**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:

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

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)**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third-Party Cellular</td>
<td>• High reliability</td>
<td>• Monthly costs</td>
<td>• Suited for applications without nearby MTO ATMS infrastructure</td>
</tr>
<tr>
<td></td>
<td>• Easy to deploy and configure</td>
<td>• Potential for weak signals in rural areas</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
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<tr>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited MTO applicability</td>
</tr>
</tbody>
</table>
**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.

<table>
<thead>
<tr>
<th>VMS Type</th>
<th>Applications</th>
<th>Example</th>
</tr>
</thead>
</table>
| **Full-size Overhead VMS**      | • 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 | ![Full-size Overhead VMS Example](image1.png) |
| Colour, full matrix             |              |         |
| **Medium pole-mounted VMS**    | • Suited for permanent applications where RTTI will be the primary use  
• Capable of signing travel times for multiple routes and destinations | ![Medium pole-mounted VMS Example](image2.png) |
| (60 by 210 pixels) Colour, full matrix |              |         |
| **Small pole-mounted PVMS**    | • 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). | ![Small pole-mounted PVMS Example](image3.png) |
| (30 by 56 pixels) Amber         |              |         |
### VMS Type

<table>
<thead>
<tr>
<th>Portable-mounted Variable Message Sign</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>(30 by 56 pixels) Amber</td>
<td>• Suited for temporary RTTI applications such as construction and special events</td>
</tr>
<tr>
<td></td>
<td>• Better visibility than PVMS</td>
</tr>
<tr>
<td></td>
<td>• Capable of signing travel time information for up to two (2) destinations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Portable VMS</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>(30 by 56 pixels) Amber</td>
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</tr>
<tr>
<td></td>
<td>• Capable of signing travel time information for up to two (2) destinations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hybrid Static Sign</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signboard with embedded dynamic display matrices</td>
<td>• Applicable only for hybrid sign applications that were previously installed.</td>
</tr>
<tr>
<td></td>
<td>• No other new applications should use hybrid signs.</td>
</tr>
</tbody>
</table>

(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, endpoint).
- 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

**QEW MOVING SLOWLY BEYOND HWY 403**
14-17 MINS TO HWY 427

Medium Pole-Mounted VMS

TO HWY 404
20 - 25 MINS

Small Pole-Mounted/Fixed Variable/Portable VMS

401 EAST
11 MINS

Single Route, Multiple Destinations
Full-Size Overhead VMS

HIGHWAY 403/FORD DR
7 MIN
HURONTARIO ST
16 MIN
HIGHWAY 427
23 MIN

**Rue. Nicholas St.**
3 MIN
Av. Maitland Ave.
9 MIN
Aut/Hwy 416
12 MIN

Medium Pole-Mounted VMS

Hwy 403/Ford
7 MIN
Huronatario
16 MIN
Hwy 427
23 MIN

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

Hwy 404
15 MINS
McCowan
22 MINS

Multiple Routes, Single Destination
Full-Size Overhead VMS

TO QEW/403
VIA Hwy 427
24 MIN
VIA Hwy 401/403
32 MIN

Medium Pole-Mounted VMS

TO QEW/403
VIA Hwy 427
24 MIN
VIA 401/403
32 MIN

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

24 MIN TO QEW/403 VIA 427
 ↔
32 MIN TO QEW/403 VIA 401/403

Multiple Routes, Multiple Destinations
Full-Size Overhead VMS

HIGHWAY 6 GUELPH
37 MIN
LINCOLN A. PARKWAY
HAMILTON
42 MIN

Medium Pole-Mounted VMS

Hwy 6 Guelph
37 MIN
Lincoln A. Parkway
Hamilton
42 MIN

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

UNION STATION/YONGE ST.
GO TRAIN: 47 MINS
HIGHWAY: 55 MINS

Small Pole-Mounted/Fixed Variable/Portable VMS

UNION/YONGE
GO: 47 MINS
Hwy: 55 MINS
 ↔
FASTER TRIP BY TRAIN AT APPLEBY

Appended to Existing Applications
Full-Size Overhead VMS

EXPRESS MOVING SLOWLY COLLECTOR MOVING WELL
12-14 MIN TO YONGE
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.

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

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.

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

**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.