Transit Priority Program: Putting Buses First

Organization
City of Ottawa — Transportation, Utilities and Public Works Department

Status
Started 1994, ongoing

Overview
About 80% of Ottawa's transit service is delivered on roads, where traffic signals and congestion cause delays to transit vehicles and reduce service reliability. Transit priority measures give buses preferential treatment over other vehicles, minimizing the delay impacts of congestion and traffic signals.

The City of Ottawa's transit priority program is supported by strong policies, dedicated resources and interdepartmental cooperation. The program uses both conventional and innovative measures to reduce traffic signal delay and congestion delay. Installed measures include dedicated bus lanes, queue jumps, various forms of traffic signal priority, special freeway interchange features and traffic management strategies.

Program benefits include reduced transit travel times and improved reliability compared to auto travel. These enable higher ridership and lower transit operating and capital costs.

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Resources
- City of Ottawa — Transit Priority (www.ottawa.ca/city_services/traffic/26_1_2_en.shtml)
- City of Ottawa — Official Plan and Transportation Master Plan (www.ottawa2020.com)

Community context

The City of Ottawa is home to about 800,000 people, 90% of whom live in the urban area. While strong regional planning and use of an urban boundary have helped to limit sprawl, suburban growth has been strong and largely automobile-dependent.

Ottawa's transportation system includes roads, pathways, extensive surface transit routes, a dedicated bus-based rapid transit network (the Transitway) and a light rail line (the O-Train). Ottawa's transit ridership (86 million trips in 2002) is higher than any North American city of its size, and its average of over 100 transit trips per capita trails only Toronto and Montreal ahead of all other Canadian cities.

Over the next 20 years, Ottawa expects its population to grow by 50% to 1.2 million. To avoid severe congestion, the City wants transit to serve much of the future growth in travel demand. Transit's proportion of motorized travel in the peak hour is targeted to increase from 17% in 2001 to 30% in 2021. This would mean a 181% increase in the number of peak hour transit trips, while peak hour auto trips would grow by only 30%.

To reach this ambitious goal, Ottawa plans to expand its bus and rail rapid transit networks. However, future infrastructure funding is uncertain. The City must make the best possible use of today's transit facilities, including the roads that carry about 80% of transit services.

Policy context

Ottawa's 2003 Official Plan states that the City will "improve the speed and reliability of transit service by providing transit-priority measures to lessen delays on transit vehicles caused by other traffic and traffic control signals. Transit-priority measures will be implemented for those transit-priority corridors identified on Schedule D [showing existing and future roads designated as transit priority corridors] and at other opportune locations."

The City's 2003 Transportation Master Plan dedicates a section to transit priority and includes eight supporting policies. The plan notes that transit priority can play an important role as a foundation for future rapid transit corridors, building corridor-level ridership by improving

service until the City can afford (or justify) a major investment in new infrastructure.

The Transportation Master Plan contains a Transit Priority Network map. It shows roads where transit priority measures are warranted by surface transit needs, and where they are a staging measure toward future rapid transit lines. The formal identification of a transit priority network validates program efforts and puts individual transit priority projects into a larger policy context. This lets staff focus on implementation and avoid the need to frequently revisit earlier planning.

Rationale and objectives

In Ottawa, rapid transit carries 60 to 70% of transit passenger trips but uses only 20% of the system's operating resources (vehicles and drivers). Surface transit routes, which provide neighbourhood access and "feed" the rapid transit system, carry the remaining 30 to 40% of trips but use 80% of operating resources. There is great potential to conserve capital and operating resources by improving surface route efficiency through transit priority measures.

At peak periods, major bus routes without transit priority suffer a 20 to 40% rate of unproductive time (e.g. at red lights, queues, merges or scheduled time points). The problem is worsened by variability in delay from one trip to the next. Transit schedules must be designed for the "slowest common denominator", and buses going faster than expected must eventually sit idle just to stay on schedule. This causes frustration for passengers and wastes precious dollars.

Transit priority can reduce unproductive time from the 20 to 40% level, bringing it as low as 5 to 15%. It can also reduce the variation in delay from one run to the next. This productivity boost can enable higher levels of service or lower operating costs, while improving schedule adherence and keeping passengers happy.

Transit priority measures combat two different sorts of transit delay:

- **Signal delay** is the time that buses spend waiting at red lights. It can be minimized through transit signal priority measures that reduce the number and duration of red lights that buses meet.
- **Congestion delay** is the time that buses spend in queues waiting to reach an intersection or merge onto a congested road, as well as time simply spent in bumper-to-bumper traffic.

Reducing signal delay is an important objective when traffic is flowing smoothly. However, fighting congestion delay becomes the most important goal during rush hours and other periods of congestion. When buses are stuck in queues and cannot even reach an intersection, transit signal priority measures lose their effectiveness. Measures that reduce congestion delay can help get buses out of the queue and make the best use of signal priority measures.

While signal delay tends to be dispersed among the intersections along a bus route, congestion delay may be greatest at one or two locations where queues are particularly long. For this reason, congestion delay may be tackled effectively by targeting a small number of locations. This makes finding solutions to congestion delay a worthwhile objective.

Transit bus delayed by congestion

Actions

The City of Ottawa applies a general hierarchy of importance to possible locations for new transit priority projects. Most important are intersections of the bus-only Transitway with other roads, where line-haul rapid transit routes can experience costly delays. Next are intersections and roads near Transitway stations, where high volumes of feeder routes converge. Third importance goes to other intersections and roads along the designated Transit Priority Network.

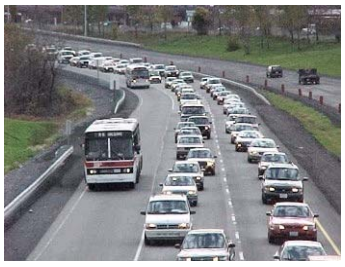
Specific transit priority opportunities are evaluated using three groups of criteria:

- **Problem criteria** — the observed travel speed (higher is better) and variability in travel speed (lower is better) on affected routes. This information is provided by sophisticated data collection systems on Ottawa buses that track vehicle location and speed, passenger volumes, and time spent at bus stops or other points of delay.
- **Benefit criteria** — the number of buses and passengers affected, and the relative importance of the corridor within the overall transit system
- **Feasibility criteria** — cost, technology and space requirements, impacts on other traffic, expected public reaction

The Transit Priority Network shown in Ottawa's Transportation Master Plan was the result of a study that screened major roads using parameters such as traffic volumes, bus volumes, transit passenger volumes, transit travel time variability, and travel speed versus the posted speed limit. The study ranked each road as a low, medium or high action priority for each variable, and a synthesis of these rankings led to the ultimate designation of a single network for long-term implementation.

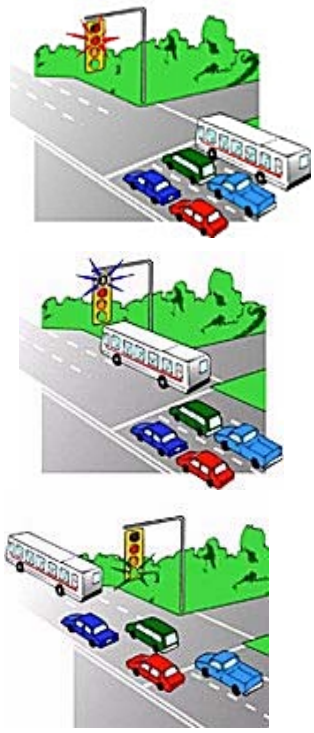
Ottawa uses several kinds of transit priority measures, as described in the following points:

- **Curb-side bus lanes on arterial roads** (more than 10 km). A traffic lane for the exclusive use of buses allows them to avoid congestion in the adjacent traffic lanes.
- **Shoulder bus lanes on freeways** (more than 20 km). A freeway shoulder, widened and strengthened for the exclusive use of buses, allows them to avoid recurring traffic congestion in high-volume corridors.



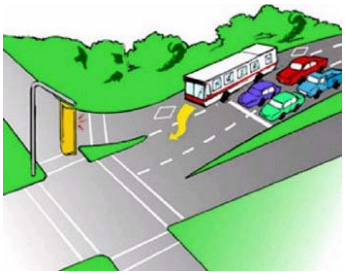
Freeway shoulder bus lane in operation

- **Traffic signal priority** (more than 30 locations). Loop detectors at intersections identify an approaching bus, and the signal controller either extends a green light or shortens a red light to help the bus get through the intersection without stopping.
- **Transit priority signal indicators** (five locations). Special traffic lights for buses—white vertical bars called "cigar signals" that are approved for use in Ontario—let buses jump traffic queues and enter intersections first.



Queue jump with priority signal

- **Advance stop bars** (one location). Advance stop bars for bus lanes at intersections allow buses to stop ahead of other traffic, and jump the queue to enter the intersection first when the light turns green.



Queue jump with advance stop bar

- **Left turns from curb lane** (four locations). Left-turning buses approach signalized T-intersections in the curb lane that is otherwise used only by right-turning vehicles, effectively jumping the left-turn queue in the adjacent lane.
- **Bus-only interchange connections** (several locations). At freeway interchanges, bus-only ramps or links let buses avoid queues as they quickly leave and re-enter the freeway to drop off or pick up passengers.
- **"Demand for service" indicators** (two locations). Passengers waiting at freeway interchanges can communicate their presence to approaching buses on the freeway by activating a remote signal light. This lets high-speed bus routes continue without interruption unless a pick-up is needed.
- **Traffic management measures**. Measures that move traffic queues from one intersection to another can reduce transit delay without increasing overall traffic delay. Simply redesignating traffic lanes or adjusting traffic signal timing can relocate traffic bottlenecks within a corridor. This inexpensive but technically delicate approach can have great benefits for transit. Similarly, relocating or reconfiguring bus stops (such as by moving near-side stops to far-side locations, or filling bus bays) can minimize transit delay caused by nearby queues.

Results

By reducing travel times and improving service reliability, transit priority measures make transit more competitive compared to automobile travel. Ultimately, they can help increase ridership, lower fuel consumption and emissions, and save money.

However, any discussion of transit priority benefits must acknowledge the complexity of large transit operations. In reality, a single transit priority measure can reduce the magnitude and variability of delay on a single route without noticeably reducing operating costs or improving service.

For example, reduced delay can attract new riders to a bus route, but picking up and dropping off those added passengers can use up some of the original time savings. The result is a route that is more efficient, but not necessarily faster. Even over a longer period of time, as synergies among many transit priority measures greatly increase their impact, the benefits may not be easily traceable due to the passage of time and changes in other variables.

Many transit priority measures, on the other hand, have clearly tangible benefits. For example, one queue jump installed at a busy Ottawa intersection reduced bus delay by over 90%, from five minutes to just 20 seconds.

Another Ottawa project that demonstrates the potential of transit priority was the addition of new curb-side bus lanes to Woodroffe Avenue, a major suburban arterial road, in 2002. That project included construction of 2 km of bus lanes in the northbound direction and 3 km in the southbound direction, along with three queue jump installations using transit signal priority.

The Woodroffe Avenue measures saved buses 3.5 minutes of travel time (a 40% reduction) in the northbound direction during peak hours, and 1.7 minutes (35%) in the southbound direction. Even greater time savings will arise as congestion grows in the corridor, allowing the implementation cost ($9 million) to be recouped in as little as eight years. Ridership in the corridor has also increased, and at some points the bus lane carries twice as many people as the neighbouring traffic lane during peak periods.

Participants

The transit priority program has two full-time staff and a dedicated capital budget. An interdepartmental Transit Priority Task Force meets monthly to discuss project prioritization and implementation, with members drawn from the following staff groups:

- **Transit priority.** A project manager and traffic signal engineer work full-time on transit priority planning, implementation and monitoring. They work within Ottawa's traffic operations organization, in close contact with the traffic signal staff who are ultimately responsible for making transit priority measures work.
- **Transit planning and development.** Transit route planners help to identify problems and priorities, and assess the benefits of possible action.
- **Traffic operations.** Traffic signal engineering, installation and maintenance staff are indispensable in making sure that transit priority measures function as intended, both on "day one" and into the future.
- **Transit operations.** Operational staff provide a link to bus drivers, who must be trained to use transit priority measures and who can provide invaluable feedback. They are also responsible for collecting the data that permits analysis of problems and potential solutions.
- **Transportation planning.** Environmental assessment and development approvals staff are essential allies, because road construction is an opportunity to proactively integrate transit priority measures. This is more effective and less costly than future retrofits.

Resources

The resource needs of Ottawa's transit priority program include:

- **Operating expenditures.** Personnel costs for two full-time engineers and supporting staff (e.g. signal designers and maintenance technologists) are about $150,000 annually.
- **Capital expenditures.** Construction, equipment and installation costs vary from $200,000 to over $1,000,000 annually.

It can be hard to identify typical costs of individual transit priority measures because of varying contexts. For example, installing transit signal priority at an intersection could cost as little as $3,000 to $5,000 when done proactively (i.e. as part of another project) or as much as $25,000 to $35,000 to upgrade detector loops and controllers at an existing intersection.

Similarly, installing an intersection queue jump could cost as little as $5,000 where an existing road lane can be dedicated to buses, or well over $100,000 where the project requires road widening, signal pole relocation or other construction work.

Timeline

1994. Creation of Transit Priority Task Force at the former Regional Municipality of Ottawa-Carleton, which was responsible for arterial roads and transit in Ottawa until 2001

1995. Hiring of full-time transit priority engineer

1997. First queue jump installation

1997. Identification of "first generation" transit priority network by former Region of Ottawa-Carleton

1998. First transit signal priority indicator installation

2002. Completion of comprehensive analysis of potential transit priority corridors

2003. Designation of Transit Priority Network in City's Official Plan and Transportation Master Plan

Lessons learned

Ottawa's transit priority program has met challenges in three main areas:

- **Institutional challenges.** A strong dialogue has been created between transit staff (who identify problems and propose solutions) and traffic operations staff (who assess trade-offs and implement solutions). Helping each group understand the other's world facilitates "outside the box" thinking, and helps to overcome resistance to new ideas. Making transit priority a way of doing business, rather than a special project, has required a shift in organizational culture.
- **Technical challenges.** Improved technical skills and tools have been needed in two areas. First, better modeling of traffic operations in congested conditions have been required to enable more effective transit priority planning and design. Second, new traffic control equipment and algorithms have been required to enable effective vehicle detection and responsive traffic signal control.
- **The challenge of public acceptance.** In the program's early stages, pains were taken to avoid creating the perception that transit priority measures increase delay to other traffic. In particular, highly visible queue jumps (with dedicated lanes, coloured pavement and special transit signals) were seen as a public acceptance risk. However, careful planning has minimized negative reaction. While drivers have accepted the need for transit priority so far, future transit priority measures that have a greater effect on other traffic may call for a more proactive public relations strategy.

Ottawa's transit priority experience offers several important lessons:

- **Transit priority measures can bring many of the benefits of rapid transit services, but in a less expensive and more incremental manner.** Transit priority can frequently be done piecemeal, as budgets allow. This makes it a valuable tool in gradually enhancing transit service in key corridors, building ridership toward levels that would warrant construction of dedicated rapid transit facilities.
- **Transit priority measures that go beyond conventional transit signal priority are feasible and effective.** Queue jumps and other means of reducing congestion delay, rather than just signal delay, become more important as congestion increases over the course of a day and from year to year.
- **There are good reasons for a transit priority program to transcend "special project" status.** Making transit priority a way of doing business can guarantee its automatic consideration when new roads and intersections are planned and built.
- **Dedicated staff and financial resources are needed to enable effective coordination and timely implementation of transit priority measures.** The active support of several staff groups is also essential. Ottawa's Transit Priority Task Force is a forum for regular, effective communication across departments, and helps staff members to better understand their individual and collective challenges.
- **A transit priority program should appeal to the energy and creativity of staff responsible for traffic signals.** Transit priority requires additional effort and new ways of thinking from signals staff, and it must be presented as an important challenge that needs and deserves their full attention.
- **Post-implementation monitoring of transit priority measures is essential.** Traffic conditions vary considerably by time of day and throughout the year. Ongoing adjustment may be required to preserve the optimal effectiveness (or even the basic functionality) of transit priority measures.
- **It is hard for transit operations to capture all the potential benefits of a single transit priority measure.** Adding more measures along a given corridor or route makes it easier to achieve concrete, readily measurable impacts.
- **Public relations need not be a major issue.** In Ottawa, communications are a smaller resource draw than expected. The consistent use of effective signage and pavement markings appears to have gone a long way to avoiding confusion among road users.

Next steps

In the face of the city's growing congestion and ambitious transit ridership objectives, transit priority is likely to play an increasingly important role in Ottawa's transit development. With strong policy support, proven tools and a successful track record, the transit priority program only requires continued investment to support ongoing planning, implementation and monitoring activities.

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