Smart Traffic Signal Pilot Results

Recommendation

That the December 1, 2020, City Operations report CR_6429, be received for information.

Previous Council/Committee Action

At the September 11, 2018, Urban Planning Committee meeting, the following motion was passed:

> That Administration provide a report with the results of the smart traffic signal pilot upon its completion, and to include, but not be limited to:
>
> 1. Impact to the movement of traffic,
> 2. Options to incorporate advancements in Smart Traffic Signal technology (ex. Artificial intelligence),
> 3. Recommendations to allow the City to incorporate new signal technology across the city, and
> 4. Any updates on the smart streetlights program.

Executive Summary

Administration conducted an accelerated pilot study of Adaptive Traffic Signal Control (ATSC) technology within an isolated corridor, at nine intersections along 101 Street between 103A Avenue and 111 Avenue. The pilot provided the City an opportunity to assess how automated traffic signal technology can improve mobility and accessibility for Edmontonians.

The intent of the pilot was to determine if ATSC Technology can positively impact mobility options for road users and improve network operations and evaluated if ATSC adjustments to green light time to account for real-time traffic demands would improve travel time reliability by progressively moving vehicles through green lights; resulting in a reduction in congestion by creating smoother traffic flow.

Starting October 1, 2019, through to January 31, 2020, Administration evaluated the technology's performance to explore opportunities for integration into existing systems. During the ATSC pilot, travel times increased along the corridor and their intersecting streets. Other measures collected, including the percentage of vehicles arriving on green and pedestrian delays, were compared to original signal operations

and did not indicate significant network improvements including an overall increase in delays for pedestrians.

The ATSC pilot, the Smart Streetlights Program and the City's response to COVID-19 support the City's Movement of People and Goods outcome, ensuring Edmonton has an accessible and adaptable transportation system moving people, goods and services efficiently.

Technology trials like ATSC and Smart Streetlights are linked with broader strategic City goals and outcomes of various action plans and partnerships. The Smart Transportation Action Plan, Edmonton's Digital Action Plan, the City Plan are pillars that guide the holistic approach to implementing technology that increases wellness, livability and connectedness.

Report

In September 2018, Administration presented the Smart Transportation Action Plan to Urban Planning Committee.The Action Plan outlined the integrated approach to preparing for new mobility options, including advances in automated, connected, shared and electric technologies. A key focus area of the Smart Transportation Action Plan is the mobility system and how the City builds, uses and interacts with the transportation infrastructure system to ensure that it is safe, simple to use, and efficient.

To that end, the City piloted Adaptive Traffic Signal Control (ATSC) to assess a new technology within the current traffic signaling system including potential benefits to pedestrian accessibility and vehicle flow. ATSC Technology continuously adjusts the timing of a traffic signal based on the changing arrival patterns of vehicles at an intersection to allow for optimized vehicle flow and improved accessibility for active modes of mobility.

The pilot ran from October 1, 2019, until January 31, 2020 to align with the peak event season at nearby Rogers Place. During the pilot, the City measured vehicle travel times along the corridor and on cross streets to evaluate the impacts on vehicle traffic. This data was compared to data collected before the pilot began. To facilitate, the City installed field equipment at nine signalized intersections along the isolated pilot corridor of 101 Street between 103A Avenue and 111 Avenue. Additionally, upgrades and new agreements to supply software upgrades were applied to integrate the pilot technology into the current central traffic management system.

The system was configured to adjust the signal timings including:

- Cycle length: changes for the entire corridor based on traffic conditions between the preset minimum and maximum cycle lengths,
- Green times for each movement: adjusts by a predefined increment to increase or decrease per movement between each adjustment,
- Offset: adjusts the coordination between adjacent signals

Impact on the Movement of Vehicle Traffic

To evaluate the effectiveness of the adaptive technology, Administration monitored travel times along the corridor and at cross streets, arrivals on green lights, delays (pedestrian and vehicle), and public inquiries received related to signal timing and operations along this corridor.

There were a number of days during the pilot period with inclement weather and corresponding poor road conditions as well as lower traffic volumes over holiday periods in December and January. These dates were excluded from analysis as they may have introduced variations in traffic and road conditions.

For the ATSC, travel times increased during the weekday AM peak (06:30-09:00), non-peak (09:00-15:30 & 18:30- 23:00) and the PM peak (15:30-18:30). During dynamic traffic periods such as arena events, similar results were observed. See Attachment 1 for full results.

ATSC pilot results were compared against the City's operationally designed timings. The existing signal operation along this corridor is a combination of fixed time and actuated signals. This operation is "smart" in that it applies detection to adjust timings where required or operate fixed time where traffic is predictable or heavy pedestrian volumes are present. Administration schedules adjustments to the signal timings for large scale events at Rogers Place that host over 10,000 people to improve traffic flow following events, these adjustments were not made for the duration of the pilot.

Arrivals on green is a measure of the number of vehicles that arrive at the traffic signal while a green light is displayed. Mixed results were observed for traffic along the corridor (north and southbound movements), while there was generally a decrease in arrivals on green for east and westbound traffic. Results generally showed an increase in both vehicle and pedestrian delays.

Other measures of effectiveness have been evaluated using data, including the percentage of vehicles arriving on green lights, vehicle delays, and pedestrian delays. Full results can be found in Attachment 2.

In addition to ATSC, thermal pedestrian detection, which detects foot traffic without the need to press a button, was also piloted at an intersection on the corridor. The system worked well for detecting pedestrians; however, it was challenging for the

system to predict desired travel direction with limited available pedestrian storage space.

Overall, the outcome of the pilot indicates that the existing signal timings performed better than the ATSC system during regular traffic patterns. This is due to the time required for signals along the corridor to coordinate with each other following a cycle length or to offset change. While results were mixed and the benefit to traffic movement on the pilot corridor was limited, Administration continues to collect data and use the technology for monitoring vehicle and pedestrian activity on the corridor. This allows for greater insights into traffic patterns and volumes for a key corridor to and from the core. Lessons and data can be applied to ongoing initiatives, notably the Safe Mobility Strategy and Dynamic Traffic Management as set out in the City Plan. Administration will continue to monitor the development of this technology and similar pilots underway in other municipalities.

Incorporating New Technology in Edmonton

Land use and transportation are intimately linked. Innovative transportation initiatives will only create a partial solution unless carefully tied to land use plans to provide services where people need them most. The City Plan incorporates information and lessons from the various smart transportation pilots and actions to create policies and plans that improve the quality of life for everyone and deliver on Councils strategic goals as Administration plans and builds for a city of two million people. The City's response to emerging technologies and transportation models is ultimately centred around the vision of building a city that increases livability, wellness and connectedness of Edmontonians.

While the initial deployment of ATSC system did not result in the desired improvements to traffic along the pilot corridor, the existing traffic signal design and operation within the City of Edmonton incorporates numerous "smart" components. Approximately 70 percent of Edmonton's traffic signal inventory currently operates with actuated signals (sensor activated by vehicles or pedestrian push buttons), while the remaining 30 percent are fixed time signals. This mode of operation adjusts green times for some or all movements based on detected pedestrian, bicycle and vehicle demand. With actuated signals, signal timings adjust based on demand and allow for traffic to progress while providing sufficient time for minor traffic movements at each signal.

The key to smarter transportation lies in the ability to integrate various data sets from across static, real-time and dynamic data sources with the use of sensors, meters and software. This requires the application of a holistic framework in smarter data via analytics and is fundamental to a smarter transportation and road safety system. The City's digital action plan outlines four principles of equity, trust, innovation, and collaboration to guide the holistic approach the organization must adopt. The City will

continue to engage with partners such as the Centre for Smart Transportation (CST), a unique research group housed in the Department of Civil and Environmental Engineering at the University of Alberta, to advance this important work and position Edmonton for the continued adoption of innovative and impactful technology changes.

Update on the Smart Streetlights Program

The City has explored “smart streetlights” as part of its ongoing streetlight replacement program. “Smart” or “intelligent” streetlights incorporate technology, such as cameras, light-sensing photocells and other sensors, to introduce real-time monitoring functionalities. The Smart Streetlights program initially began in 2013 as part of the adaptive lighting dimming pilot project in the Woodcroft community. The original intent was to reduce energy consumption by dimming lights during off-peak periods when there was decreased pedestrian and vehicular traffic.

To date, a total of 400 streetlight units have been converted to smart streetlights across the city, including two additional trial areas in the Canora neighbourhood and along Stony Plain Road, with the intent of achieving energy savings, decreasing maintenance and reducing light pollution. Administration continues to seek alignment with the Smart Transportation Action Plan on incorporation of “smart” streetlights and outcomes in City Plan.

COVID-19 Response

During the early stages of the COVID-19 response, traffic volumes across the City decreased by 48 percent compared to pre-pandemic levels. As of September 2020, traffic volumes have returned to on average 8 percent reduction with some areas still seeing volumes 20 percent lower than pre-pandemic levels.

To allow for physical distancing in high density areas and help slow the spread of COVID-19, Administration provided a number of lane closures and Shared Streets in high density areas to support pedestrian and cyclist movements. A number of lessons were learned through the Shared Streets and lane closures implemented in 2020, including confirming (through a partnership study with the University of Alberta) how they positively impacted individuals' abilities to physically distance. Additionally, pedestrian push buttons at high pedestrian traffic locations and near hospitals throughout the City were deactivated to reduce required surface touch points.

Administration also supported a temporary patio program that was launched in May 2020 as a response to the business impacts of COVID-19 and public safety measures. Upwards of 110 businesses registered to take part in the program with Administration providing temporary traffic control services to support adjacent travel lane and parking lane closures to expand the patio areas for approximately 37 locations.

Lessons from these initial responses to the pandemic will be applied as Administration continues monitoring and adjusting transportation network operations to maintain the safe and efficient movement of people and goods. Learnings will also be applied to the City's ongoing reimagine work to take advantage of opportunities for service level improvements and find efficiencies in service delivery.

Corporate Outcomes and Performance Management

Corporate Outcome(s): Conditions of Success			
Outcome(s)	**Measure(s)**	**Result(s)**	**Target(s)**
Efficient or effective service delivery	Pilot of adaptive signals technology	Completed January 31, 2020	N/A

Attachments

1. Travel Time Results - Adaptive Traffic Signal Control Technology Pilot
2. Additional Measures

Others Reviewing this Report

- M. Persson, Chief Financial Officer and Deputy City Manager, Financial and Corporate Services
- C. Owen, Deputy City Manager, Communications and Engagement
- J. Meliefste, Acting Deputy City Manager, Integrated Infrastructure Services
- S. McCabe, Deputy City Manager, Urban Form and Corporate Strategic Development
- B. Andriachuk, City Solicitor