetcar 12km
- ROW C; No priority; 12 km/hr
- Ridership 18,000 ppd
- Urban redevelopment goal
- Traffic and parking retained
- Traffic congestion *less*



Case Studies: Seattle Streetcar

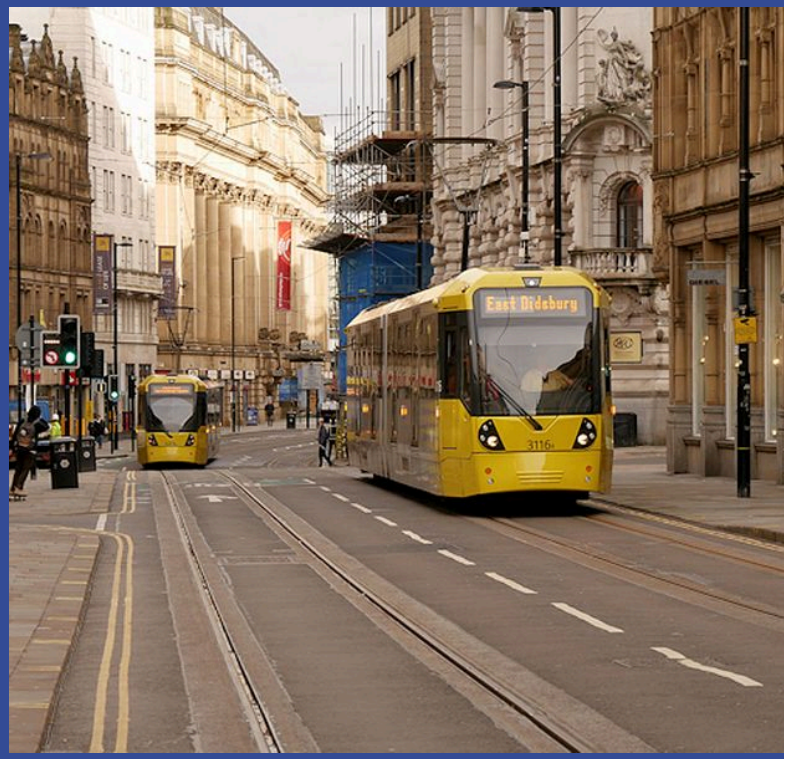
- Two lines 4.2km
- ROW C; 12 km/hr
- Ridership 6,000ppd
- Urban redevelopment
- Parking retained
- Congestion *worse*

Case Studies: Salt Laker City LRT

- Street LRT 72km
- ROW B; 38 km/hr
- Ridership 60,000 ppd
- Traffic congestion *less*

Case Studies: Manchester Metro LRT

- Transport Impact Study (Knowles 1996)
- Patronage 41,000 ppd
- Network 30km; ROW A/B
- Service traffic only permitted
- Ridership forecast exceeded
- City traffic drop; mode shift



Case Studies: Nantes Tramway Ligne 2

- In 1970s, 50 Otages = 8 lane road, 50,000 vpd
- Now 2 lanes; 20,000 vpd
- LRT ROW B: 160,000 ppd
- 2 min headways
- Traffic congestion less
- CBD activity increased

Case Studies: Grenoble Tramway Ligne C

- In 2000, Ligne C = 4 lane road, 60,000 vpd
- Now 2 lanes; 25,000 vpd
- LRT ROW B: 38,000 ppd
- 4 min headways
- Traffic congestion less
- Ped activity increased

Case Studies: Bordeaux Tramway

- 3 line LRT opened in 2004
- 43km ROW B signal priority
- Traffic crossings signalised
- Service traffic only in CBD
- Traffic 20,000-50,000 vpd
- Patronage 150,000 ppd
- City PT mode share increased from 8% to 15%

Case Studies: Paris Tramway T3A

- 13.4km streetcar open 2006
- ROW B Signal priority 18km/hr
- Ridership 100000 ppd (+100%)
- Traffic 80,000 vpd now -40%
- Congestion unchanged
- Travel time – 25% vs prior bus
- Ridership in 2018 = 210,000 ppd

System level case studies: For

- Sacramento (Litman 2006)
- Denver LRT (Bhattacharjee & Goetz 2012)
- Melbourne (Nguyen Phuoc, Currie, 2017)
- Utah Trax (Ewing & Tian, 2014)
- LA Expo Line (Guiliano, 2018)
- ***All*** show net traffic congestion benefits of LRT & Streetcar networks

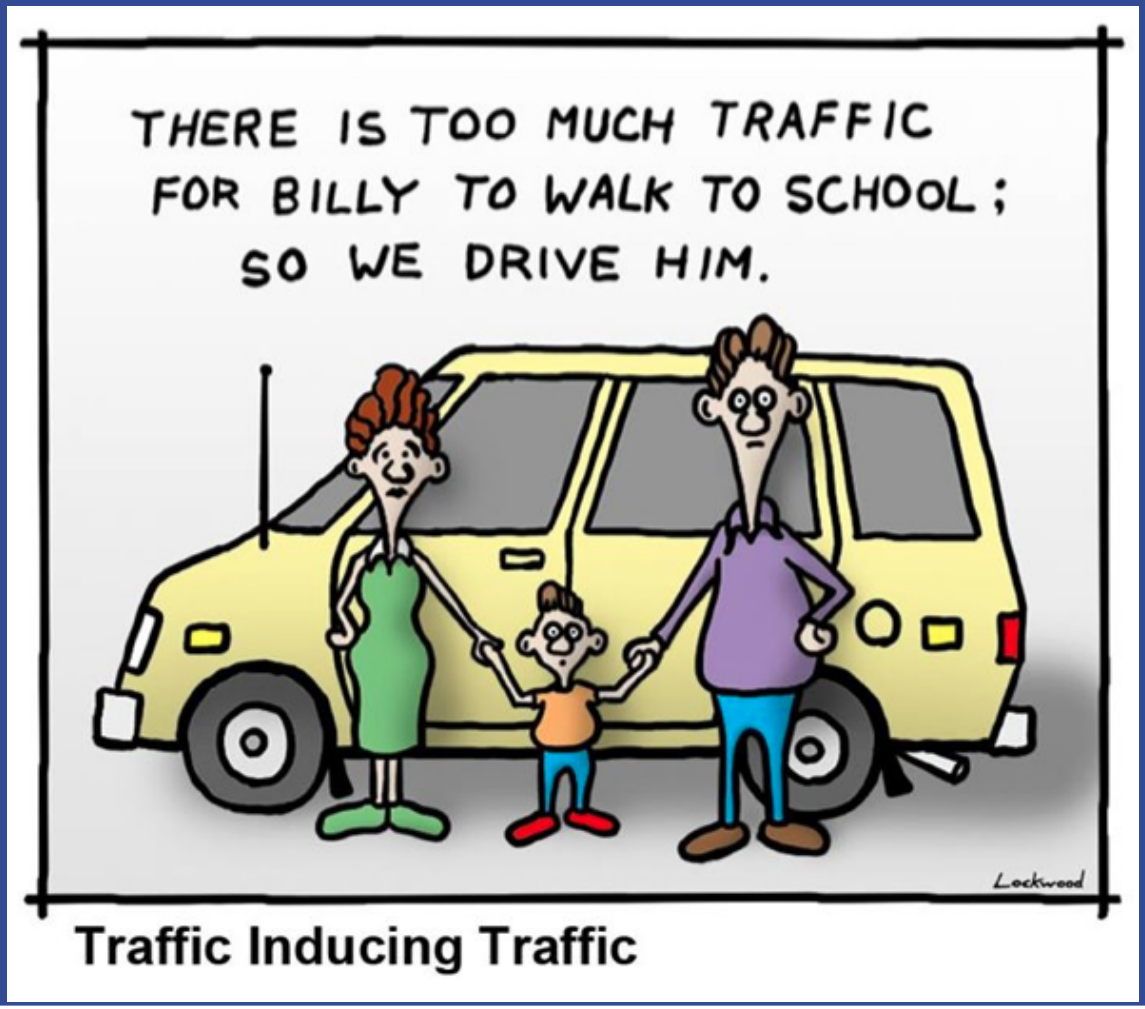
System level case studies: Against

- Denver LRT (Ransom & Kelemen 2016)
- Norfolk Tide (O'Toole et al)
- UK (Lee & Senior): no effect on car ownership
- Paris T3 (Prudhomme): tramway diverted traffic
- All challenge if change is due to streetcar / LRT
- No actual contrary evidence cited

5. Congestion: LRT < Streetcar

	ROW	Traffic Pre	Traffic Post	Speed	Ridership
Adelaide	Separate	26000	21000	12 km/hr	28,000
Gold Coast	Separate	57000	46000	22 km/hr	21,000
Melbourne	Shared	NA	30000	15 km/hr	45,000
Toronto	Shared	20000	?	12 km/hr?	84,000
Denver	Separate	NA	NA	27 km/hr	98,000
Portland SC	Shared	NA	NA	10m km/hr	16,000
Seattle SC	Shared	NA	NA	12 km/hr	6,000
Salt Lake City	Separate	NA	NA	38 km/hr	60,000
Nantes	Separate	50000	20000	22 km/hr	130,000
Grenoble	Separate	60000	25000	19 km/hr	38,000
Bordeaux	Separate	50000	20000	18 km/hr	150,000
Paris T3A	Separate	80000	50000	18 km/hr	130,000

Induced demand: some travel is avoidable



Traffic Inducing Traffic

Why no traffic problem? Induced demand

- Duranton & Turner (2009) induced demand
- Increasing lanes increases traffic volume
- Reducing lanes reduces traffic volume
- Adding Streetcar/LRT encourages mode shift
- Improved walkability encourages active trips
- Q: Why so hard to convince traffic engineers?

LRT & Streetcar Safety

LRT & Streetcar Safety

- COST Study – streetcar safety in 6 EU countries
- TCRP137: data 36 US, Canadian LRT/Streetcars
  - ROW B preferable, in median alignment
  - Opposed turns (left turns in US) a safety issue
  - Pedestrian issues in ROW B and C; median safest
- Overall evidence: LRT safety > Streetcar safety

Summary of case studies

- Separate ROW (B) key to LRT performance
- Allocated LRT lanes reduce traffic volume
- ROW B LRT capacity > lost lane capacity
- LRT (*ROW B)* has *less* traffic impact than Streetcars (*ROW C)*
- Separate ROW (B) is safer than shared ROW C
- So why is it so hard to get ROW B?

Demand Models poor at induced demand

Duranton & Turner (2009) US Study evidence:	Is it in 4 Step Demand Model?
Increase in driving per capita (new trips)	No – trip generation not related to road space
Increase in driving per capita (longer trips)	Yes – trip distribution is altered if road space increased
Increase in driving per capita (mode shift)	Yes – via mode choice function
Inflow of new residents (minor)	No – demographics fixed

What is *the real problem*? Resistance

- Residents supported King St pilot (10,000+)
- Some Businesses opposed (3)

Why are businesses the main resistance?

- Traffic? ✗
- Parking ✓
- Service access ✓

What is the solution?

- Maintain traffic connectivity
- Access to parking
- Service vehicles

What is *good practice*?

Streetcar Planning Principles

- Always plan for ROW B if possible
- Do NOT plan for traffic growth in LRT corridor
- Assume LRT will increase PT ridership +20%
- Assume traffic volume will be flat or decline
- Benchmarking may be more reliable than 4 step demand models to predict LRT ridership

Streetcar design: Link/Move and Place

- Diemer et al (2019)
- Categorise corridor by street (move) and place function
- Identifies suitable streetcar corridor
- Guides cross section

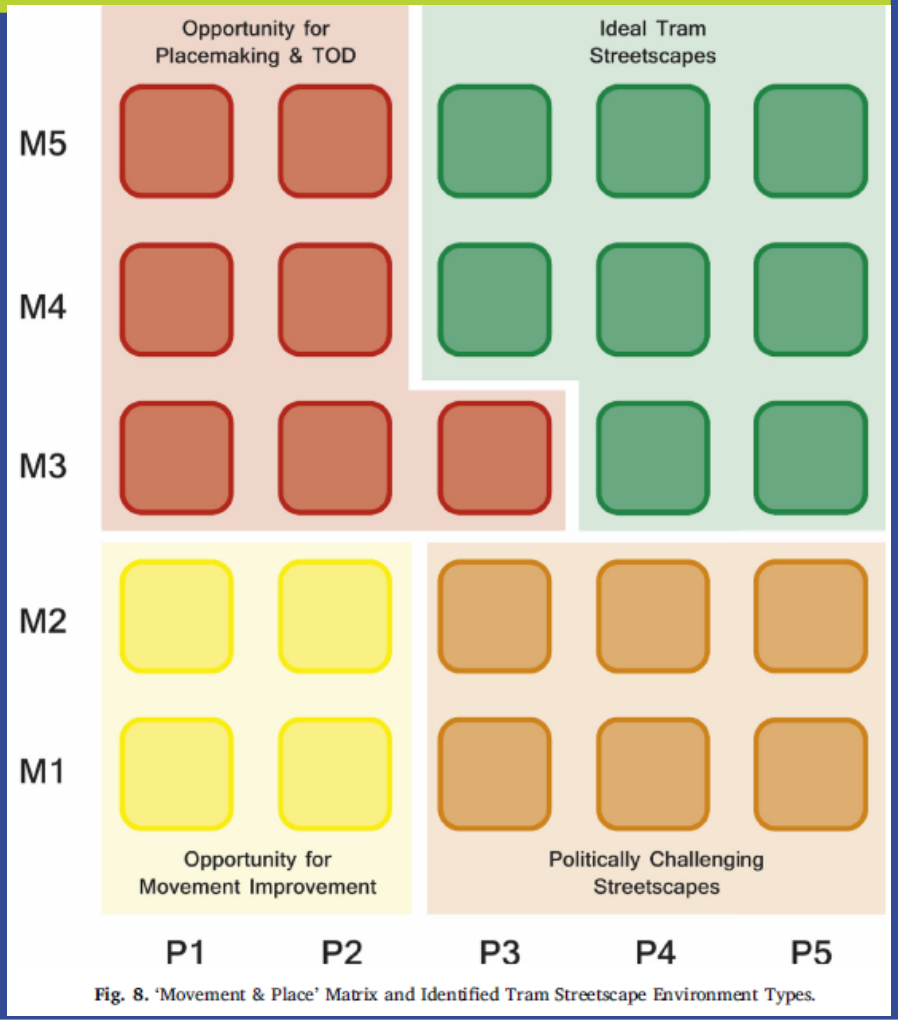


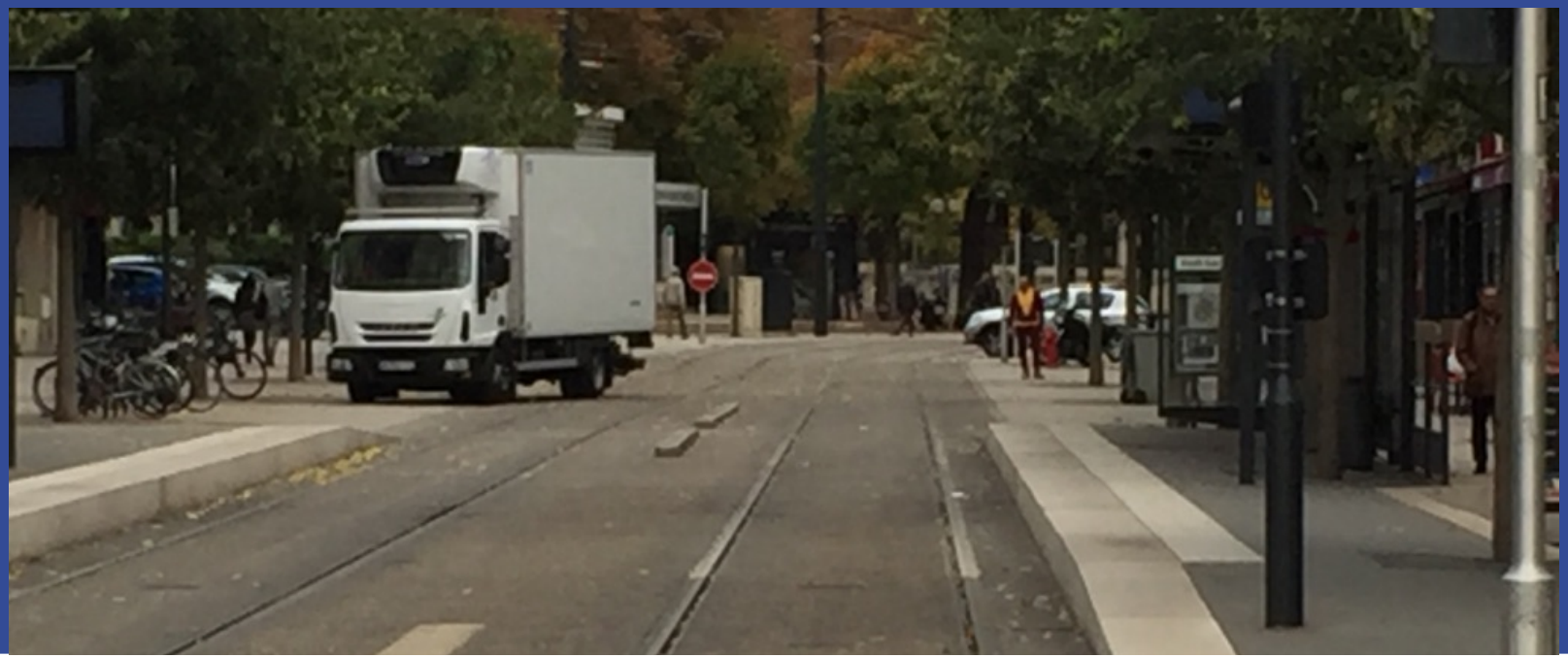
Fig. 8. 'Movement & Place' Matrix and Identified Tram Streetscape Environment Types.

Traffic Management Rules for Streetcars

- Safety before capacity:
  - Ban or signalize opposed turns across track
  - No unsignalized crossings of track
  - Signalise pedestrian crossings to platforms

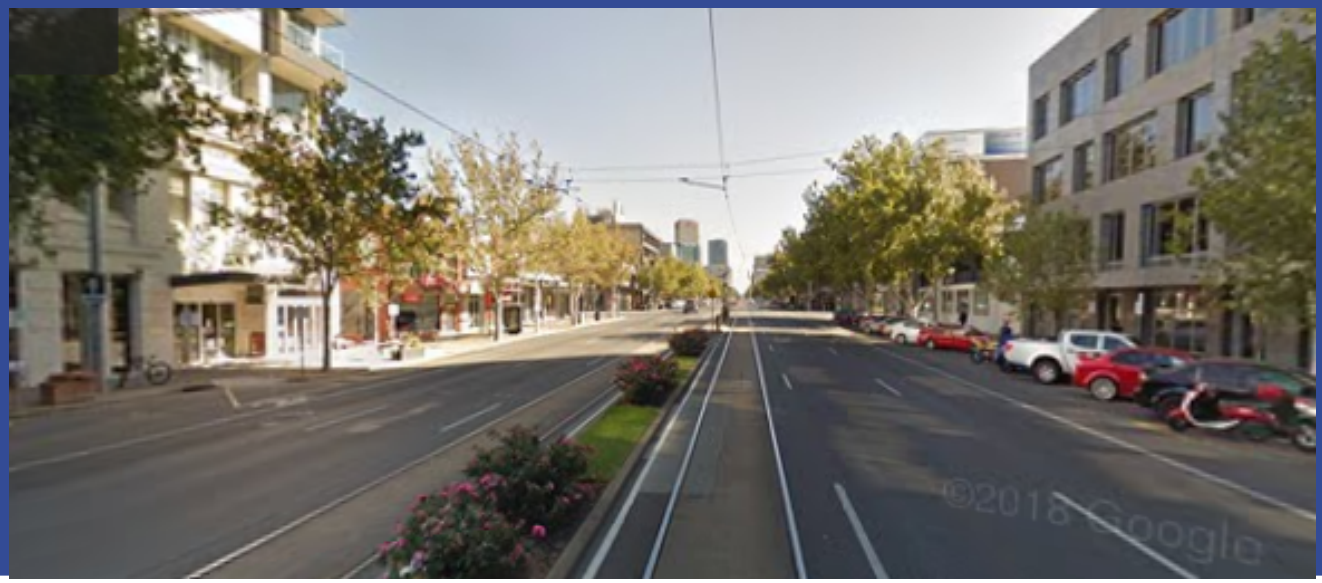
Traffic Management: Talk to businesses!

- Permit service vehicles on track if no alternative
- Permit service vehicle parking if clear of track



If you can't get ROW B, get ROW C+

- Remove adjacent parking except service vehicles
- Limit through traffic e.g. turn bans, one way



Closing thought – think optimistically

- For all systems built since 1985, once ROW B is obtained, it has *never been removed* for traffic

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