ITS SERVICE BOOK

ITS906 ROADSIDE TRAVEL TIME INFORMATION

Purpose

Roadside Travel Time Information (RTTI) provides an estimated time of travel from a driver's current location to one or more destinations using a combination of detection technologies and variable message signs.

The objectives of RTTI are to provide:

Traveller information

- **Driver awareness:** Allow drivers to make their own route planning decisions and or become aware to alleviate/manage driver frustrations

Congestion Management

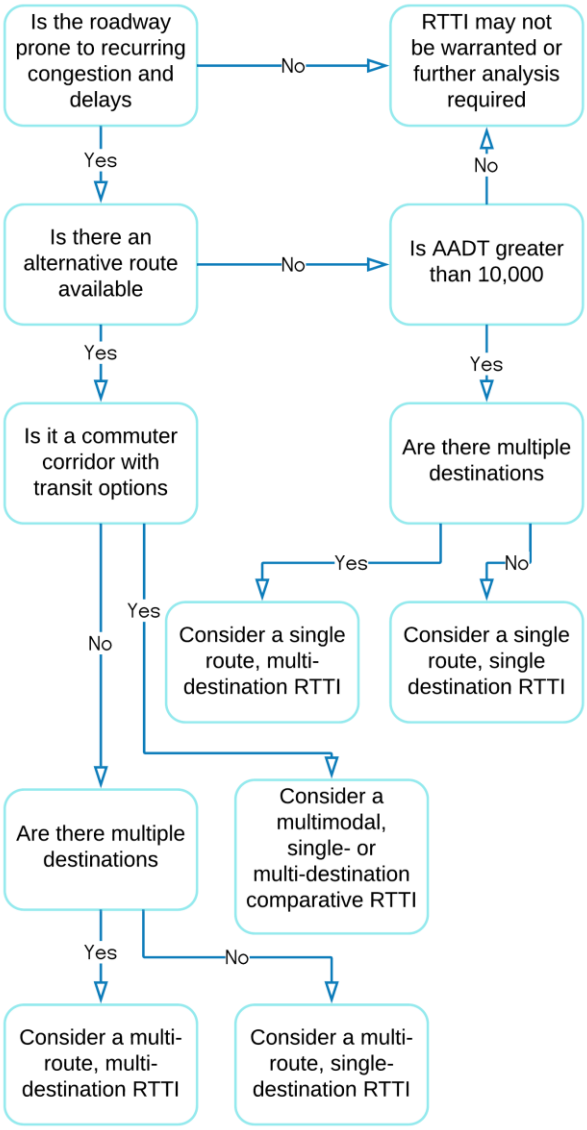
- **Infer a detour**: Promote the use of alternate routes to reduce travel demands in work zones or around incidents. Real-time information on optional routes (or modes) can encourage drivers to avoid routes with a higher potential for congestion.

Considerations for Use

RTTI may be warranted when:

- Alternate routes are available to drivers that may detour based on the travel time information (urban)
- There is no alternate route available and travellers would benefit from information/delays for awareness purposes (rural)
- There are large fluctuations in travel time

The following decision tree provides a reference for when RTTI may be considered.



ITS Service Applicability and Limitations of this Service Book

This Service Book may be used in conjunction with other related MTO ITS Services that may have Service Books associated with them.

- ITS201 – Planning Data
- ITS904 – Congestion Balancing on Express/Collectors

- ITS905 – Congestion Balancing Between Parallel Routes
- ITS908 – Regional Traffic Management
- ITS925 – Border Crossing Delay Information
- ITS1001 – Broadcast Traveller Information
- ITS1005 – En Route Traveller Information

Limitations

This Service Book will aid in determining the need, components, purpose and general placement of RTTI. Further analysis is encouraged to identify the specific needs of an RTTI system.

While technologies and data sources continually evolve, this Service Book references technologies already approved by MTO.

System Components

The application of RTTI typically consists of the following components:

- Traffic Data Collection
- Communications
- Message Dissemination

Traffic Data Collection

Roadside detectors collect data and transmit to a host for processing. Some of the technology options available include:

Technology	Advantages	Disadvantages	Comments
Bluetooth/Wi-Fi	• Portability • Low cost • Data ties back to an actual vehicle • Proven-technology for RTTI applications	• Represents only a portion of the traffic stream • Vehicle needs to travel between readers for travel time to be identified	• Established solution for RTTI used by the MTO and other prominent agencies
Radar Sensors	• High sample size • Real-time speed determination	• Requires pole-based infrastructure (new/existing) • Travel time estimates based on average speeds per segment • Higher cost • Limited deployments for RTTI	• Not as widely used as Bluetooth • Limited portability • Limited MTO applicability

The remaining portion of this Service Book focuses on Bluetooth-based detectors, as it is the established technology and offers local travel time system providers with proven algorithms.

Communications (Field Devices to Gateway)

Technology	Advantages	Disadvantages	Comments
Third-Party Cellular	• High reliability • Easy to deploy and configure	• Monthly costs • Potential for weak signals in rural areas	• Suited for applications without nearby MTO ATMS infrastructure

Technology	Advantages	Disadvantages	Comments
Hardwired	• High reliability, independent	• Feasibility based on existing infrastructure (e.g. cabinet locations) • Can be costly to deploy and maintain	• Suitable for corridors that have MTO ATMS infrastructure

Message Dissemination

Travel time information is typically broadcast through variable message signs (VMS) in the field. Common types of VMS are listed in the table below. Additionally, travel time information can also be used by the TMC/TOC and published on Ontario511 and/or available as a public data feed for implementation into third-party applications. Historical travel time data can assist with future planning and congestion studies.

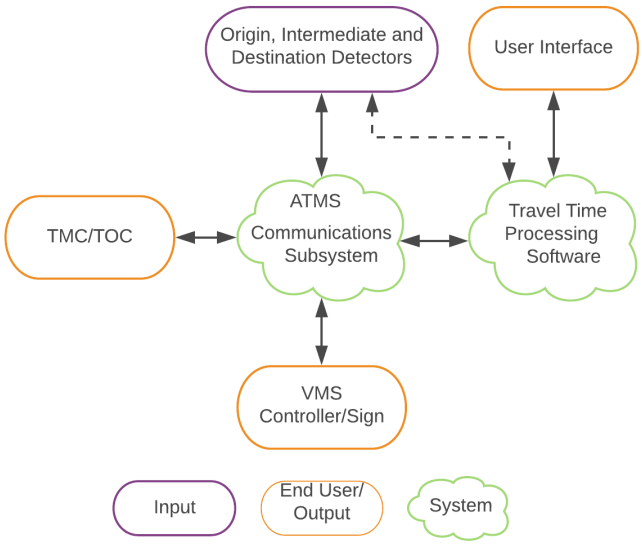
VMS Type	Applications	Example
Full-size Overhead VMS (70 by 360 pixels) Colour, full matrix	• Applicable for existing overhead signs • New overhead VMS would not be installed for travel time information only, rather must be justified for other applications as well. • Capable of supporting multiple routes and destinations • No multi-phasing	
Medium pole-mounted VMS (60 by 210 pixels) Colour, full matrix	• Suited for permanent applications where RTTI will be the primary use • Capable of signing travel times for multiple routes and destinations	
Small pole-mounted PVMS (30 by 56 pixels) Amber	• Suited for permanent applications where RTTI and long term construction • Capable of signing travel time information for up to two (2) destinations • A new sign type (60 by 120 pixels), colour and full matrix, will be recommended as the replacement of this sign type (30 by 56 pixels).	

VMS Type	Applications	Example
Portable-mounted Variable Message Sign (30 by 56 pixels) Amber	• Suited for temporary RTTI applications such as construction and special events • Better visibility than PVMS • Capable of singing travel time information for up to two (2) destinations	
Portable VMS (30 by 56 pixels) Amber	• Suited for temporary RTTI applications such as construction and special events • Capable of signing travel time information for up to two (2) destinations	
Hybrid Static Sign Signboard with embedded dynamic display matrices	• Applicable only for hybrid sign applications that were previously installed. • No other new applications should use hybrid signs.	

(Source: MTO Travel Time Policy 2016 08 19)

Architecture

The following architecture provides a general overview of the typical system components of RTTI. Roadside detectors capture and transmit data to a hosted service provider. The service provider's system uses an algorithm to match the data between the detectors to estimate the travel time. The algorithms must filter unwanted data (such as duplicate sources or vehicle diversions on-route) and develop an average travel time. Many algorithms produce confidence levels to suppress messages displayed to the public when data is limited.

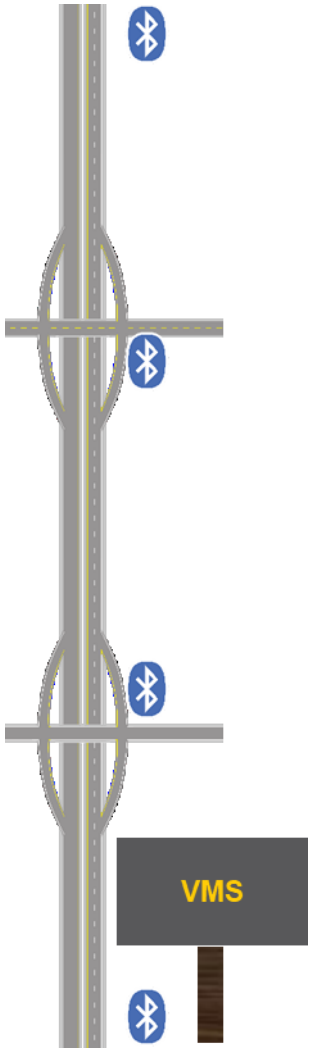


Traffic Management

While RTTI is capable of working autonomously, the TMC/TOC can modify VMS messages to suit other, more urgent needs through a manual and automatic override. Example applications of automatically

replacing travel time messages with those of higher priority may include downstream incidents or Amber alerts.

Concept



Deployment Considerations

The following are some considerations for deployment:

- Travel time destinations may support a granularity of 1 minute for destinations up to 30 minutes and 5 minute granularity for longer travel times
- Travel Time destinations should range from 8 km to 50 km (assuming a posted speed of 100 km/h) for a calculated travel time of 5 to 30 minutes at free-flow speeds respectively. Roadways with other posted speeds will require similar distance calculations to accommodate a similar 5 to 30 minute travel time range.
- Origin detector shall be located as close as reasonably possible to the VMS
- Destination detector shall be located within 250 meters of the destination (e.g. interchange, end-point)
- DMS shall be located upstream of the destination a minimum distance of 8 km to a maximum of 50 km. Longer distances may be considered however accuracy and relevance of the travel time data may vary significantly
- For destinations up to 50 km, intermediate detectors shall be located at least every 10 km or less and equally spaced between upstream and downstream detectors where possible
- For a destination to DMS greater than 10 km, an intermediate Bluetooth Device shall be placed at a convenient interchange with a roadway crossing (i.e. potential decision point) approximately halfway along a measured route. Not every interchange requires a detection device but spacing should not exceed approximately 10 km.
- Where there are multiple routes along the same corridor, Bluetooth detector installations shall be considered to capture relevant data for each option (e.g. expressway/collector, car/truck border traffic, and managed lane configurations)
- The sign type deployed should be capable of supporting the required number of routes and/or destinations. No more than three routes or destinations should be provided for any given sign message.
- No phasing of messages on overhead VMS
- Refer to MTO's Travel Time Policy and DMS Policy for additional information on message types and RTTI guidelines
- Consider local terrain and clear zone requirements to assess the placement of PVMS
- Consider battery spares, maintenance and operations processes when deploying solar-powered solutions (particularly in winter)
- Deployments in Northern / rural locations should consider and ensure adequate cellular coverage

Message Types

The illustrations below display the potential messaging strategies focused on travel time messages:

Single Route, Single Destination

Full-Size Overhead VMS

Medium Pole-Mounted VMS

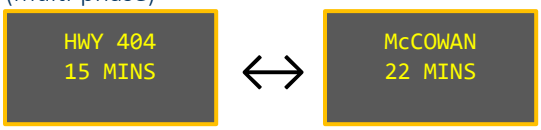
Small Pole-Mounted/Fixed Variable/Portable VMS

Single Route, Multiple Destinations

Full-Size Overhead VMS

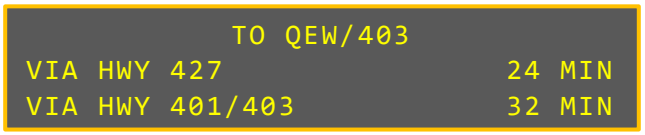
Medium Pole-Mounted VMS

Small Pole-Mounted/Fixed Variable/Portable VMS (multi-phase)



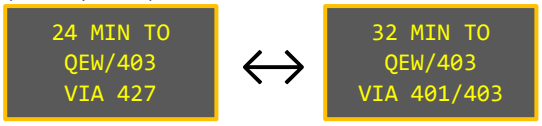
Multiple Routes, Single Destination

Full-Size Overhead VMS



Medium Pole-Mounted VMS

Small Pole-Mounted/Fixed Variable/Portable VMS (multi-phase)



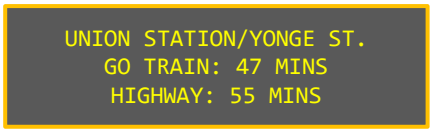
Multiple Routes, Multiple Destinations

Full-Size Overhead VMS

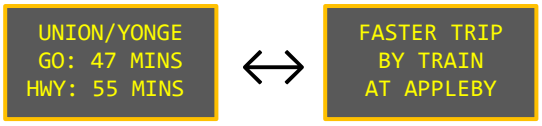
Medium Pole-Mounted VMS

Multimodal Comparison

Full-Size Overhead and/or
Medium Pole-Mounted VMS



Small Pole-Mounted/Fixed Variable/Portable VMS



Appended to Existing Applications

Full-Size Overhead VMS

Costs and Procurement Strategy

Budgetary cost estimates are provided below for Bluetooth purchase options.

However, there may be additional costs to integrate the Bluetooth system to MTO's TMC/TOC Operations and associated systems.

Refer to HiCo for additional details and regional estimates.

Element	Cost (2019)
Purchase: Supply and Install	
Bluetooth Detector	$7,000
Solar Power Kit	$3,000
Cellular Modem	$1,000
Pole-Mounted Cabinet	$12,000
9.0 m Concrete Pole	$2,800
9.0 m Wooden Pole	$1.800
Traffic Control (per lane closure)	$4,000
Portable Variable Message Sign	$30,000
Pole-Mounted Variable Message Sign	$100,000
Fixed-Mounted Variable Message Sign	$70,000
Overhead VMS Sign	$400,000-$500,000
Operations and Maintenance	
Cellular Fees	$75 per month
Hosted Data Processing and maintenance of Bluetooth Detectors and modems	$125 -175 per month per detector
Maintenance of signs, cabinets, and solar power systems.	~10% of capital/year

Sample Cost Deployment

An example of Roadside Travel Time Information may consist of:

- Four (4) Bluetooth Detectors with wooden pole, pole-mounted cabinet, cellular modem and solar kit

  4 x $7,000 = $20,000

  4 x $1,800 = $7,200

  4 x $12,000 = $48,000

  4 x $3,000 = $12,000

  4 x $1,000 = $4,000
- One (1) PVMS

  1 x $30,000
- Four (4) devices' data processing

  4 x $125 per month = $500 per month
- Five (5) devices' cellular fees

  5 x $75 per month = $375 per month
- Total Deployment: $121,200
- Total Operations: $875 per month plus maintenance

System Life Cycle

The expected life cycle may range from 5 to 10 years depending on the configuration.

The mean time between failures (MTBF) of relevant equipment for planning, and rehabilitation purposes:

- ATMS Controller – 15 years+
- Bluetooth Detectors – 5 years
- Cellular Modem – 5 years
- Civil Provisions – 25+ years
- Controller Cabinet – 25+ years
- F/O Cable – 25+ years
- Network Switch – 15 years+
- Overhead VMS – 15 years
- Pole-Mounted VMS – 15 years
- Poles – 25 years+
- Portable-Mounted VMS – 5 years
- Portable VMS – 5 years

Case Studies/Previous Deployments

The use of Roadside Travel Time Information is now mature, having been tested and operated in several

MTO regions. Some key deployments are detailed in the following table.

Description	Components
Highway 400-Series Corridors Ministry of Transportation Ontario	• Various corridors including 400, 401, 403, 404, and 427 • Border crossing applications along 405, 420, and QEW
2015 Pan/Parapan Am Games Ministry of Transportation Ontario	• Various Bluetooth detectors along key Games corridors • Combination of PVMS and eighteen (18) FVMS deployments
Technology Pilot along Highway 26 Ministry of Transportation Ontario	• 6 Bluetooth Detectors • 2 PVMS • 6 cameras • Mobile power and communications • The pilot was used testing the accuracy of travel times, penetration rates, and reliability between various vendors
Don Valley Parkway and Gardiner Expressway/Lakeshore Boulevard between Islington Avenue and Carlaw Avenue City of Toronto	• 28 Bluetooth Detectors • 18 Variable Message Signs, overhead and roadside • Originally hosted, now in-house • The system utilized directionality and logic filters to decipher Gardiner traffic versus Lakeshore traffic • The initial deployment was approximately $150,000
Various Lessons Learned United States of America	• Same signage should not be used for HOV/HOT vs. general purpose travel time • Alternative route options are used when primary routes are approximately double the typical travel time

Performance Measures

- Travel Time accuracy and reliability
- Time/hours the system is in operation due to non-typical travel times

Emerging/Alternative Technologies

This section details emerging technologies and/or alternative technologies not currently supported by the MTO.

- On-board probe data or crowd-sourced data provides an alternative data collection source. Sources such as INRIX, TomTom, Waze, and Google Traffic provide potential sources for travel time data which require no roadside infrastructure.

  These solutions are scalable but may require significant integration to be compatible with a Traffic Management System and associated VMS controllers