Streetcar and Local Bus Comparative Review

A Technical Memorandum For The City Of Vancouver's Downtown Streetcar Project Update

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IBI GROUP

Contents

INTRODUCTION

This review compiles a set of quantitative and qualitative indicators that compare streetcars to buses. This review is based on available literature and knowledge base in the transit engineering industry, and has been prepared in context of the City of Vancouver's Downtown Streetcar project update.

It compares the general characteristics of streetcars and bus services ***(in terms of financial, operational, traffic, and social impacts)*** and also looks at the specific characteristics of the proposed Downtown Streetcar in Vancouver. The context of this review is important for interpretation of the issues discussed in this review. As illustrated in the figure below, there are various levels of bus and rail transit, and the focus of this review is a comparison of "local bus" with "streetcar and light rail" type systems. Since the distinction between streetcar and light rail is essentially segregation and signal pre-emption, light rail benefits are partially relevant to the downtown Streetcar corridor which is visioned to include both. At the same time, express bus and BRT are not relevant to this review because of the nature of the downtown street car corridor, and the nature of the South False Creek Development and public input received to date.

		Rail Transit		
		Streetcar	Light Rail	Heavy Rail
Bus Transit	Local Bus	FOCUS OF THIS COMPARISON		
	Express Bus			
	Bus Rapid Transit			

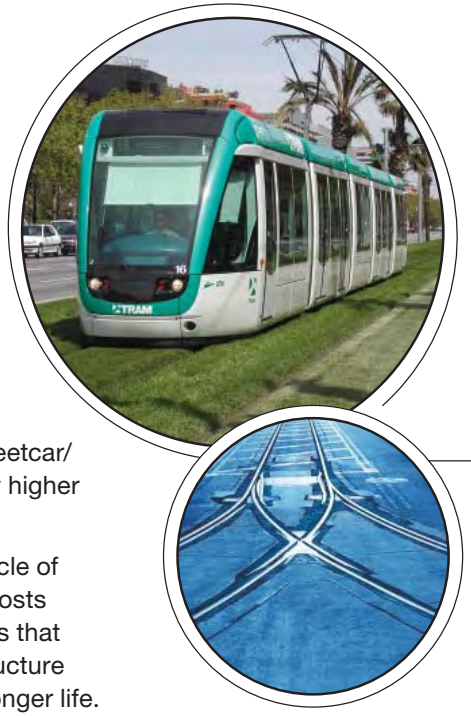
2 FINANCIAL

On the surface, serving an area by bus appears less expensive than rail since buses are less expensive than streetcars, and since buses do not need rail infrastructure. However, the bottom-line financial outlook of streetcar versus bus service has to consider the life-cycle costs, potential benefits of service integration between modes, and incremental ridership and fare revenues that may result. A discussion of these financial indicators follows.

Capital and Operating Costs

The key cost differentiators between streetcar and local bus service include:

- Higher capital costs for streetcar infrastructure, including civil construction, stations, tracks, signals and power distribution along the streetcar alignment. Electric trolley buses would also require overhead power if they were being contemplated, but none of the other elements.
- Higher capital costs for streetcar vehicles. The typical price for a modern streetcar is in the range of $3 to $3.5 million. In comparison, 40-foot transit buses have a capital cost of some $0.4 to $0.5 million, and articulated buses cost in the range of $0.6 to $0.9 million.
- Potentially lower per-passenger operating costs for the streetcar, depending on service policies and the resulting ridership. On busy transit corridors, it is more cost-effective to carry passenger loads on higher capacity streetcars instead of replacing them with diesel buses. While the average cost per mile or hour of streetcar/LRT service is typically 50-100% higher than for buses, this is typically offset by higher ridership on most services.
- The longer service life of streetcars (25 years) compares favourably to the life cycle of a transit bus (17 years). The longer life helps to reduce some of the annualized costs relative to the net present (current year) values. (These are average financial lives that account for the median time an agency either replaces the vehicles and infrastructure or spends an equivalent amount of money refurbishing and restoring them for longer life. The values are guidelines the United States Federal Transit Administration – or FTA – requires agencies to use for project justification studies and funding applications).



Fare Revenues

Another consideration is the higher ridership potential of the streetcar, which leads to greater operating revenues.

There are two contributing factors:

- Rail systems have higher operating speed where separated from other traffic, such as along the section between Granville Island and Science World where rail right-of-way exists but local buses would have to share the road.
- Streetcars and rail systems have a built-in attraction for tourists and occasional “choice” riders. Studies and observations in other cities have demonstrated significant increases in ridership due to a change from bus to rail. This is due to comfort factors such as easy access, large windows, smooth rides, quiet environment, and visible routings. In addition, there is a certain cachet to streetcars, often revealed by rider preference studies, that has to do with the perceived special level of service.

3 OPERATIONAL

This section presents a comparison of operational measures for buses and streetcars, organized by measure.

Speed

- Streetcar – Higher acceleration and braking abilities than bus, therefore better travel time performance. Travel time is enhanced significantly with dedicated right-of-way (R.O.W.). Separation from other traffic is commonplace in European systems and second-generation North American systems. Downtown Streetcar includes sections with dedicated right-of-way, resulting in more attractive travel time performance.
- Bus – Travel time depends on type of service (local, community shuttle, BRT). These types of bus are all present or soon to start in the vicinity of the proposed alignment. None of the planned bus services include dedicated right-of-way; buses would operate in mixed traffic lanes, and experience the same congestion as other traffic streams.

Reliability

- Streetcar – Travel time reliability is higher than bus where streetcar tracks are on exclusive ROW. Reliability is also increased if streetcar tracks are combined with transit signal priority. If in mixed traffic lanes, streetcar experiences similar benefits from transit signal priority as bus.
- Bus – Local bus in mixed traffic lanes is less reliable as it has to contend with traffic congestion, being blocked by turning, stopped or parked cars. There are potentially similar benefits from transit signal priority in mixed traffic as a streetcar.

Capacity

- Streetcar – Streetcars are often used as an intermediate capacity urban circulator. Per vehicle, a 50-foot (16m) streetcar carries 70% more passengers than a standard low floor bus and 10% more than an articulated low floor bus, assuming the same space per standing passenger. For example, the Portland Streetcar has 29 seats, and at Vancouver standard would comfortably carry 64 standees, or 93 passengers in total. The maximum capacity is 156 passengers.
- Bus – considered to be low to intermediate capacity. Per vehicle there are 38 seats, and 17 standees [55 total] on a standard low floor 40-foot (12m) bus. There are 54 seats, 31 standees [85 total] on an articulated bus (per TransLink peak period 15 minute standards).

Stations and Stops

- Streetcar – Stations stand out and are more clearly identifiable because the approaching tracks add a sense of permanence, and can also be shared with bus services.
- Bus – Local bus stations are typically roadside shelters, and although they can be architecturally attractive, they do not have the same sense of permanence.

Routing Flexibility

- Streetcar – Routes to stops are limited to places where trades and power supply have been built. Real-time ability to re-route or detour a streetcar is limited; this requires built-in locations for turn-backs on the track network, requiring crossover tracks and potentially traffic intervention.
- Bus – High ability to add stops and change the route. Real-time flexibility exists to deviate from route due to special event or emergency.

Transit Service Permanence

- Streetcar – Investment in tracks and stations represents a longer term commitment to providing service. The flip side to streetcars being 'confined' to their tracks is passengers know the streetcar is on its way.
- Bus – Given its flexibility advantage, local bus service can always be reprioritized throughout the region. This could mean changes in frequency but possibly complete deletion of service.

Depot Requirements

- Streetcar – The yard and maintenance facility must be on or near the alignment, and connected by yard lead tracks. Proposed locations in Vancouver are: on Quebec Street under Georgia Viaduct; and under/near the Hemlock ramp onto Granville Bridge.
- Bus – Additional buses would require space in existing or new bus depots. Local buses in Vancouver typically originate from Oakridge, and have moved to Eburne, which is also at capacity and overflowing to the Burnaby Transit Centre.

Equipment Life

- Streetcar – Typically, 25 years for the vehicles and 30 years for the tracks, signals and power system.
- Bus – Typically, 17 years of service before they are replaced.

4 TRAFFIC IMPACTS

The following presents a comparison of traffic impacts between buses and streetcars.

Impact to Vehicles

- Streetcar – similar impacts to vehicles as buses, where both are street-running. In the case of this proposed system, the Downtown Streetcar also has off-street segments where there are no impacts to vehicles, except at intersections.
- Bus – similar impacts to vehicles as streetcars, where both are street-running. Greater reliance on street-running than proposed streetcar, and therefore more mixing with traffic.

Impacts to Bicycles

- Streetcar – The streetcar vehicle has a more predictable path because the streetcar follows tracks (it won't make lane changes), but there is also the risk that thinner bicycle wheels might become caught next to tracks if riders are unprepared.
- Bus – Less predictable path than streetcar but has no track infrastructure and drivers have an ability to pass cyclists with a greater shy distance.

Impacts to Pedestrians

- Streetcars – are quieter and produce no exhaust fumes for passing pedestrians. Running ways and stations are often accompanied by broader sidewalks, an improvement to the walking environment.
- Buses – are noisier and diesel buses have exhaust fumes. Can also be accompanied by broader sidewalks.

Signal Priority

- Streetcar – Implementation of transit priority is easier and more cost effective for rail-based vehicles because detection can be hard wired into the tracks.
- Bus – Transit priority will require method of bus detection, and supporting roadside detection equipment and communications.

Safety

- Streetcar – Lower overall rate of accidents than bus, due to predictable path of operation (tracks) and portions of the alignment separated from traffic. Some rail-vehicle accidents occur because rail cannot swerve to avoid other vehicles whose drivers make sudden lane changes.
- Bus – Higher rate of accidents than streetcar, due to operation in mixed traffic and movement between traffic lanes.

Design Flexibility

- Streetcar – Because of the predictability of operation and the easy ability to restrict other vehicles, streetcar systems have been incorporated in parks, plazas, greenspaces, and boulevards where bus routes would not be acceptable. Tracks can be fully integrated into plaza pavers and even grassed areas.
- Bus – routes can operate within exclusive transit malls, but these are sometimes shared with taxis, motorcycles and delivery vehicles.

5 SOCIAL IMPACTS

The following presents a comparison of social impacts between streetcars and buses.

Street & Neighbourhood Design

- Streetcar – Lateral segregation of different uses, where practical, with curbs and landscaping – as a means of limiting automobile influx into narrow downtown streets. In addition, the higher overall cost of constructing a streetcar system on city streets is partially offset by the benefit of rebuilding streets and therefore improving the public realm.
- Bus – No impact on street & neighbourhood design.*

Environmental

- Streetcar – Benefits, include congestion relief and air quality improvements. Electric streetcars produce zero-emissions as a mobile source.
- Bus – Can be low or zero-emission, depending on the type of motor. Diesel buses emit fumes and particulate matter, although newer vehicles emit much lower levels.

Noise

- Streetcar – Modern electric vehicles make very little noise, less than diesel engines.
- Bus – Diesel and CNG buses create significantly more noise than either electric trolley buses or streetcars.

* Note: As stated in the introduction, express bus, BRT, and hard rail are not part of this comparison.

Market Attraction

- Streetcar – Streetcar and LRT systems have spun off benefits to nearby retail and commercial establishments. For example:

  a. San Diego Trolley caused a 10% benefit in hotel occupancy near stations (1992 study); 80% of riders at Fashion Valley and Mission Valley riders also shop at the malls; 57% of those said they would not have shopped without the transit service.

  b. In a survey of businesses along Spadina Avenue in Toronto (where an old streetcar line was renovated to replace a bus route), 43% indicated a positive impact, 38% indicated no change, and 19% of the respondents felt business had dropped. Overall, this was an improvement.

  c. The F-Line in San Francisco was extended in 2000 along the Embarcadero and has boosted the number of visits by local office workers, residents and tourists to food shops at Fisherman's Wharf and the Ferry Terminal at the foot of Market Street.

- Bus – Overlaying higher-quality bus services such as Bus Rapid Transit onto a street with local services usually increases ridership and benefits businesses close to stops. This type of service doesn't apply to the proposed streetcar alignment in Downtown Vancouver.

Redevelopment Stimulus

- Streetcar – Investment in rail encourages often revitalization of urban areas, starting from the time the project becomes committed:

  a. Hudson-Bergen Light Rail – In Jersey City, actual and approved development in 4 years after the LRT started was nearly double the development activity of the previous 27 years; commercial, residential and institutional investment. The City of Bayonne is undergoing a turn-around in property values, building permits, sale prices of residential units, and redevelopment of depressed areas.

  b. Spadina Avenue, Toronto – Following re-introduction of streetcars in 1997, employment growth exceeded the city average, and sections with slumping employment underwent a recovery after the new streetcar started service.

  c. Portland Streetcar (which runs perpendicular to city's main LRT system) is credited with sparking more than $1 billion of brown field redevelopment. Systematic studies of development in Portland showed that new development within one block of the alignment was at higher densities than new developments elsewhere in downtown Portland after 1997. (The streetcar alignment was chosen in 1997 and the service opened in 2001.) In addition, the share of new downtown development within one block of the alignment rose from 19% to 55%. Expressed as a rate, square footages within one block increased nearly 6% compared with an overall rate of 2% in the entire downtown. Two of the key issues were increased accessibility and lower parking requirements, making bigger developments feasible.

- Bus – Conventional bus services are not known for triggering redevelopment, although they can provide access to developing areas that were previously unserved. Because bus services can easily be removed, they do not encourage developers to the same extent as rail with its fixed infrastructure.

Ridership Impacts – A Comparison

Streetcars attract more choice riders because of curiosity and observed passenger preference for rail over bus, for various reasons (presence of stations and tracks gives it a sense of permanence, historic vehicles act as an attraction to tourists, comfort and reliability are perceived to be better). For example:

a. A bus route in The Hague, Netherlands, was replaced by a rail line that attracted 22% more riders, 32% more in the off-peak.

b. The F Market-Wharves streetcar line in San Francisco uses mostly restored vintage streetcars (PCC's and Peter Witts) and attracted more ridership (9,700 per day on just the Market section, in 1998) than the bus line it replaced (5,400). The full line now carries over 20,000. Tourists view the line as a type of tourist attraction in conjunction with the cable cars, and local riders use it more heavily. Sometimes, buses are used to handle heavy peak loads, but people often refuse to ride the bus and wait extra for the streetcar instead.

c. In Toronto, on Spadina Avenue, a bus service was replaced by the return of median-running streetcars in the mid-1990's. The #77 TTC bus carried 31,000 per day; running at a less frequent headway than the bus but carrying more passengers per vehicle, the streetcar moves 38,000.

6 HIGHLIGHTS

These are the key findings in this comparison of streetcar services with bus alternatives for the proposed Downtown Streetcar:

- ✔ Streetcars have higher initial capital costs for vehicles and rail infrastructure, but most of this cost can be offset through additional passenger fare revenues and operating cost savings from service integration with other transit services.
- ✔ Streetcars have an average 25-year lifespan compared to a diesel or electric trolley bus, which offer only 17 years of service.
- ✔ Benefiting from the initial investment, streetcars with dedicated ROW can run at higher average speeds than local buses in mixed traffic, offer greater reliability and capacity, and feature more dominant stations.
- ✔ Installation of a streetcar line has more presence than a bus route and the streetcar service has a distinct appearance and operation. Businesses that build themselves around a streetcar line typically have better economic stability. In particular, restaurants and shops that are able to attract tourists and become readily accessible to commuters in the midday or after working hours tend to prosper.
- ✔ Streetcar corridors act as a redevelopment stimulus, increasing market attraction and property values near stops.
- ✔ Streetcars can enhance urban design and streetscapes and the proposed project includes improvements such as bicycle lanes and pedestrian enhancements along its alignment.
- ✔ Streetcars attract tourism riders in addition to commuters and recreational/ shopping trips by area residents. Since streetcars can carry approximately 1.5 times the number of passengers as articulated buses, they are better suited to handle this extra volume.
- ✔ Streetcars run on electricity and are environmentally friendlier than diesel buses, with less vehicle noise and fewer emissions.

In summary, while it is true that simply running a bus service might have lower average capital and operating costs, there are numerous transit operations, personal mobility, urban environment and economic spin-off benefits from a streetcar service that support its implementation in a well-chosen corridor.