Submitted by:

DILLON CONSULTING

TOWN OF MILTON

Transit Master Plan 2013 - 2017

MOVING MILTON FORWARD

Appendix G - Transit Technology Working Paper

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1.0 INTRODUCTION

Technology, and in particular, Transit Intelligent Transportation Systems (ITS) is increasingly becoming a strategic resource in the field of public transportation. These systems can provide cost-effective means to monitor performance and improve efficiency, but will especially play an increasingly important role in the enhancement of the quality of transportation services for customers, whether it be through improved incident management and reliability, better information for planning and network design, and enhanced traveler information services on the web, at stations, or on mobile devices.

The Town of Milton has recognized the potential of technology to assist a variety of municipal services, and issued in August 2012 a Request for Proposals (RFP) entitled *Supply and Installation of a GPS/AVL System*. The RFP was primarily aimed at procuring GPS-based location technology for various municipal fleet operations (e.g. monitoring snow plow performance, etc.), transit functionalities had been included as an option. The evaluation is still underway, but at the very least, this will assist staff in exploring future options.

The purpose of this working paper is to:

- provide a brief overview of Transit ITS and related technologies;
- explore the potential benefits from investing in Transit ITS;
- identify pertinent opportunities and challenges;
- explore other potential technologies for consideration; and
- recommend a Transit ITS strategy for Milton Transit for the future.

Each of these topics will be explored in the following sections of this Working Paper. The attachments contain a Glossary and a list of key references and resources related to Transit ITS.

2.0 TRANSIT INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Transit is a labour-intensive industry with 65 to 75 percent of operating costs represented by salaries and benefits. As a result, optimizing the use of human resources has always been a major focus of transit systems, and has led to the development of sophisticated transit scheduling software. Canadian software firms are among the world leaders in the field of transit scheduling software. These scheduling software systems enable a number of tasks including:

- the building of trips to maximize the effective scheduling of buses;
- the cutting and fitting together of pieces of work that incorporate all effective work rules and provisions included in worker agreements;
- the optimizing of the schedule of operators and buses to minimize operating cost;
- the process of organizing the selection of work by employees;
- the daily dispatching of operators, and the logging of assigned buses and daily adjustments to the schedule (e.g. for absences, vacations, overtime, etc.);
- the printing out of individual assignments and route schedules with timepoints; and
- special versions of the schedules to assist telephone agents, and/or information for the public (e.g. timetables, web-displayed schedules, etc.).

Up to now, Milton Transit has been small in size, with limited variations in the schedule, and under these conditions, a manual process was sufficient for the contractor to schedule operators and vehicles. However, as the system grows, Milton Transit will be reaching a size where more sophisticated systems may be required for the contractor to carry out the above tasks. This requirement will be accelerated by the consideration and deployment of any technology, since they all use as their foundation an automated schedule of trips and assignments of operators to vehicles.

Many of the technologies being deployed by transit systems fall under the umbrella of Intelligent Transportation Systems (ITS). At the core of Transit ITS is the integration of three key components:

1. A “smart” bus (with on-board data logging systems and computing power);
2. Automatic vehicle location (AVL) tracking capabilities (typically through the use of the satellite-based Global Positioning System (GPS); and
3. The capability for voice and especially data communications between vehicles, wayside systems, and centrally located computers and centres.

These three components create a considerable synergy that can be used for a wide range of potential applications. One of the key problems facing small to medium sized transit systems is to determine which of these technologies have value in any given specific context. The fact that Milton arranges for private contractors to deliver its municipal transit services adds a further interface that must be considered in developing an ITS strategy.

2.1 Transit ITS Functionalities

The *Intelligent Transportation Systems Architecture for Canada* (Transport Canada, undated) defines "User Services" that may benefit from the application of ITS technologies, and this provides a high level understanding of the many uses of ITS. User Services document what ITS should do from the user's perspective. A broad range of users are considered, including the travelling public as well as many different types of system operators. Thirty-five user services form the basis for the Canadian ITS Architecture. The concept of User Services allows a system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs. User Service Bundles divide User Services into logical groups that provide a convenient way to discuss the range of requirements in a broad stakeholder area. In the Canadian ITS Architecture, the User Services are grouped into the following bundles:

- Traveller Information Services;
- Traffic Management Services;
- Public Transport Services;
- Electronic Payment Services;
- Commercial Vehicle Operations;
- Emergency Management Services;
- Vehicle Safety and Control Systems; and
- Information Warehousing Services.

For the purposes of this working paper, it is however more useful to focus specifically on the following basic functionalities being pursued through the deployment of transit ITS technologies in buses. These are grouped below into 11 categories, and lists typical functionalities under each category.

2.1.1 Communications (Voice and Data)

- Voice communications between control centre, individual buses, and/or field inspectors.
- Two-way data messaging to minimize voice traffic (including user-defined standard "canned" messages). This is particularly useful when the number of available radio channels is limited.
- Voice and message calls to single and multiple (e.g. by route or for all) vehicles.
- Public address capabilities to single and multiple (e.g. by route or for all) vehicles.

2.1.2 Computer-Assisted Dispatch (CAD)

- Automatic display of operator identification, vehicle identification, and route/run information.
- Sorting, filtering, and prioritizing of incident queues.
- Incident form templates with auto-fill option.
- Extensive reporting tool for historical data review, documentation, trend analysis.
- User-defined priority, colour, and audible characteristics of incidents.

2.1.3 AUTOMATIC VEHICLE LOCATION (AVL)

- Real-time vehicle location tracking through a Global Positioning System (GPS).
- Vehicle route information display.
- Ability to zoom in/out to selected routes and vehicles.
- Display of landmarks, street names, time-points, exact latitude/longitude coordinates.
- Provision of specific location information to facilitate expedient response by emergency services.

It should be noted that in the majority of Transit ITS applications, Computer-Assisted Dispatch is combined with Automatic Vehicle Location, referred to as CAD / AVL, in order to build a powerful synergy for purposes of incident management and enhanced security; integrating accurate location with the dispatch / control system makes supervision more efficient, and saves precious minutes in case of emergencies.

2.1.4 SECURITY

- Silent emergency alarm.
- Emergency covert on-board audio monitoring.
- Automatic emergency alarm map.
- Emergency public address message capabilities.
- Closed Circuit Television (CCTV) cameras.

2.1.5 SCHEDULE ADHERENCE MONITORING

- Automatic polling/reporting of vehicle location on a regular basis (e.g. 90-120 seconds).
- Comparison to scheduled location, via an interface to the scheduling software.
- Display of vehicle schedule and route adherence (based on polling rate).
- Sorting and filtering of vehicle performance, and colour coding by pre-determined selected schedule adherence level (e.g. green for on-time, often defined as 0 to 3 minutes late; yellow for 3-5 minutes late; red for early or over 5 minutes late).
- Calculation of estimated time of arrivals at downstream stops (next bus arrivals).

2.1.6 TRAVELER/CUSTOMER INFORMATION (PRE-TRIP, EN-ROUTE)

- Real-time information on arrival/departure times at desired stops; this information can be potentially delivered via different media (e.g. telephone, web page, mobile devices).
- Service alerts; this information can be potentially delivered via different media (e.g. telephone, web page, mobile devices).
- Information to customers to assist them with the planning of their itinerary (i.e. trip planning).
- Information at displays at stops or terminals concerning next departure times.
- Audio and/or visual announcements in vehicles concerning next stops and/or other information.

2.1.7 Automatic Vehicle Monitoring (of bus mechanical features)

- Monitoring of the performance of various mechanical components or systems (e.g. engine, transmission, brakes, electrical).
- Warning messages when sensors detect critical performance thresholds.
- Logging mechanical performance reports; this monitoring may be used to diagnose mechanical problems, or as input to preventive maintenance processes.

2.1.8 Analysis Using Archived Data, typically captured through an Automatic Passenger Counting (APC) System

- Logging of boardings (on's) and alightings (off's) by stop to monitor passenger activity and route profiles.
- Detailed calculation of exact schedule adherence at timepoints or stops.
- Over time, identification of distribution of running times by route segment, by time of day, day, and month that can be used to reflect actual experience and refine schedules.
- Monitoring of vehicle utilization and/or performance (e.g. hours, kilometres, speed, stop dwell times, intersection delays, layovers).
- Use of archived data to research/respond to customer complaints.

2.1.9 Management Reporting

- Summaries of incident reports by type of incidents, route, etc.
- Summary of missed pull-outs and missed trips by division, route, etc.
- Summaries of road calls and bus replacements.
- Summary of on-time performance by division, route, etc.
- Use of archived data to monitor performance of operating contractors.
- Processed information may be incorporated into an executive information system (e.g. Key Performance Indicators, Dashboard).

2.1.10 Transit Signal Priority (TSP)

- Request to intersection traffic controller to initiate a traffic control strategy that extends the green phase, truncates the red phase, inserts a transit-only phase for queue jump or left-hand turn, etc.
- Request may be conditional on schedule adherence (i.e. assist late bus to get back on schedule) or headway separation from previous bus.

2.1.11 Advanced Fare Collection (AFC)

- Use of smart card as media for electronic payment system.
- Placement of periodic passes on smart card.
- Introduction of stored value payment system to reduce/replace cash and/or tickets.

In addition, Transit ITS components are often integrated with other technological systems in order to enhance the traveler information that is provided to customers; examples include:

- web applications, such as trip planners;
- telephony systems integrated with the use of Interactive Voice Recognition (IVR) technologies to provide next bus arrival information for specific stops;
- SMS texting technologies to provide next bus arrivals or service alerts; and
- e-mail blasts to provide service alerts (E-Alerts).

3.0 BENEFITS OF INTELLIGENT TRANSPORTATION SYSTEMS FOR MILTON TRANSIT

There are many types of benefits for Milton Transit to be derived from ITS, and these are outlined in the following section.

3.1 Benefits of Transit ITS to Assist Milton Transit in Meeting the AODA

The Accessibility for Ontarians with Disabilities Act (AODA) has led to the promulgation of several Provincial regulations. The Integrated Standards, including Accessibility Standard for Transportation, Ontario Regulation 191/11, are of particular relevance, and became e*ffective as of July 2011.*

The Integrated Standards include "Transportation", "Information and Communications", and "Employment" Standards. The Transportation Standard applies to public transportation providers that operate solely in Ontario, such as the Ontario government, municipalities and transportation commissions or authorities that provide passenger transportation services. This also includes any transportation services that may be brokered by the types of organizations noted above.

With respect to technology, the following requirements must have been met by July 1, 2011:

- Milton Transit must make verbal on-board announcements of destination points or route stops.
- Electronic on-board "next-stop" announcements, as well as external route number and destination announcements, need to be in place by January 1, 2017.

Ensuring that next-stop announcements are made verbally, by every operator for every stop, is literally impossible to achieve. Several transit systems have already received Human Rights challenges on this issue put forward by customers with disabilities through the Human Rights Commission. As a result of such a challenge, the TTC was forced to deploy a stand-alone announcement system on streetcars and buses in a six-month period. This was achieved at great cost, and the resulting system is not integrated with other on-board systems. The threat of such challenges has even affected transit systems that had already equipped 3/4 of their fleet, resulting in installing equipment that will be disposed of in a few years' time. Milton Transit is at risk of such a challenge, and this would result in a wasteful expenditure of capital investment in a one-off system that would only partially meet Milton Transit's needs.

The need to deploy a Transit ITS solution that will enable both automated audio and visual next stop announcements at Milton Transit is therefore becoming an urgent concern because of the requirement under the AODA.

3.2 Benefits of Transit ITS for Milton Transit's Customer Service

A Transit ITS can provide Milton Transit with greatly enhanced customer service and promote the image of a modern transit service.

Providing Greatly Enhanced Customer Information

Currently, Milton Transit provides schedule information to customers via the web site, printed schedules, and telephone agents. A Transit ITS can provide real-time information that would provide the real-time location of vehicles and next bus arrival times, and be able to deliver it via multiple delivery mechanisms. This information can be delivered on the web site, or with the addition of an Interactive Voice Recognition (IVR) system, via a telephone to a specifically identified bus stop. In the future, once a fully operational AVL and arrival time prediction systems are deployed, this information could also be delivered via mobile devices, either through SMS texting, or via special purpose applications for Smartphones.

It has been demonstrated that a rider's perception of time as they wait for a vehicle is longer than the actual time. Thus, many people believe that they are waiting more time than they really are for the transit vehicle to arrive. This is compounded by the riders arriving at transit locations early to avoid the chance of missing their ride. By providing better on time performance and increased reliability, AVL can reduce the time needed by a user to arrive early to a stop and gives them more confidence that a vehicle will arrive at its posted time. Recent research has shown that transit customers benefit from the improved quality of real-time information, and use that time productively.

In addition, there is a certain anxiety associated with waiting for a bus whose arrival time is uncertain, especially if the customer may fear that they may have missed the bus because it was running ahead of schedule. This anxiety is compounded by long headways (e.g. 30 or 60 minute service) where the wait time until the next bus is extremely long. The availability of easily accessible real-time information may significantly reduce the anxiety and perceived burden of waiting for the bus and increase the attractiveness of transit service.

Better Complaint Response

An important part of dealing with the public is having the answers to their questions. Many of these questions come in the form of complaints about the service, and in particular early-running buses that are particularly aggravating for customers when service is infrequent. AVL gives an agency a tool to validate complaints, rather than rely on perceptions by customers and operators. In this fashion the management can acknowledge or dismiss claims with the documentation that AVL can provide. For example, complaints such as "the vehicle did not show up" can be verified and handled appropriately.

Image

We are rapidly evolving to a technology-driven society with high expectations with respect to the application of technology in the lives of customers, and this is in particular true for younger generations. AVL, when used to provide real-time information to customers, would greatly enhance the image of the Milton Transit system and help to meet current public expectations with respect to the service offered.

3.3 Benefits of Transit ITS for Milton Transit's Performance Monitoring and Planning

Milton Transit currently has limited data with which to monitor and measure the performance of the system, or on which to base improved design of the service. Currently, the GFI electronic registering fareboxes provide summary reports by route, but with no specific information on where customers boarded or alighted, or where transfers were made.

AVL/APC systems provide tools for systematic monitoring and analysis of schedule adherence. If available, an Automatic Passenger Counting (APC) functionality will introduce a whole new category of information concerning alightings. The introduction of new sources of information, in particular in the areas of schedule adherence monitoring and route ridership profiles, and the enhancement of data quality through vastly increased observations, opens up the possibility of new performance indicators and the assessment of route performance and contractor performance on a more systematic basis. This also opens up the feasibility of reviewing existing service standards, and introducing more use of benchmarking.

3.4 Benefits of Transit ITS for Milton Transit's Operations, and Security

A Transit ITS has been shown to provide a range of benefits for operations, security, and management.

Improving Dispatching Operations

Receiving and displaying accurate vehicle locations enhances the operations of the fleet. Dispatchers will have the ability to track a vehicle, and know in real time any incidents that are affecting the service schedule. On the basis of this information, the Dispatcher can make necessary run adjustments.

Improving Security for Transit Customers and Operators

Installing closed circuit TV cameras on board buses improves security for customers and transit operators. The ability of AVL to pinpoint the location of any vehicle in the fleet will enable the dispatching of emergency response services with much greater accuracy and security.

It has been also shown that installing CCTVs on buses, both internally and externally facing, has a secondary benefit in terms of reduced insurance claim payments. The recording of events in case of accidents, involving either customers inside or exiting, or collisions with other vehicles or pedestrians, provides a non-disputable record of actual events, reducing fraudulent claims and excessive payments, and reducing insurance premiums over time.

4.0 CHALLENGES FACING MILTON TRANSIT WITH RESPECT TO ITS AND TECHNOLOGY

Although the potential benefits of Transit ITS are significant, these benefits can only be obtained by making a significant investment in resources, in terms of financial cost (both capital and operating) and staff resources to plan, deploy, and then operate the systems.

Milton Transit, given its size, resources, and structure, also faces some unique challenges with respect to technology. These are as follows:

Size of Operations

Milton Transit has to date operated a very small fleet of buses with a small number of operators. Its size has been below the threshold at which advanced technology is typically cost-effective, and it has operated efficiently using a manual system. The rapid growth of the municipality is however leading to a rapid growth in transit operations and fleet size, and it is now crossing a threshold at which a higher level of sophistication will be required. As well, public expectations with respect to traveler information are creating a desire for technological investment. This is especially true of technology, in the form of automatic stop announcements (internal and external), is mandated by the AODA.

However, most of the Transit ITS technologies available on the market were designed for much larger transit operations that face more significant challenges (daily service disruptions, security issues, more costly labour provisions, etc.), are able to operate and maintain sophisticated communications and operations systems, and have the staff to effectively use the vast array of information being created by these systems. These conditions do not exist in small transit systems like Milton.

In addition, common practice in the industry is to budget for such systems on a per bus unit cost (e.g. $10,000 to $20,000 capital cost for ITS per bus), but these systems include a significant fixed cost portion, so the cost per bus for small fleets is hard to assess through comparisons of experience of procurements by much larger fleets.

Staff Resources

Although Transit ITS has existed for many years and is generally relatively mature technology, it is extremely sophisticated, as seen from the discussion of the array of potential functionalities, and as a result, is extremely complex to plan for, to project manage, and then to operate and maintain once deployed. There are many choices to make in the design, some of which have great significance on future operations, functionality and cost. The procurement of such systems is generally complex as is the oversight during deployment. And these systems then introduce an array of new tasks for dispatchers, planners, call agents, operators, and mechanics.

Milton Transit is extremely lean in its staffing, with only two permanent staff, and a private contractor for operations and maintenance. It is clear that it will be a significant challenge to plan, deploy, and operate these types of ITS systems with the currently available resources.

Municipal IT Resources

Limited staffing is an issue not only for Milton Transit, but also the Town's Information Technology Department, which is another significant challenge for the deployment of ITS technologies. These systems involve an array of IT-related systems, including potentially:

- scheduling software;
- CAD/AVL dispatch console and software;
- cellular or wireless local area networks (LANs) for communicating data to/from buses in real-time or when in the garage;
- web-based portals (with firewalls) for the public; and
- web-based portals (with firewalls) for disseminating information to third party developers, etc.

These systems require in many cases unique servers and racks, all interconnected via software interfaces, and firewalls with external parties. It is clear that the lack of IT resources at the Town of Milton creates a significant challenge for deployment and ongoing operation and maintenance of such systems.

Contract Operations

Milton Transit service is provided under contract with a private operator. This creates cost efficiencies in general, but creates a specific challenge for the deployment of ITS technology from a few perspectives.

Location of CAD/AVL Console: The CAD/AVL system would need to be located with the dispatcher in the offices of the private contractor, which creates some practical issues of space and server connections. It also creates a longer-term question of what happens if the contractor is changed in a future procurement. It will also likely require the need for a second CAD/AVL console location in Town premises in order to collect all data, and to be able to use the system for monitoring contractor performance. This issue would be resolved with a Town-owned transit operations facility as recommended in the Facilities Working Paper.

Firewall: Since the system needs to have at least one location at the Private Contractor's site, there will need to be an interconnection with the IT network of the Town, which will require a firewall. This can be complex to deploy as was found in York Region, where the systems were designed to be separate, at least initially, which made schedule uploading and data downloading semi-manual and complex.

Renegotiations: The CAD/AVL system will entail significant changes to the Dispatch and maintenance functions, and changes to operator tasks as well. Given the procurement horizon is shorter than the time horizon until the next contract retendering, there will be a need to renegotiate the contractor's responsibilities, and related costs.

5.0 OPPORTUNITIES

The consultations carried out in this study identified some opportunities or developments that may be pertinent to Milton Transit's ITS Strategy. Four were identified and discussed below:

5.1 Web-Hosted Solution

Recently a few suppliers have been offering scheduling, CAD/AVL, and / or Traveler Information systems as web-hosted solutions, sometimes referred to as System as a Service (SaaS). Under such architectures, the capital infrastructure would be limited to on-board equipment (GPS location device, data logging/communications device, internal/external PA system, desktop consoles, etc.), and all software and servers would be operated and maintained at the suppliers offices, with high speed internet communications creating the bridge. System upgrades are handled by the supplier on their system. This concept has considerable appeal for Milton's situation with the limited resources for IT, operations, and maintenance.

In terms of procurement, a typical pattern is to include the first three years of operational fees, including license and operations (which are significantly higher to compensate for the shift in risk and responsibility, cellular costs, texting costs) in the capital procurement, and these become a much higher stream of operational costs after the initial period.

However, several significant challenges exist:

- There have been extremely few deployments of scheduling and/or Transit ITS using this model in Canada, and some have only happened in the last year. Reports on experience to date have been uneven. Any changes in corporate structure and strategy can have a more significant impact on service quality than if a system is owned and operated by the municipality.
- The ongoing operating cost is significantly higher: though there is little experience to reliably base on, it appears that ongoing costs range in the 18 to 20 percent of capital cost range, as opposed to 5 to 8 percent for municipally owned systems.
- The major, and well established, suppliers of ITS technologies have not engaged significantly in this architecture because it requires a significant change from standard architectures, and significant re-engineering. This approach increases their risk, and the long-term business case viability is not yet clear.
- As a result, the firms that have engaged in this approach are often newcomers to the industry, without a long-time established track record. A web hosted solution entails much greater risk.

It is nonetheless a valuable approach that will grow over time, with more and more deployments to come. It is especially attractive to contexts such as Milton's. There are in fact a few newcomers to the market that have more experience elsewhere, in particular with systems designed for small urban or rural contexts. Another related development for Transit ITS suppliers is to explore the use of lighter-duty

devices, such as iPads, on-board buses. These provide considerable functionality, including GPS, map navigation, data logging, and cellular communications at a much reduced cost. Availability of replacement equipment in case of failure is also easier and faster.

Although there remains considerable risk, challenge, and uncertainty about reliability and life-cycle cost, in trying to adopt a web-hosted approach, it remains a potentially interesting option for Milton Transit.

5.2 Oakville (and Burlington) Transit ITS

Oakville Transit has budgeted and is proceeding with the planning and procurement of a Transit ITS, with the RFP to be released most likely by year-end 2012, with the system to be deployed by year-end 2013. Oakville Transit has already developed technical specifications for a comprehensive CAD/AVL system, with many options for Traveler Information, TSP, etc. Oakville Transit management are very open to some form of coordinated procurement with Milton Transit. This interest is particularly related to the long-term discussions that have been taking place for a more integrated transit system in Halton Region. A common, or at least consistent, Transit ITS technology platform would be valuable to facilitate coordinated operations in the future.

Burlington Transit is also actively considering a CAD/AVL-based Transit ITS, although they are not as far advanced in the process as Oakville. As a result Oakville Transit has been holding ongoing discussions with Burlington Transit to explore a coordinated procurement. The technical requirements would be somewhat different since Oakville has its own radio system and will be transmitting the data via its radio system. Burlington on the other hand uses the Halton Region radio system for voice communications (as does Milton Transit), so data communications would need to be based on a cellular communications platform.

One possible procurement approach is for Milton to look into joining the Halton Cooperative Purchasing Group's (HCPG) contract for ITS. The Town of Oakville called the bid on behalf of the group with Burlington as the other named user. However, due to the nature of the current service contractor arrangement at Milton Transit, this will be very complex, and will require a significant amount of resources to fully develop in a short timeframe.

It is recommended that Milton Transit staff continue to monitor the development and deployment of the Oakville / Burlington Transit ITS to ascertain possible interest and technical feasibility of a coordinated system in the future.

5.3 Metrolinx Transit Traveler Information Strategy

Metrolinx is currently engaged in an initiative to develop a comprehensive strategy for traveler information for transit across the Greater Toronto Hamilton Area (GTHA). One of the possible directions would be to develop an integrated framework to tie the 10 (or more) transit systems into a single architecture database (with information fed by all the individual systems), in order to provide policy information, trip planning based on real-time information and alerts, real-time transit arrival

information at stops, service alerts, real-time information kiosks at key hubs, etc. Information may be pushed out in a variety of ways, including third party developers. Each transit system would be responsible for procuring its own core Transit ITS, but the integrated approach may provide support down the road for other valuable requirements for traveler information, such as development of policies and procedures for dealing with third party mobile device application providers, or the development of bus stop identification protocols. To be able to participate in this initiative, Milton Transit would have to be capable of transmitting information to the central system. It would not be able to do so without a Transit ITS of some sort.

It is recommended that Milton Transit staff should continue to monitor the Metrolinx project, in order to ascertain any potential implications for the design of their own system.

6.0 ITS OPTIONS AND TRADE-OFFS

6.1 Three Strategic ITS Options

There are three different deployment strategies that can be contemplated:

OPTION 1 - Standard Transit ITS Architecture

In this case, the system is purchased as a capital project and would be structured along the lines of a comprehensive Transit ITS. This is represented by the approach being pursued by Oakville and Burlington Transit. In this case, Milton would determine if they can participate in the coordinated procurement, but would have to determine how the system could be operated and maintained.

- Benefits are extensive, and cover the full range discussed above including traveler information, service reliability, security, contractor performance monitoring, system planning, etc.
- However, the cost for a complete ITS would be greater.
- Technical challenges are complex and significant, especially given the lack of staff resources in Milton. Milton would benefit from cooperation with Burlington and Oakville, but there would remain significant institutional issues, as well as need for considerable IT support.
- This option would likely require the hiring of one staff for project management, combined with planning and traveler information activities, in addition to the support from IT.
- This option would support regional-wide transit service coordination.

OPTION 2 - Web-Hosted Scheduling / Transit ITS

In this option Milton transit would explore supplier response to a transit-specific web-hosted combined scheduling/CAD/AVL/Traveler Information system, using lighter duty Tablets. This would be done through a Request for Information (RFI) or Request for Proposals (RFP) and would ascertain the degree to which traditional and new suppliers are prepared to offer a web-hosted solution, and under what cost or conditions.

- Benefits would be more limited than with a full Transit ITS solution, such the Oakville/Burlington option.
- However, it is conceivable that a more attractive bundling of scheduling and other services might be available; scheduling software is not offered by all suppliers.
- Risk is potentially higher given the lesser transit industry experience with the web-hosted strategy.
- This option would require less staff support than previous solution.
- This option may be more compatible with the contracted operations since there would be no special equipment at the contractors, and less interface with the Town's IT network.
- The costs remain a large area of uncertainty.

OPTION 3 - Web-Hosted Minimal Automated Stop Announcement System

Milton could deploy just the minimal Automated Stop announcement system as required by the AODA.

- This is less attractive to most suppliers, and there are few suppliers providing just this system, and very few deployments. The risk is therefore highest.
- Benefits are minimal. Some of these suppliers also offer time of arrival estimates at stops that can be obtained on the web, or via texting.
- Based on the limited experience to date, the cost of these one-off systems has not proven very attractive, and small firms are more likely to increase the ongoing operating fees to reduce their exposure to risk.

6.2 Scheduling Software

In all three scenarios, Milton Transit would have to obtain a computerized scheduling system that would serve to drive the Automatic Stop Announcement and other ITS systems. Procurement of this would be included in Option 2, and would have to be done separately in the other two options.

Recommendations

Given the discussion of constraints, opportunities, and strategic approaches, a dual-track approach is being recommended:

- Initiate immediately a discussion with management at Oakville and Burlington Transit systems to explore to what extent an approach can be crafted that provides an acceptable technical system architecture for Milton Transit and its contractor, a procurement system that meets the Town's requirements, and an operating and maintenance solution that is workable for all.
- In parallel, launch a RFI for the second strategy of a web-hosted scheduling/CAD/AVL/traveler information system to determine supplier interest and technical requirements.
- Depending on the outcome of these two activities, pursue the appropriate path for deployment.
- Procure the necessary scheduling system, either prior or as part of the ITS procurement.

7.0 ASSESSMENT OF OTHER TECHNOLOGIES

There are other technologies that have been discussed and reviewed as part of this Technology Working Paper.

7.1 Customer Contact Software

The Customer Service and Marketing and Communications Working Papers recommended that Milton Transit needs a basic Customer Contact database program to log, and track customer calls, complaints, and commendations. In most municipalities, such systems are developed internally by municipal IT departments. It may be possible for Milton Transit to obtain a version of such software from another municipality. Alternatively, a basic package can be obtained commercially for $3,000-5,000.

A project, on a corporate basis, has been included and approved as part of the 2013 capital budget. It is recommended that Milton staff should participate in this effort to ensure that Transit's needs are addressed.

7.2 CCTV

CCTV offers enhanced security; however, the benefits in terms of reduced exposure to false claims may be of even greater importance to the town of Milton. Working with Risk Management Services, Milton Transit staff should explore the feasibility of installing CCTVs on board the buses, whether as part of a comprehensive ITS deployment, or as a stand-alone project.

7.3 Public Access Wi-Fi On-Board Buses

Mobile Wi-Fi technology has been introduced on public transportation vehicles in recent years on some fleets. Generally, the few systems that offer this technology tend to be intercity carriers (MegaBus, Greyhound, VIA) or long distance transit commuter runs from Park and Run lots for runs over 30 minutes and often on comfortable coaches with room for laptops. A few transit systems offer it on premium services (e.g. YRT on VIVA, or Montréal Transit on their Airport Express service). Few conventional transit routes with short average travel times offer this service.

Wi-Fi on-board is mostly useful for laptops, and less so for persons with smart phones where people tend to have their own data plans. There have been mixed reports on the experience with the reliability of these systems. It is unclear who would be responsible for maintenance of a new technology under Milton Transit's contracted operations and maintenance. Given Milton Transit's short travel times and limited staff resources, this is not recommend as a stand-alone system without further exploration of maintenance requirements. However, On-Board Wi-Fi could be added as an option to a more comprehensive Transit ITS procurement in order to determine the added cost and maintenance requirements.

7.4 Technology for Specialized Transit

There exists software for scheduling specialized transit that allows for managing several functions:

- manage the database of eligible customers;
- record standing reservations and individual trip requests;
- schedule and route the trips;
- create manifests for operators;
- record and track cancellations and no shows;
- insert day-of requests and revise manifests;
- monitor denied requests; and
- provide management statistics.

In some cases, such a system can be interfaced with a CAD/AVL system that allows for integration with cellular communications with the operators, the wireless transmission of manifests, the automated tracking of the vehicle kilometres, logging of trip pick-ups and drop-offs, the on-the-spot recording of no-shows, etc.

Given the small size of the specialized transit operation in Milton, and the relative priority and complexity of equipping the fixed route fleet with automatic stop announcement for the AODA and traveler information systems, it is recommended that this be considered in future years after the paratransit scheduling/scheduling function has been brought in-house.

7.5 Advanced Fare Collection (AFC) System

Advanced Fare Collection using smart card technology provides a greater level of convenience for transit passengers. The PRESTO stored value smart card has been deployed on most of the transit systems in the GTHA, and incorporates a mechanism that would increase the convenience for customers using both Milton Transit and GO Transit to use a single card to benefit from the GO Transit Fare Integration discount.

Deploying smart card-based AFC systems remain nonetheless extremely complex undertakings, involving many challenges and decisions, and considerable staff time to plan, procure, and deploy. The PRESTO card has experienced considerable challenges, and continues to evolve, with more attractive functionalities being implemented in the future versions being deployed in Ottawa and especially by TTC; the latter should incorporate for example an Open Payment capability that would allow commercial contactless credit / debit cards to be used. Given the extremely limited staff resources available in Milton, it would be important that Milton Transit staff explore the experience of other transit systems, in particular the staff time required, identify the potential benefits received, and understand the planned changes to the future versions of the PRESTO system before engaging in this technology. This is of relatively lower priority than other technology deployments discussed in this Working Paper.

It is recommended that staff initiate preliminary planning for a future AFC system such as PRESTO, including consultations with other transit systems about experience and lessons learned, and identify staffing requirements for planning the future AFC system based on such experience.

8.0 MILTON TRANSIT ITS STRATEGY AND RECOMMENDATIONS

8.1 Summary

Deploying an automated stop announcement system is a legislated requirement that should be pursued as soon as possible. However, the benefits from this system alone are minimal. Extending the technology to include estimated time of arrival information, which can be disseminated via multiple devices is an important priority. A comprehensive Transit ITS will provide an even greater array of benefits for customers, through enhanced reliability, incident management, security, and better service design.

However, Milton Transit faces significant challenges related to the planning, deploying, operating, and maintaining an ITS. Potential opportunities exist because of the deployment of systems in Oakville and Burlington, and also because of new developments in web-hosted architectures.

8.2 Short-Term Recommendations

Customer Contact Software

A corporate project to develop a Customer Contact system has been included in the Town's 2013 capital budget. Milton staff should participate in this effort to ensure that Transit's needs are addressed.

Scheduling Software and Transit ITS

Given the above discussion of constraints, opportunities, and strategic approaches, a dual-track approach is being recommended:

- Launch a Request for Information (RFI) for the second strategy of a web-hosted scheduling/CAD/AVL/traveler information system to determine supplier interest and technical requirements.
- Initiate a discussion with management at Oakville and Burlington Transit systems to explore to what extent an approach can be crafted that provides: 1) an acceptable technical system architecture for Milton Transit and its contractor, and 2) an operating and maintenance solution that is workable for all.
- Depending on the outcome of these two activities, pursue the appropriate path for deployment.
- Procure the necessary scheduling system, either prior, or as part of, the ITS procurement.

The ITS solution should include as a minimum the following functionalities:

- Mobile Data Terminals (or ruggedized tablets) to provide the necessary on-board computer processing and data collection capabilities for the various ITS functionalities;
- Automatic Vehicle Announcements (AVA), including audio-visual internal next stop announcements, and external route announcements to meet AODA requirements;

- Estimated time of arrival (ETA) calculator, to enable delivery of real-time information to customers via the web and text messaging, and including a secure web interface to provide real-time information to third-party mobile device application developers;
- Computer-aided dispatch with automatic vehicle location through GPS (CAD / AVL), with interfaces to timekeeping system and existing radio communication system; and
- Logging of bus activity to provide playback function and performance statistics.

Options to include are:

- Transit fixed-route scheduling system;
- New Interactive Voice Recognition (IVR) system to provide real-time information for each bus route;
- CCTV system;
- Wi-Fi on-board;
- APC on 5 of the buses; and
- Feasibility and cost of interfacing with a TSP system.

8.3 Longer-Term Recommendations

Longer-term recommendations are as follows:

Transit Signal Priority (TSP)

The Transit Master Plan has identified a number of intersections where buses experience, or are likely to experience, delay at the intersection, and would therefore benefit from priority treatment, physical (e.g. queue jumps) and/or TSP. Milton Transit staff should explore the options for deploying TSP at specific locations. In the short-term, depending on the circumstances and traffic signal controllers, isolated intersections could be provided with bus-actuated priority with transit signals. In the long-term, a TSP system could be deployed system-wide if a sufficiently accurate ITS solution is deployed.

Automatic Fare Collection

It is recommended that staff initiate preliminary planning for a future AFC system such as PRESTO, including consultations with other transit systems about experience and lessons learned, and identify staffing requirements for planning the future AFC system based on other's experience.

Specialized Transit Software

It is recommended that staff explore the potential deployment of a scheduling system for specialized transit that would enhance quality of service and cost-efficiency. This software should be considered after the reservation function has been brought in-house or contracted out to a third party.

Metrolinx' Transit Traveler Information Strategy

Milton Transit staff should continue to participate and monitor the Metrolinx' Transit Traveler Information Strategy in order to identify future requirements and/or potential opportunities.

CCTV

CCTV offers enhanced security; however, the benefits in terms of reduced exposure to false claims may be of even greater importance to the Town of Milton. Working with Risk Management Services, Milton Transit staff should explore the feasibility of installing CCTVs on board the buses, whether as part of a comprehensive ITS deployment, or as a stand-alone project.

8.4 Budget Recommendations

Given the uncertainty of the strategy that will ultimately be pursued, and the uncertainty related to the feasibility and cost of a web-hosted solution (given the lack of industry experience to date), budget estimates are difficult to determine. Recommendations are as follows:

Capital Budget

A capital budget of $200,000 to $270,000 is estimated for the scheduling and ITS system. The capital cost is likely to be similar irrespective of what strategy is pursued.

Operating Budget:

Operating budget estimates were developed based on experience in other transit systems. These are as follows:

- Annual operating costs for license and operating fees will range tremendously depending on the strategy pursued from $20,000 (5 to 8 percent) for the traditional ITS strategy to potentially $50,000 (20 percent) per year for the hosted solution.
- The traditional Transit ITS solution will likely require the cost of a contracted IT function starting in 2013 (estimated $70,000) and/or a hosting fee for service with another transit system or contractor.
- Operating costs may also include a renegotiated fee base for the private contractor.

Depending on the outcomes of the above explorations, the Town should recognize the importance of Transit IT infrastructure and implement adequate human resources to provide ongoing IT support to implement the short and long-term recommendations.

GLOSSARY

AFC	Automatic Fare Collection
APC	Automatic Passenger Counting
AVA (ASA)	Automatic Vehicle (Stop) Annunciation
AVL	Automatic Vehicle Location
BRT	Bus Rapid Transit
CAD	Computer-Assisted Dispatch
CCTV	Closed Circuit Television
GPS	Global Positioning System
ITS	Intelligent Transportation Systems
TSP	Transit Signal Priority

KEY REFERENCES - TRANSIT INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

ITS Architecture for Canada Version 2.0

The ITS Architecture for Canada provides a common framework for planning, defining, and integrating intelligent transportation systems. The architecture defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS
- The physical entities or subsystems where these functions reside (e.g., the field or the vehicle).
- The information flows and data flows that connect these functions and physical subsystems together into an integrated system.
- http://wwwapps.tc.gc.ca/innovation/its/eng/architecture/menu.htm

Transit Technology Fact Sheets

These Fact Sheets provide a summary of the most basic and useful technologies for different types of transit systems. (Note: Only half of the fact sheets have been completed)
http://www.pcb.its.dot.gov/factsheets/factsheets.asp

TCRP Synthesis on Automatic Vehicle Location (AVL) systems (TCRP Synthesis 73).

This 2008 Transit Cooperative Research Program (TCRP) Synthesis provides a good snapshot of how AVL systems are built into the core operational systems of transit agencies and of experience to date.
http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_syn_73.pdf

Intelligent Transportation Systems Benefits, Costs, Deployment, and Lessons Learned: 2011 Update

This valuable document prepared by the US Department of Transportation summarizes all the current knowledge on ITS (all applications) with respect to benefits, costs, and lessons learned based on experience with ITS deployment.
http://www.itskrs.its.dot.gov/its/benecost.nsf/files/BCLLDepl2011Update/$File/Ben_Cost_Less_Depl_2011 Update.pdf (6MB)

The chapter specifically devoted to ITS applications related to Transit Management is Chapter 7. Other areas of potential interest covered in the complete report include Traveler Information and Electronic Payment and Pricing.

Advanced Public Transportation Systems (APTS) State of the Art: Update 2006

This document is more technical in nature and describes in detail the ITS-related challenges faced by the transit industry (in particular focusing on architecture and integration issues):
http://fta.dot.gov/12351_5091.html

Transit Communications Interface Profiles (TCIP)

TCIP is a standard that provides a library of information exchange building blocks to allow transit agencies and transit suppliers to create standardized tailored interfaces between ITS applications. In addition, a windows-based software application entitled TIRCE (*T*CIP *I*mplementation, *R*equirements and *C*apabilities *E*ditor) has been developed to assist the user in tailoring TCIP for a specific project. Both TCIP and TIRCE are available for free at the following site:
http://www.aptatcip.com/