York Region ITS Strategic Plan

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ABSTRACT

York Region is one of the largest Regional municipalities in Canada and the fastest growing Region in the Greater Toronto Area. The Region's Transportation Services is responsible for the operation and maintenance of over 900 kilometres of Regional Roads covering an area of nearly 1800 square kilometres, from the City of Toronto to the south, to Lake Simcoe in the north. Within this area there is tremendous growth in both population and employment, with a population of nearly 1 million people, and 500,000 jobs. It is served by three major highways, Highway 400, Highway 404, and the 407ETR, and by York Region Transit.

Intelligent Transportation System (ITS) technologies provide staff with another tool to monitor, manage traffic flow, manage congestion, and provide alternate route information to travelers, as well as save lives, time and money. ITS technology helps staff collect, analyze, and archive data about the performance of the road system. With this data messages can be relayed to drivers through ITS technologies enhancing traffic operators' ability to respond to incidents, adverse weather or other capacity constricting events.

With rapid growth has come a need to find innovative methods of "managing congestion". As a result Region staff initiated a Intelligent Transportation Systems (ITS) Strategic Plan. This strategic plan followed a proven process developed by Transport Canada, and used by other Canadian provinces and municipalities. This strategic plan identifies projects to address short, medium and long term goals for the next 10 years and provides the basis for future funding initiatives.

York Region includes nine local municipalities. In addition, it is bordered by the City of Toronto, Durham Region, and Peel Region. Therefore, it was essential to perform coalition building with the twenty-five agencies who participated in the strategic planning process. The key needs identified through this process were: better management of planned road disruptions, improved transportation system safety, better traveller information, and improved incident management. Greater use of ITS to support the York Region Emergency Operations and Command Centre was an important link.

Each regional ITS Strategic Plan is different, and this paper will discuss the process, the identified needs, and the specific deployment plan for York Region.

INTRODUCTION

Intelligent Transportation System (ITS) technologies provide a tool to monitor traffic conditions, manage traffic flow, manage congestion, and provide alternate route information to travellers resulting in saved lives, time and money. ITS technologies help staff collect, analyze, and archive data about the performance of the road system. With this data, information can be relayed to drivers through different ITS technologies, enhancing traffic operators' ability to respond to incidents, adverse weather or other capacity constricting events.

ITS Strategic Plans identify opportunities and associated deployment plan that take into consideration the input of relevant stakeholders. The Intelligent Transportation Systems (ITS) Strategic Plan for York Region (YR) is consistent in terms of scope and outcome with other efforts across Canada and worldwide. The basic approach in developing ITS Strategic Plans, and applied to the Region of York needs, is to:

1. Establish a coalition of interested and impacted stakeholders;

2. Identify their surface transportation needs and conduct an opportunities analysis to address those needs;

3. Develop an *ITS Architecture*, defining functionality and interfaces between key technologies and systems; and

4. Define a *Deployment Program* that phases implementation over a realistic timeframe.

COALITION BUILDING

The overall objectives of the coalition building plan were: to identify and contact key stakeholders for participation in the study; to ensure that the Region has up-to-date ITS inventory information; and to collect information from a variety of stakeholders to assess the needs for ITS on a Region-wide basis. At the beginning of the project, stakeholders were contacted to complete a Stakeholder Questionnaire. In addition, two workshops were held to address specific aspects of the strategic plan: a user needs stakeholder workshop was conducted on September 8, 2006 and an ITS architecture workshop was held on December 13, 2006

Table1 below lists the stakeholders who provided input to the Strategic Plan, through completing the Stakeholder Questionnaire, participating in interviews, and/or participating in the stakeholder workshops:

TABLE 1: LIST OF STAKEHOLDERS

Internal Agencies	External Agencies
• Transportation and Works • Planning & Development Services • Information Technology • York Region Transit (YRT) • Police • Emergency Medical Services • YR Rapid Transit Corporation • Central York Fire Department • City of Vaughan • Town of Richmond Hill • Town of Markham	• Ministry of Transportation, Ontario (MTO) • City of Toronto • Toronto Transit Commission • Durham Region • Peel Region • City of Brampton • City of Mississauga • GO Transit • 407 ETR • Greater Toronto Airports Authority • CN Rail • Smart Commute 404-7

EXISTING PROJECTS

York Region staff have implemented a number of ITS-related projects over the past few years.

Traffic Responsive Control Signal (TRC)

A TRC system was implemented along Jane Street and Weston Road parallel to Highway 400 between Highway 7 and King Road. The objective of this initiative was to design and implement a system capable of initiating appropriate signal timing plans automatically from among a predetermined library of timing plans in response to incidents along Highway 400. In addition a series of closed circuit television (CCTV) cameras were implemented along the corridor to validate incidents. A detailed model comparing TRC and typical signal timing patterns indicate an average reduction in delay of 15% and 25% fewer stops are attributed to TRC. This strategy has evolved into a new more responsive ITS strategy, adaptive signal control which is the subject of a current Transport Canada funded program.

Transit Signal Priority (TSP)

TSP reacts to the presence of a bus in near proximity to the traffic control signal and provides transit vehicles with a longer “green” time through congested corridors to effectively decrease transit travel times. This TSP project provided a pilot deployment project along York Region Transit (YRT) route 85/85A, which operates primarily on 16th Avenue/Carrville Road between Mural Street/Vogel Road and Bathurst Street in the Town of Richmond Hill. Having completed this project, staff gained significant experience in the design and deployment of TSP systems. The TSP results showed a reduction in the travel time through the corridor thus reducing the delay at signalized intersections. In addition, this experience allowed the Region to move more

effectively towards the design and deployment of a more advanced TSP system, which uses a similar optical based selective detection technology, through the YRTP Quick Start program.

Remote Access PDA (RAPDA)

The RAPDA project allows staff to resolve concerns reported by the public regarding signal malfunctions and timing quickly. This project allows staff to modify intersection signal timing and analyze data via the latest wireless communication technology to the centralized traffic control system central server. It provides staff with technology to efficiently and effectively fix malfunctions and change signal timing while at the site.

Adaptive Signal Control (ASC)

A pilot corridor of ASC has been implemented along Kennedy Road between Avoca Drive and Clayton Drive. ASC accurately monitors traffic patterns and optimizes signal timing parameters in response to changing on-street traffic volume patterns. By comparison, typical traffic control signal timing is pre-determined and defined for traffic control signals along the Regional road network.

NEEDS IDENTIFICATION

Needs were based on a review of key documents, including, but not limited to, the York Region Transportation Master Plan and the York Region Traffic Control Signal System Evaluation, and supplemented by stakeholder input. Table 2 below presents the identified transportation needs.

TABLE 2: TRANSPORTATION NEEDS

Need	Description
1	Better management of planned road disruptions
2	Better enforcement of traffic regulations
3	Improved transportation system safety
4	Improved availability of real-time traveller information
5	More real-time transportation systems data
6	Increased travel demand management
7	Improved incident management and response
8	Improved management of Region Transportation assets
9	Transit service coordination with other agencies
10	Improved transit security

OPPORTUNITIES ANALYSIS

The opportunities analysis examined the identified needs in terms of beneficiaries and delivery participants, barriers to implementation and partnerships with the purpose of refining the draft

set of potential projects. The types of opportunities that were deemed most applicable in York Region, included:

- Arterial and freeway traffic management and control: Signal systems that adapt to conditions on the road and provide priority to transit vehicles so as to minimize person-delay. Incidents are identified automatically and in a timely manner thus reducing response times;

- Improved response to incidents: Emergency services that respond to incident calls using real-time travel information and vehicle-based dynamic route guidance, hazardous material information included in the incident alerts, traffic management systems that implement traffic plans to clear the route of traffic;

- Personalized and advanced traveller information services: systems to provide information on the best route and estimated travel time, available through various media and portable devices; and

- Transit management systems: Transit service that operates safely, efficiently and effectively through the application of smart technologies, providing a high level of service to customers including access to traveller information at home, en route and at work, electronic payment tools and integration of transit services.

ARCHITECTURE DEVELOPMENT

The development of an ITS Architecture for York Region, based on the Canadian ITS architecture, provides a unified framework to guide the co-ordinated deployment of ITS programs within the public and private sectors. Now that the York Region ITS architecture has been established, it can be used in the future to describe the physical components, the data flows within and between systems, and to help establish the requirements for any new systems, as shown in Exhibit 1 below.

Now that the regional architecture has been developed, it can be used by York Region as a transportation planning tool. First of all, it can assist with providing structure for how they are proceeding with ITS deployment in the region, from a physical infrastructure perspective. Secondly, it can help look beyond the current set of projects, to establish:

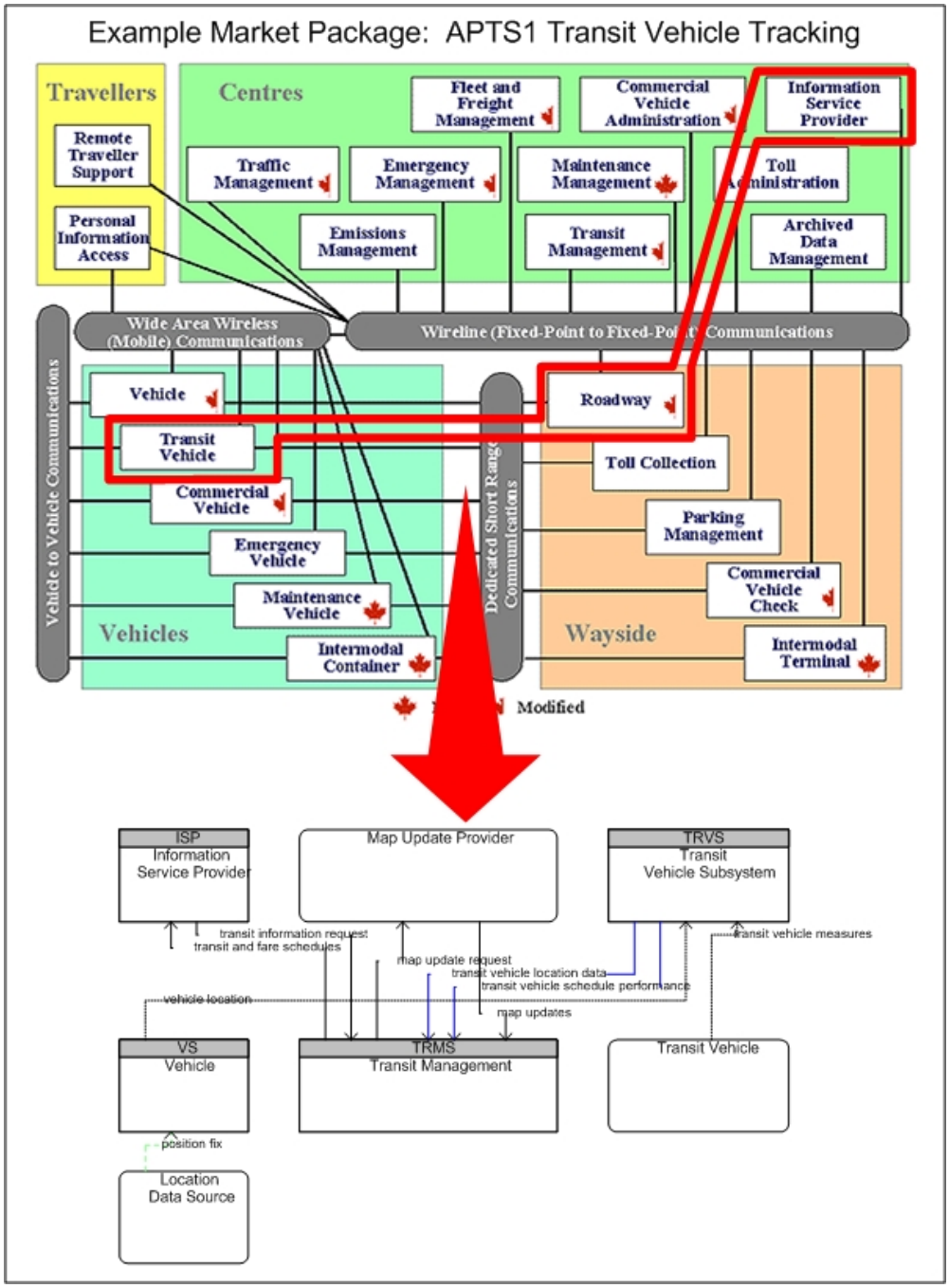
- What new or enhanced ITS services can be provided?

- What systems would they connect to, and what information would be shared?

- What agreements need to be in place to make it happen?

In Canada, the development of regional architectures is just beginning. York Region and the City of Calgary have developed regional architectures at the municipal level, and the BC Lower Mainland and Quebec have developed regional architectures at the provincial level. By comparison, over 270 regional/statewide architectures have been created in the United States.

EXHIBIT 1



DEPLOYMENT PROGRAM

One of the primary outputs of the ITS strategic plan is a compilation of ITS projects to address regional transportation needs, as identified at the outset of the project. The emphasis is on

"managing congestion". The projects are given a designation based on user services specified in the Canadian ITS architecture, and arbitrarily listed sequentially within those groupings, as shown in Table 3 below.

TABLE 3: ITS PROJECTS

Project Type	Project Name	Capital Costs	Operating Costs
TI	Telephone Traveller Information	$700,000	$100,000
	Web Traveller Information	$300,000	$80,000
TM	Travel Demand Management Website	$200,000	$50,000
	Traffic Management for Highway 400 Closures	$800,000	$50,000
	Highway 7 / Highway 404 Traffic Management System	$1,600,000	$100,000
	Highway 7 / Highway 400 Traffic Management System	$1,600,000	$100,000
	Highway 7 / Highway 48 Traffic Management System	$1,100,000	$100,000
	ITS Support of Enforcement	$1,200,000	$100,000
	Traffic Signal Control System and Communications Design	$5,300,000	$500,000
	Area-wide Traffic Signal Control	$1,100,000	$100,000
	ITS Virtual Data Warehouse	$300,000	$10,000
T	Transit Video Survey Tool	$100,000	$10,000
EM	Roads Integrated Operations	$1,700,000	$200,000
TI – Traveller Information; TM – Traffic Management; T – Transit; EM – Emergency Management			

The ITS strategic plan provides a deployment plan that phases the design and implementation of the projects over a ten-year timeframe.

Reviewing the project profiles, in conjunction with the deployment schedule in Table 4, reveals the following:

- The projects need to be coordinated with existing ITS projects, and planned ITS projects by York Region Transit;
- The timing of projects may be modified as funding opportunities become available;

- The emphasis of the Short Term projects is to begin providing better access to Traveller Information, and to make improvements to traffic management capabilities in key corridors; and

- Many of the projects require coordination and/or interfaces with MTO/Provincial Government facilities, and therefore MTO staff would need to provide support for the proposed projects.

To deal with the issues, it was suggested that York Region may wish to establish an ITS Implementation Committee. Depending on the agenda, and the active projects, representatives from affected agencies would be invited to participate, and to provide input and resources as required.

TABLE 4: DEPLOYMENT SCHEDULE

	Time Frame		
Project Title	**Short Term 2007-2010**	**Medium Term 2011-2013**	**Long Term 2014-2017**
Telephone Traveller Information			
Web Traveller Information			
Travel Demand Management Website			
Traffic Management for Highway 400 Closures			
Highway 7 / Highway 404 Traffic Management System			
Highway 7 / Highway 400 Traffic Management System			
Highway 7 / Highway 48 Traffic Management System			
ITS Support of Enforcement			
Traffic Signal Control System and Communications Design			
Area-wide Traffic Signal Control			
ITS Virtual Data Warehouse			
Transit Video Survey Tool			
Traffic Operations Support for the Emergency Command and Operations Centre			

Traveller Information

Traveller Information provides real-time interactive request/response systems and information systems to the traveller. Typically, the traveller can obtain current information regarding traffic conditions road conditions transit services ride share/ride match parking management and pricing information. A variety of interactive devices may be used by the traveller to access information prior to a trip or en-route including phone kiosk Personal Digital Assistant (PDA) personal computer and a variety of in-vehicle devices. Successful deployments rely on availability of real-time transportation data.

Projects highlighted within this section include, telephone and web based traveller information, and travel demand management.

Telephone Traveller Information

This project involves designing and deploying a system through which pre-trip and en route travel conditions can be accesses over the telephone, including:

- Real-time and static traffic information, including temporary or long-term road closures, flow and incident information;

- Real-time and static transit information, including service delays, schedule and fare information, service announcements (some static information presently available through York Region Transit (YRT) call centre system), trip planning, etc.;

- Other relevant traveller information, including weather updates and public service announcements; and

- Public feedback on programmes.

An initial consultation would be required to identify stakeholders internal to York Region (YR). The system could then be developed in a modular fashion, allowing for phasing in of information as it becomes available. As an initial deployment, static transit and traffic information will be readily available. As real-time information is generated and the interfaces are developed, the functionality could be extended. Ultimately, the system should be deployed in the context of the Canada 511 program (deployment guidelines are available) and should be integrated into a regional system when available. In the short-term, there are regionally based Interactive Voice Recognition (IVR) and hands free systems providing similar information for the Greater Toronto Area (GTA).

Web Traveller Information

This project involves development of an internet-based system to disseminate pre-trip planning and real-time information regarding transit and traffic conditions to the general public. Information delivered would parallel that provided through the proposed 511 system (Project No. TI-1).

Unlike with telephone information, a fair amount of web information is available to travellers through different sources. The following table highlights what is and is not available for travellers in the Region.

Travel Demand Management Website

Building on the existing Smart Commute 404-7 association, this project involves expanding the ability of the Smart Commute 404-7 Association to match drivers with alternative transportation means within targeted areas. The main tools to be expanded include website capabilities and outreach or marketing efforts to reach new employers/employees.

Advanced Traffic Management Systems (ATMS)

Advanced traffic management systems are used to improve the efficiency and operation of the existing surface transportation infrastructure such as traffic control signals, and create safer conditions for travellers. This can include traffic signal control strategies, dynamic message signs, road weather information systems, and automated enforcement systems. ITS links these together and monitors changes sending messages and adjusting signal timing etc.

Projects highlighted within this section include area-wide traffic signal control, targeted traffic management systems strategies, and ITS support of enforcement.

Traffic Management for Highway 400 Closures

Highway 400 is the main transportation corridor that covers 30 km through the western portion of York Region (YR), from Steeles Avenue in the south to Highway 9 in the north. Within YR, Highway 400 has eight arterial interchanges and one freeway-to-freeway interchange.

This project is to consider the implementation of Intelligent Transportation Systems (ITS) components to provide traffic management for the arterial traffic network during closures of all, or part of Highway 400.

Depending on the level of system sophistication, this project may require several elements:

- Review Emergency Plan to determine how ITS serves the plan and revive Road Closure Action Plan (RCAP) committee;
- Definition of a process to prioritize the deployment of Closed Circuit Television (CCTV) cameras;
- Development of a practise for Dynamic Message Sims (DMS), data accuracy, time frame, support and library of messages;
- Centre-to-centre (C2C) interface with Ministry of Transportation of Ontario (MTO) for event notification and coordinated response;
- Traveller information, both macro-level (email, radio broadcast) and micro-level through arterial DMS;
- Traffic adaptive/responsive signal control; and
- CCTV coverage.

Highway 7/Highway 404 Traffic Management System

York Region (YR) plans to implement a 41 km, 2-lane median-transitway along Highway 7. In the vicinity of Highway 404, the transitway will be implemented through a very tightly constrained section of Highway 7. Given the entrance and exit ramps connecting to Highway 404, an incident along this portion of Highway 7 or the adjacent Highway 404 could have a severe impact on traffic flow along Highway 7. Quick detection and removal of an incident is imperative to maintain traffic flow in the area. This project is to consider the implementation of ITS components to provide micro level traffic management for a 6 km section of the corridor, Bayview Avenue to Warden Avenue.

Highway 7/Highway 400 Traffic Management System

York Region (YR) plans to extend Applewood Crescent over Highway 400, just north of Highway 7. It is expected that the new crossing will relieve some of the transportation pressures on Highway 7 and hopefully allow for the implementation of the 2-lane median-transit Rapidway along Highway 7. With traffic volumes and congestion levels already high on Highway 7, it is expected that the implementation of Intelligent Transportation Systems (ITS) components on Highway 7, in advance of the completion of the new overpass, will help relieve congestion until the new overpass is completed. If designed appropriately, the ITS components could also be

instrumental in relieving congestion during the construction of the Rapidway. Given the entrance and exit ramps connecting to Highway 400, an incident along this portion of Highway 7 or the adjacent Highway 400 could have a severe impact on traffic flow along Highway 7. Quick detection and removal of an incident is imperative to maintain traffic flow in the area. This project is to consider the implementation of ITS components to provide micro level traffic management for a 6 km section of the corridor, Pine Valley Drive to Keele Street.

A review of the impact on signal sequencing and traffic flow of development entrances onto Highway 7 is to be undertaken as part of this project.

Highway 7/Highway 48 Traffic Management System

With the implementation of the Markham bypass proceeding in stages, road improvements for various east-west links to the bypass are required. Highway 7, between Ninth Line and the Markham Bypass, has been upgraded from a 2-lane road with rural cross section to a 4-lane road with an urban cross section. Other links will require capacity improvement in the future but will experience increasing levels of congestion in the meantime. The implementation of Intelligent Transportation Systems (ITS) components on these unimproved links could be used to assist in managing the existing capacity. This project is to consider the implementation of ITS components to provide micro level traffic management within the area bounded by 9th Line to the west, 16th Avenue to the north, the York / Durham Line to the east and Highway 407 to the south.

ITS Support of Enforcement

This project lays the groundwork towards developing an appropriate role for Intelligent Transportation Systems (ITS) in the area of enforcement and requires two approaches and ultimately four stages to complete implementation:

Stage 1 Building cooperation and understanding (Approach 1). The goal would be to build rapport between York Region (YR) Roads and YR Police/Fire/Emergency Management Services (EMS) through outreach meetings, and develop understanding of enforcement shortcomings, needs and potential.

Stage 2 Monitoring developments elsewhere (Approach 2). The goals would be to: develop in-house understanding (tracking industry); participate on committees and product review; and contribute to further development of enforcement tools.

Stage 3 Pilot Project

Stage 4 Initial deployment

The potential areas for exploration of ITS enforcement include: red light running; school zone speed infractions; speeding; High Occupancy Vehicle (HOV) lanes; and at-grade railroad crossings.

Traffic Signal Control System and Communications Design

Central Traffic Control System (CTCS), the current traffic signal system in York Region (YR), has been in place for several years. While functioning well the system is not National Transportation Communications for ITS Protocol (NTCIP) compliant. An NTCIP compliant signal

system requires a robust wire line and wireless communication system. A detailed communication design is required to support traffic signal control, and other Intelligent Transportation Systems (ITS) initiatives in the Region. A key objective of the communications system is to support NTCIP as a communication protocol for ITS. The use of NTCIP will facilitate inter-changeability (e.g. multiple brands of controllers on a communication channel) and interoperability (e.g. dissimilar devices, traffic controller and Dynamic Message Signs (DMS) controller on a common channel).

In parallel with the communications design, a signal system functional specification is required that defines: NTCIP requirements; transit signal priority; traffic adaptive control; Closed Circuit Television (CCTV) control; and DMS control.

The functional design of the system would define the following elements: required functionality; and, architecture that best fits the current and future needs.

Based on the results of the Traffic Signal Control System and Communications design, Central Traffic Control System (CTCS) will either be upgraded to support the design or replaced.

Area-wide Traffic Signal Control

York Region (YR) has coordinated traffic signals at jurisdictional boundaries (e.g. City of Toronto) by synchronizing the time clocks for both traffic signal systems. While this approach works well for day-to-day operations, it is functionally limited. Ideally traffic analysts would have access to traffic signal timing from both jurisdictions (to confirm current operations) and monitoring capabilities to check operations. This functionality is available through a Centre-to-centre (C2C) interface.

Traffic signal operation becomes more complex across jurisdictional boundaries when considering transit signal priority (TSP), emergency vehicle pre-emption and traffic responsive/traffic adaptive control. C2C, area wide traffic control provides a viable solution.

Area-wide signal control includes integrating systems internal to YR, such as the York Region Transit (YRT) management, Management System operated by the Ministry of Transportation of Ontario (COMPASS) and YR Police Computer Aided Dispatch / Automated Vehicle Locator (CAD / AVL). This integration is required to support daily operations (e.g. TSP), and provide traveller information and incident response.

ITS Virtual Data Warehouse

This project is to plan for and develop the requirements of a data warehouse for York Region (YR), where data can be archived and easily retrieved. This conceptual project will wait on the development of several other projects before implementation. The implementation of a data warehouse will consolidate the processes and systems used to archived data, make data retrieval easier and allow the owner to more properly asses the value of the archived data.

This project requires the following elements:

- Striking of an advisory committee to steer the warehouse development project;
- Assessment of data archival needs including the type, size and format of data to be stored, the length of time the data will be archived, the likelihood of retrieval, who will be retrieving the data and for what purposes (commercial, private, research) and ownership of the data;

- Discussion of motherhood questions including the need for a virtual versus concrete warehouse, ownership of the data collected by the region, access to the data, and cost recovery;

- The implementation of processes to ensure that all data-intensive projects are included in the inventory of requirements on an on-going basis; and

- Development of a timeline for the implementation of the data warehouse.

Subsequent phases of the project will coincide with the initiation of other projects that require data warehousing. Each project will fine tune the data warehouse requirements and begin to look at technical aspects of the eventual warehouse.

Transit

York Region Transit is in the process of installing security cameras on the buses. This will provide an opportunity to use the recorded video to monitor traffic conditions during various times of the day and take appropriate measures to address traffic congestion.

Transit Video Survey Tool

This project involves the deployment of security cameras on-board buses and at key transit stops/terminals, as well as developing appropriate links to allow the information collected to be made available for traffic studies. The project would consist of two distinct phases. Phase 1, already underway, would involve design and deployment of security cameras on-board buses and at key terminals. The on-board camera installation includes one forward-mounted camera capturing traffic in front of the bus. Phase 2 would involve expanding the system software to allow for automated extraction and distribution of the forward-facing camera along identified routes. This video would be made available to the Roads group for use in traffic/safety studies.

The ITS Strategic Plan also takes into account the various on-going ITS transit projects while developing the network architecture.

Roads Integrated Operation

York Region has established an Emergency Operations Centre (EOC). A project has been identified to integrate the Roads branch operations to provide traffic management functions which support emergency responses. For instance, co-ordination between dispatch functions, and CTCS supports emergency response to incidents and VIVA operations.

The scope of work includes:

Stage 1 Design

- Develop emergency response processes and define emergency response needs in terms of traffic operations;

- Develop emergency response plans;

- Develop infrastructure requirements (communications, incident detection, facilities); and

- Design and implement response-based management system.

Stage 2 Implementation

The implementation of an emergency command and operations centre requires that several Intelligent Transportation Systems (ITS-related components be in place:

- Communications infrastructure to link various agencies;
- Detection of emergencies through traffic monitoring and management (VDS, Closed Circuit Television (CCTV); and
- Emergency management system based on response plans.

The many ITS projects collect and process valuable data on the state of the transportation systems. This project determines how operations and data can be best managed and shared.

CURRENT STATUS

Regional Council has approved the plan, and included costs within the Capital Program.

Recently, the Transportation Services group has been created, consisting of the Roads Branch and York Region Transit. This new department has recognized opportunities for roads and transit to work together, and use ITS as a building block.

Region staff are identifying funding and partnering opportunities to deploy the short term projects identified within the strategic plan.

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